1 AEROSPACE AMERICA JANUARY 2012

January 2012

AEROSPACE AMERICA

What's next for U.S. human spaceflight?

Indigenous fighters make a comeback

ISS: Dawn of a new era

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January 2012

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The Orion MPCV ground test vehicle is prepared for a Launch Abort Vehicle Configuration Test at Lockheed Martin's facilities. Turn to page 24 to read about some interesting future prospects for human space transportation.

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Editorial

The not so super committee

The Budget Control Act of 2011, created as a final attempt at resolving the United States' debt ceiling crisis, calls for the creation of the Joint Select Committee on Deficit Reduction, the 'supercommittee,' whose goal was to issue formal recommendations on how to reduce the U.S. deficit by at least $1.5 trillion over the next 10 years. These steps would not eliminate the debt; rather, they would slow down its growth, as they would not decrease federal spending but reduce increases.

The recommendations from this bipartisan committee were to be presented to Congress by November 23. If agreement could not be reached in both chambers by December 23, the act calls for automatic across-the-board cuts, split 50-50 between defense and nondefense spending, including Medicare, an event referred to as sequestration.

To the surprise of absolutely no one, on November 23 the supercommittee, comprising six members of the House and six from the Senate, announced that the supercommittee had reached agreement on the fact that they could not reach agreement.

After the announcement a collective sigh of relief was heard from all potentially affected parties, followed immediately with panic-filled statements to the press that directed cuts would devastate the Defense Department, hobble NASA, cripple Medicare….

However, the automatic cuts mandated by sequestration would not go into effect until 2013, giving lawmakers ample opportunity to rewrite the original law, rendering the 2011 act toothless. This also brings us back to the game politicians on both sides have been playing for years now. The rules are simple: Acknowledge that we are in a serious debt crisis. Affix the blame somewhere. Call for cuts across the board except for—fill in the blank.

And now we get to raise the stakes in this game, because 2012 is a presidential election year. This should increase the decibel level on the discussion to ever higher levels.

But as all this goes on, we are back to business as usual. In December, NASA Administrator Charles Bolden told reporters that the agency's budgeting plans do not factor in the possibility of cuts demanded by sequestration. Leon Panetta, the secretary of defense, has stipulated that cutting his department's budget will make the nation less safe: "If Congress fails to act over the next year, the Department of Defense will face devastating, automatic, across-the-board cuts that will tear a seam in the nation's defense," he said. "The half-trillion in additional cuts demanded by sequester would lead to a hollow force incapable of sustaining the missions it is assigned."

But all of this political and fiscal posturing cannot drown out the fact that the nation is facing crippling debt. We can continue to kick this can down the road, or we can face the fact that everyone, every department, is going to have to take a hit. Otherwise, that silver bullet we all seem to be looking for may come barrelling right at us.

Elaine Camhi
Editor-in-Chief

Pilot training for fifth-generation fighters

DETAILS ON ONE OF THE WORLD'S most complex defense system procurement contracts are due to be announced this year. The Air Force's T-X program will not just set a new benchmark for the way pilots are trained to fly single-seat fifth-generation fighters; it will also, if successful, set a new benchmark in the procurement of highly complex long-term defense capabilities. The current Northrop T-38 Talon, on which the USAF's advanced training capability is based, has been in service for 50 years; if the T-X lasts as long, it will have to cope with over 30 new generations of software enhancement, at the current rate of software evolution.

The challenge

The T-38 replacement program will involve far more than just finding a new aircraft. It will require new thinking in the way ground-based training aids will be integrated with real flying experiences. The fifth-generation fighter/bomber training challenge is simple: Train pilots to manage, on their own, beyond-visual-range combat missions against integrated air defenses with a host of ground and airborne threats. And do it all in the most realistic and cost-effective way possible.

The USAF and its suppliers have already developed integrated training programs for the Lockheed Martin F-22 Raptor and F-35 Lightning II, but the T-X process will take this capability several steps further. There will be new aircraft with built-in fifth-generation data display capabilities, new training devices with enhanced realism, and new ways of thinking about how to integrate the real and virtual worlds. And it is highly likely that non-U.S. companies will play major roles in providing several of these components.

Because there will probably be at least a five-year gap between the contract award and the first T-X operations, program managers will have to have a very clear idea of which over-the-horizon technologies, such as artificial intelligence and voice recognition software, might reach maturity within the next few years, and how these should be factored now into both the ground-based and airborne platforms.

"To reproduce the complexity of the operating environment in the real-world live flying environment is perhaps the greatest challenge, for a variety of reasons. The first and most widely acknowledged is the prohibitive cost," says John Graham, director of business development for major air programs at Canadian simulator manufacturer CAE.

"Fifth-generation fighters are intended to operate in two- or four-ship formations beyond visual range and penetrate well-defended hostile environments characterized by advanced integrated air defenses, including ground-based systems, and be numerically outnumbered by adversary air defense fighters," he explains. "Therefore, to train for this environment, a larger number of supporting adversaries in the air and on the ground would be required. In addition, due to the enhanced ranges of their sensors as well as the low observable characteristics of the fifth-generation aircraft, 'set-up' ranges will demand larger airspace volumes to train in capitalizing these inherent advantages."

T-38 Talon

The key difference

The key difference between a fourth- and a fifth-generation fighter training system is that in the older system pilots need to be taught primarily how to fly; in aircraft such as the F-35 or F-22 the onus is on managing operations—with the pilot processing and then acting correctly on the large amounts of mission-critical information being relayed from onboard and remote sensors.

"In fifth-generation fighters, flying will be easier, and the flying skills will be dealt with earlier in the training program," says Paul Dawkins, head of business development, air training, at BAE Systems. "The systems will look after the aircraft and reduce the flying workload on the pilot." Instead, the training system will focus on ensuring the pilot can optimize the automated tools available, concentrating on the overall mission requirements.

"Winning the T-X contest therefore may not depend on the performance of the trainer aircraft but on the way real and synthetic training are integrated, allowing for the most comprehensive and realistic training of fifth-generation fighter capabilities at the lowest through-life costs," Dawkins continues.

At the moment, student pilots at the USAF's advanced fighter training school fly about 80 sorties in the air and just 30 on the simulator. But as simulator technology improves and the range of operations that these aircraft are likely to encounter widens, the balance will tilt toward more ground-based operations. In the future time in the air will probably focus increasingly on areas such as managing the weapons system while maneuvering the aircraft and experiencing the physiological stresses of high *g*-loads.

The human factor

One of the main challenges in developing an integrated training system for fifth-generation fighters is to develop an environment where a large number of adversaries in the air and on the ground can dynamically engage the student pilot. Ideally, adversaries and supporting forces should all be humans, able to interact with the trainee pilot within a common synthetic environment. The U.K., Canada, and the U.S. are all developing and implementing the capability to conduct full 'distributed mission operations' using a wide area network connecting a large number of virtual training devices—flight simulators of varying fidelities—working together against computer-generated adversarial forces.

"By connecting the simulators and command and control nodes, participants not only are able to train in utilizing their individual platform, but must do so as part of a larger mission package with a number of real-time human-in-the-loop decision-makers. It is the potential for human-in-the-loop interactions that adds to the complexity and brings it to life for participants," according to one Canadian military training expert.


Hawk T2/128

Such training networks are called 'advanced distributed mission simulation' systems. Their effectiveness in developing the appropriate levels of knowledge, skills, and experience required to cope with complex missions involving numerous active participants is improving year on year with advances in key enabling technologies: common databases for terrain, target complexes, and weather; enhanced network bandwidth; and agreed-on common standards for simulation technologies and processes to enhance interoperability.


M-346 Master

The key issue for T-X program planners will be to build the framework for an integrated air/ground-based training system with the agreed connectivity protocols, allowing software advances to improve environmental realism and participant numbers to be fed into the framework as they become available. As the technology develops, it will soon be possible to link a fighter training simulator with training devices used by other services—improving realism and, potentially, saving money.

"It will be equally important to ensure the simulators are interoperable with related land and maritime simulations," explains CAE's Graham. "For example, many countries are investing in simulators for forward air controllers [FACs]. They use computer-generated forces (friendly and adversary) and targets, and use a computer-generated close air support aircraft. At the same time, many combat aircraft simulators use computer-generated forces, friendly and adversary, and targets to train for close air support missions, and use a computer-generated intelligent agent or role player as a forward air controller. With distributed and joint mission training, both the FAC simulator and the aircraft simulator could be connected over a distributed mission training network within a common synthetic environment to conduct mutually beneficial joint training."

Future training regimes for this class of aircraft will involve integrating not just new technologies but new training concepts as they become available. Advances in voice recognition software should increase the number of adversary inputs into a networked training system a single operator can manage. New display formats, such as 3D visual systems, will increase overall realism and specific mission training capability—such as air-to-air refueling.

There is also new research into developing 'rangeless' training concepts, where the beyond-visual-range combat performance of a fifth-generation fighter will no longer be limited by the size of the military airspace available for weapons training.

ACMI (air combat maneuvering instrumentation) system pods are now in widespread use, simulating air combat and air-to-ground weapon missions by relaying virtual targets and


T-50 Golden Eagle

> ***T-X: The early contenders***
> *Up to 450 USAF Northrop T-38 Talon trainers will be replaced with a combination of aircraft and ground-based training systems. The winning contender will also be well placed as the lead in fighter trainers for F-35 operators around the world. At the start of December 2011 there were three main contending teams for the aircraft role: Alenia Aermacchi with its* ***M-346 Master****; Lockheed Martin with a U.S. version of the Korean Aerospace Industries* ***T-50 Golden Eagle****; and BAE Systems/Northrop Grumman with a new U.S. version of the* ***Hawk T2/128****.*
>
> *It is likely other teams will join the competition once further details on the exact procurement requirements are announced sometime this year, depending on the state of the U.S. defense budget.*

threats to the pilot in the air. But near Paris, at the Bretigny experimental center run by Eurocontrol (the Brussels-based international air traffic management agency), researchers are going one step further. They are working on developing dynamic airspace concepts where next-generation military can fly unhindered in shared civil and military airspace, with civil aircraft flights automatically rerouted around the military aircraft's flight path, wherever its mission takes it.

International dimension

Another major change is that future training systems will be increasingly international. There are a number of drivers to this process. NATO nations have for many years recognized that the complexities and costs involved in developing appropriate training regimes for network-enabled operations can often best be met by developing synthetic training networks. NATO's Modeling and Simulation Group ran its first pan-national mission training via distributed simulation exercise (Exercise First WAVE) back in November 2004, involving Canada, France, Italy, Germany, the Netherlands, the U.K., and the U.S. The group is now working on a program to develop standards for simulator interoperability between member states.

The NATO Industrial Advisory Group has also set up a study to develop a road map for the use of advanced distributed air and joint mission training concepts for NATO and its member nations, to deliver more realistic training at lower cost and lower risk.

Second, the development of the F-35 as the choice of fifth-generation fighter for a number of different countries has meant its training regime is being planned by defense organizations from both sides of the Atlantic. For example, in 2009 Lockheed Martin signed a contract with Dutch Space and the National Aerospace Laboratory (NLR) in the Netherlands for the development of a multiship, embedded training system for the F-35, providing multiship interaction, local and distributed weapons simulation, data link, data collection, and offboard debriefing. The aircraft will open up new possibilities for transnational training regimes, even though customers have very different operating priorities.

There is a third but by no means unimportant consideration: None of the aircraft that can potentially make up the flying component of next-generation fighter training systems, for the moment at least, have their origins in North America.

In such a relatively small sector, the huge size of the T-X program will redefine the market for jet trainer competitions, with the winner (almost) guaranteed a global cash-cow for years, and the losers having to think seriously about whether it will be worth their while staying in the market at all. The program will also redefine how new technologies and concepts that integrate the real and virtual worlds can be introduced within a flexible training platform that will itself have to adapt to counter as-yet unknown threats.

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I agree with Col. Kennedy (**Space and risk analysis paralysis**, November, page 29) that risk aversion is a big factor in the greatly increased time and cost of developing and deploying space systems. But that doesn't explain why the estimates of time and cost are so far off in the first place: Why haven't we learned from previous projects that extensive testing and other risk-reduction measures will lead to excessive cost and schedules?

More on this later.

Rationally, risk mitigation activities such as extensive testing should be balanced against the cost of failure, including not only the dollar cost of the lost spacecraft but also the impact of the failure to obtain the system's capabilities as planned. Risk is, of course, a composite of probability of failure and consequence of failure, so both these factors should be applied to determine the value of a risk mitigation activity.

However, rational risk management is seldom applied because of the 'punishment' of the guilty. We can't expect people to take any risk of failure if a failure would terminate their careers. Col. Kennedy places this in the context of 'indispensable node' architectures where a failure impacts national security, and surely we need to avoid such architectures, but we also need a culture of 'freedom to fail' in inherently risky situations; otherwise it could be career suicide to take any risks. I addressed this issue in a blog post a few months ago (http://rosetogroup.com/wp/?p=243).

Back to the question of why project cost and schedule estimates are so

All letters addressed to the editor are considered to be submitted for possible publication, unless it is expressly stated otherwise. All letters are subject to editing for length and to author response. Letters should be sent to: Correspondence, Aerospace America, 1801 Alexander Bell Drive, Suite 500, Reston, VA 20191-4344, or by e-mail to: elainec@aiaa.org.

unrealistically low in the first place. I believe this is inherent in our culture, all the way from the top (Congress) to individual project managers. If the cost and schedule were presented accurately at proposal time, the project would be cancelled (if all bidders submitted accurate estimates) or a bidder who made an unrealistically low bid would win the contract and, inevitably, incur massive overruns. The only way to get a project started is to be unrealistically optimistic about how long it will take and how much it will cost, so there is huge if subtle pressure to make estimates as low as possible rather than as realistic as possible.

Col. Kennedy notes that the response to a failure is to institute more risk reduction measures ("…more testing, more checks, more documentation, more oversight might have prevented said failure. So additional personnel are hired, standards and directives are issued, augmented test strategies are implemented."). As a software process engineer I have also seen this: Process steps are added that prevent recurrence of a problem, but no consideration is ever given to whether carrying out that step costs more than the damage that would be done if the problem recurred.

I had one enlightened boss who tried to judge the amount of risk any project had taken on, and would insist that a project that had too little risk add some. In company with the 'freedom to fail,' identifying and requiring the proper level of risk for a project might help resolve the problems Col. Kennedy has identified.

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In Col. Kennedy's article, the often researched problem of the cost and schedule growth of the space industry was examined. The author points out the culture of risk aversion, often manifested by multiple studies and tests. In my space career I have seen this all too often. However, there is another important factor not considered by Col Kennedy, namely the lack of trust emanating from the Pentagon, to higher headquarters, through program offices down to the individual project engineers.

Its easy for those on top to assign blame on those below and so a strong desire to prevent failure builds in the bureaucracy. This desire though does not result in 'agile acquisition' but rather in slow and deliberate processes. This snowballs in on itself and, ironically, induces its own failure on cost and schedule.

Barry R. Witt
Colorado Springs, Colorado

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Editor's Note: The author of the December report **Meshing, visualization, and computational environments** was misidentified. The author is Vincent C. Betro. We regret the error.

Events Calendar

JAN. 9-12
Fiftieth AIAA Aerospace Sciences Meeting, including the New Horizons Forum and Aerospace Exposition, Nashville, Tennessee.
Contact: 703/264-7500

JAN. 11
Engineers as Educators, Nashville, Tennessee.
Contact: Lisa Bacon, lisab@aiaa.org

JAN. 23-26
Annual Reliability and Maintainability Symposium, Reno, Nevada.
Contact: Patrick Dallosta, patrick.dallosta@dau.mil; www.rams.org

JAN. 24-26
AIAA Strategic and Tactical Missile Systems Conference, AAIA Missile Sciences Conference (SECRET/U.S. ONLY), Monterey, California.
Contact: 703/264-7500

JAN. 29-FEB. 2
AAS/AIAA Space Flight Mechanics Meeting, Charleston, South Carolina.
Contact: Keith Jenkins, 480/390-6179; keith@jenkinspatentlaw.com

FEB. 15-16
Fifteenth Annual FAA Commercial Space Transportation Conference, Washington, D.C.
Contact: 703/264-7500

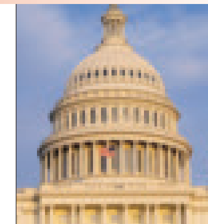
MARCH 3-10
2012 IEEE Aerospace Conference, Big Sky, Montana.
Contact: David Woerner, 626/497-8451

MARCH 20-21
Congressional Visits Day, Washington, D.C.
Contact: Duane Hyland, 703/264-7558; duaneh@aiaa.org

MARCH 21-23
Nuclear and Emerging Technologies for Space 2012, held in conjunction with the 2012 Lunar and Planetary Sciences Conference, The Woodlands, Texas.
Contact: Shannon Bragg-Sitton, 208/526-2367; shannon.bragg-sitton@inl.gov

MARCH 26-28
3AF 47th International Symposium of Applied Aerodynamics, Paris, France.
Contact: Anne Venables, 33 1 56 64 12 30; secr.exec@aaaf.asso.fr

Deadlocked Congress delays decisions



A WIDELY PREDICTED FAILURE IN THE nation's capital happened so quickly that even Washington insiders were taken aback. Without surprises, drama, or even a public announcement, Capitol Hill's 'supercommittee' failed to meet a November 21 deadline for finding $1.2 trillion in budget cuts to be made over the next decade.

Created in a compromise between President Barack Obama and congressional Republicans, the bipartisan supercommittee never really had much chance to agree on huge, unpopular fiscal changes. Under the terms of the deal that raised the debt ceiling last summer, a process called sequestration will now inflict across-the-board cuts of $1.2 trillion beginning in January 2013, with half coming from defense programs.

At least that is how the law is written as of now.

Observers in Washington wonder whether Congress will choose to avoid the doomsday mechanism of sequestration by enacting a law to overturn existing legislation, thereby postponing difficult budget decisions. Obama has said he will veto such a measure. Lawmakers purposely timed the sequestration to occur shortly after an election, in hopes of minimizing political discord when it occurs.

Rep. Howard P. McKeon

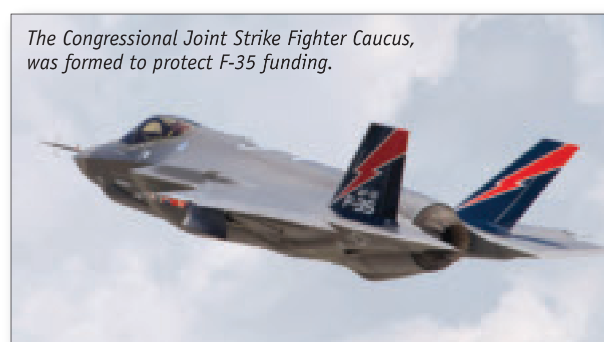
If no change is made, sequestration will bring colossal defense cuts with a tectonic effect on the aerospace industry and jobs. Supporters say the U.S. is powerful enough that it can absorb big cuts in order to take a painful step toward fiscal responsibility. Others say the nation cannot handle the loss to its industrial base, or the effects on warfighting capability that sequestration will bring. Lost in much of this chatter is the issue of military capabilities. One widely held view is that the U.S. can still be a globe-girdling superpower even after major cuts.

Secretary of Defense Leon Panetta, who was expected to be a budget hawk when he came to the Pentagon in February 2011, has instead become a vocal advocate for keeping defense spending at current levels. Now, Panetta is warning that the $600 billion in automatic cuts, combined with reductions made earlier this year, would force the Pentagon to slash its spending by 23% across the board. That includes funding to buy hardware such as UAS, surveillance systems, and a new bomber. He warns of "devastating, automatic, across-the-board cuts that will tear a seam in the nation's defense." He adds, "The half-trillion in additional cuts demanded by sequester would lead to a hollow force incapable of sustaining the missions it is assigned."

During the months that the supercommittee deliberated, Panetta consistently urged lawmakers not to reduce national security spending beyond the more than $450 billion already approved by Congress in August.

Rep. Howard P. 'Buck' McKeon (R-Calif.), chairman of the House Armed Services Committee, wants to overturn the automatic cuts. "I will not be the armed services chairman who presides over crippling our military," he says. For McKeon and others with the same view, the greatest obstacle may not be the Obama veto threat but the leaders in both parties in the House and Senate. They control what legislation reaches the floor and have shown little interest in reversing the cuts.

Reps. Kay Granger (R-Texas) and Norm Dicks (D-Wash.) announced the formation of a Congressional Joint Strike Fighter Caucus, with 49 members from both parties. Its purpose: to protect funding for the F-35 stealth fighter. The plane, as the most expensive weapons program in history, is vulnerable to defense cuts. Its Marine Corps version, the F-35B, spent much of the fall carrying out shipboard tests aboard the assault ship USS Wasp (LHD 1) and performed well. In November the F-35 was noticeably absent from the Dubai trade show, the world's third-largest trade exposition after Paris and Farnborough, possibly because no Middle East nation except Israel has a stake in the program.



The Congressional Joint Strike Fighter Caucus, was formed to protect F-35 funding.

Asked whether legislators might intervene to prevent sequestration, Rep. Steny Hoyer (D-Md.), the second ranking Democrat in the House of Representatives, pointed out the obvious. "That's more than a year from now," said Hoyer.

A rare look at NRO

When the National Reconnaissance Office was established in 1961, the fact of its existence was itself top secret. Over the years, it has become a little more public—although not much. Its 68-acre, seven-building headquarters on Lee Road in Chantilly, Virginia, on the outskirts of the nation's capital, opened in 1994 and accommodates 3,000 employees. NRO workers, many of them in uniform, flock to the Thai Basil restaurant in Chantilly for lunch. They do not, however—at least not over lunch—discuss the NRO's job, which is the design, acquisition, and operation of U.S. reconnaissance satellites. "That stuff is still pretty hush-hush," says NRO Director Bruce Carlson, who gave reporters a rare update on agency operations to mark NRO's 50th anniversary. (See "Vigilance from above: The NRO at 50," November, page 20.)

In a rare public appearance before reporters, Carlson said his agency has emerged from years of schedule and cost problems with its satellite programs. He noted, "as recently as a couple of years ago, more than 30% of our programs were in the yellow or red, meaning they weren't performing appropriately." Today, said Carlson, "major system acquisitions are in the green," meaning that satellites and associated equipment are being delivered on schedule and at price.

Carlson, 62, a retired Air Force general who was once responsible for acquisition within the military, told reporters that the nation's satellites, like most of its military aircraft, are aging and that considerable effort is being expended to update and upgrade them. He discussed older satellites being used in new ways.

When asked to geolocate the source of push-to-talk radio transmissions that emanate from insurgents in Afghanistan and elsewhere, Carlson said that at first the NRO could achieve accuracy only "within 3 miles." Militants use push-to-talk radios "extensively in the combat zone" because they are difficult to geolocate, he said. Moreover, they are perceived, apparently incorrectly, as more secure than cell phones. Carlson said that with updated sensors, satellites can now pinpoint a transmission within a few meters. "That means it's targetable."

The NRO is doing less long-range strategic intelligence and more tactical surveillance, making the agency a direct participant in current battles, said Carlson. In a situation like one last spring in Libya, where a two-person crew bailed out of an F-15E Strike Eagle, "we can, within a matter of seconds, turn an incredible number of our sensors on a specific area." He also cited NRO's "Red Dot program," which literally puts a red dot on the computer screen of a soldier on the ground, warning of the location of an improvised explosive device.

Carlson noted that his agency has launched six satellites in seven months—an unprecedented flurry of space activity, most of which was largely ignored by press and public. He said scientific and technological efforts within the NRO are responsible for 60% of the equipment carried by those satellites. The agency is always looking for new ways to collect and process imagery and to get useful information to decision-makers quickly. "We can do it in a matter of hours," he pointed out.

His first priority today, Carlson said, is to shield the scientific and engineering talent in the NRO from the draconian budget cuts expected to occur when sequestration kicks in. His second is to maintain baseline programs. With science and technology now following the "historical level" of making up 8% of NRO's total budget, up from a low of 5% a year ago, Carlson recognizes that his agency may be vulnerable to cuts. But he said he will cut operations before he'll slash people or programs.

NRO Director Bruce Carlson

Hexagon was a mainstay of U.S. intelligence collection between 1971 and 1984.

The NRO boss is "happy" with his budget but "would always like more." He said he has several emerging technologies that he'd like to evaluate but does not have sufficient funds for all. He would like to continue to develop both large and small satellites but concentrate on a 'sweet spot' where satellites weigh between 800 and 1,000 lb.

Sometimes, however, size matters. "We tried, 10 years ago or so...to take the capability that we put in our imaging satellites and make it compact and put it on a smaller lift vehicle," said Carlson. "That process was...a colossal failure."

To mark its 50th anniversary, Carlson's NRO released new details about the KH-9 Hexagon reconnaissance satellite, which was a mainstay of U.S. intelligence collection between 1971 and 1984. Also called 'Big Bird'—60 ft long, 10 ft in diameter, and weighing

30,000 lb—it is believed to be the largest intelligence satellite ever launched by the U.S. The declassification of tens of thousands of documents enabled Joseph Prusak, head of the KH-9 design team, to speak about it publicly for the first time. But critics say the NRO—like much of the government—is seriously behind schedule in meeting an Obama administration target to declassify 10% of holdings.

Taking aim at TSA

Two Republican congressmen are reviving a proposal that arises from time to time in Washington—to take the job of airport screening away from federal employees and turn it over to private contractors. Rep. John Mica (R-Fla.), chair of the House Transportation and Infrastructure Committee, and Rep. Darrell Issa (R-Calif.) of the Oversight and Government Reform Committee jointly issued a report in November calling for moving airport screening away from the Transportation Security Administration and to "private contractors under federal supervision."

Rep. John Mica

This is the arrangement that existed before September 11, 2001. The two lawmakers say that if the shift is made, it will end up saving dollars in the long run, even though there will be a spike in initial costs.

The two legislators wrote, "Almost all Western countries have evolved their airport screening programs to meet current aviation threats through federal oversight of private contract screeners. The U.S. must also evolve to provide the most effective transportation security system at the most reasonable cost to the taxpayer."

Rep. Darrell Issa

They were careful to write that, despite the change they propose, today's uniformed TSA screeners are "hard-working, dedicated personnel."

John Pistole became TSA director in June 2010 and is best known for expanding his agency's imaging technology and pat-down procedures. He disagrees with the Mica-Issa proposal. Having federal employees for airport security preserves the TSA "as a federal counterterrorism network that continues to evolve to keep the traveling public safe," Pistole's spokesman Greg Soule told *Washington Post* columnist Joe Davidson. Most in Washington would say the TSA is an antiterrorist agency, meaning it is part of a defense against terrorism; the term counterterrorism is usually used to refer to striking back at terrorists where they live.

TSA Director John Pistole

Pistole acknowledges that it is part of his job to confront flak from Congress. A few days before the Mica-Issa report, Sen. Claire McCaskill (D-Mo.) told Pistole that she is an "expert" on commercial air travel, and that with her artificial knee, she tries her hardest to avoid what she calls "unbelievably invasive" pat-downs in favor of the advanced imaging technology scanning machines. McCaskill called the work of one particular TSA screening agent "ugly."

Sen. Claire McCaskill

"When you have the traveling public tell you these pat-downs are unacceptable, they are not exaggerating," said McCaskill.

Many in Washington say TSA does not receive enough credit for the very real security it has provided over the years, and that it does not deserve its status as the agency everyone loves to hate. According to Darrell Jenkins of the American Aviation Institute, passengers frequently carp about TSA when they ought to be complaining about the "ever-increasing tax and regulatory burden on airlines and passengers." The Mica-Issa proposal to privatize some screening is not expected to progress very far.

Robert F. Dorr
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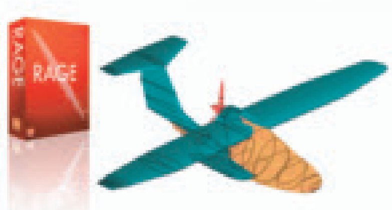

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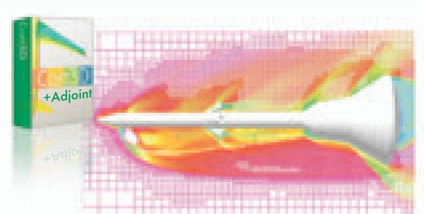

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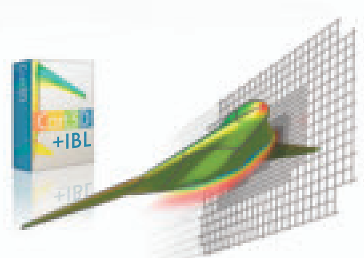

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Domingo Ureña-Raso

What are the prospects for the global military transport aircraft market? Are we in a growth or consolidation phase?

We are in the same phase as the rest of the economy. It is true that many countries need more capacity and greater capability in this sector, but budgets are being capped, and we understand that many nations face an economic crisis. This means they are moving budgets to social areas such as health care and unemployment; defense does not look like a fashionable area in which to invest.

On the other hand, countries are contributing more and more to military, paramilitary, and humanitarian missions. When you look at the capabilities these involve, it is clear that military transport has become the key player—not just in the military arena, but in international cooperation efforts in support of disaster relief and security operations. Military transport has become the capability that is most used by everyone. So the demand is there, but the budget restrictions are also there—we are looking at what this means and what opportunities will emerge from this situation.

Budget issues are certainly a problem for European and north European governments, but not in other regions such as the Far East.

The only country I know that is really raising defense spending is China. But throughout the world the transport market features aircraft that are very old and have very limited capacities. Most are more than 30 years old—C-130s, Russian aircraft, and some different western models, all very old and very close to the end of their life. We are seeing at the same time an increased demand for military transport capacities. There are no countries that don't have this need; they need to renew their fleets, but they won't increase their budgets, and for Europe and the U.S. these budgets will decrease significantly.

But in this environment, for Airbus Military it's a great period. If you take the A400M, we have a new generation of strategic and tactical transport aircraft that will fulfill the new requirements, which are completely different in size from a few years ago in relation to the military and paramilitary requirement. They can move materiel much closer to where the equipment is needed. We are starting off with orders for 174 A400Ms, but we see a potential for some 400 over the next 25 years, on top of the current 174 orders; aircraft that are far more economical and flexible than today's.

Flexibility seems to be a key component to success in this market—producing a single platform that can perform an increasing number of roles, from air tanker to surveillance and communications.

Flexibility is paramount. In the past we had aircraft developed for a single type of mission. These were developed during the Cold War, and today we can witness the pros and cons of employing capabilities based on that situation.

The A400M was designed and launched after the Cold War, and to meet a requirement from seven different countries, each with its own needs. The U.K. and France, for example, are very operational countries; Germany has a different use of the aircraft—maybe more for humanitarian support—and Spain is perhaps a mixture between the two. Turkey is very operational. This means you need an aircraft that can fly in the civil corridors at high speed, at Mach 0.72, but with extensive logistical capability, carrying a load of 37 tonnes of modern equipment near the battlefield or the scene of humanitarian disaster.

Is the A400M now back on track?

The first delivery, the first production aircraft, will be with the French air force by the end of 2012. This aircraft is already in production, and all components will arrive at the production line by the end of this year. So it's very real. We will see another four coming off the line in 2013.

Beyond the current orders, where do you see other demand coming from—the U.S., for example?

We don't exclude anyone. The U.S. is very oriented toward efficiency, and at one point of time we would like to demonstrate the capabilities of the product to the U.S.

On the technical side of building new military transports, what are the essential new systems or operating procedures, the game-changing attributes of an aircraft—reliability, or cost of support—that will ensure a competitive advantage?

With the A400M, from day one we designed it to operate any type of mission, no matter how complex, with just two crew. Of course it's up to the customers to decide how many crewmembers they want, but the concept, the workload, has been designed with just two people in mind. Most of our customers have decided to put a third member in the cockpit—the mission commander—but theoretically the aircraft is capable of operating with just two. This is a big step forward.

The second point is a step change in technology: an integrated civil and military environment, so both opera-

"The second point is a step change in technology: an integrated civil and military environment, so both operations can be performed automatically, or at least in an integrated way."

Interview by Philip Butterworth-Hayes

tions can be performed automatically, or at least in an integrated way.

The third is that each mission, whether high- or low-altitude operations, air-to-air refueling, or low-level tactical flight, is integrated within the computer system, so each mission is automated as much as possible. A single aircraft for each different mission.

We are also focused on delivering a high level for the maturity of the equipment on board and the dispatch reliability rates of the aircraft—we have introduced tests and certification of systems as if we were operating in the civil sector, allowing for high dispatch reliability even in very severe conditions. We have developed the aircraft with an autonomous self-troubleshooting capability. In maintenance and repair we are combining our civil aircraft capabilities with the best knowledge we have on the military side.

When it comes to integrating civil maintenance concepts with predictive maintenance systems and integrated systems support, doesn't this start to change the role of manufacturing? You must become involved in mission support while finding new cost-effective solutions for owning and flying the aircraft. How is this changing your business?

This is a big change in the market. Before, the roles were very well determined. The manufacturer delivered the capability, the air force had its own maintenance operation, and you just supplied them with the logistics to carry out their role. But budget restrictions have meant that as governments pass to their armed forces responsibility for battlefield operations or humanitarian support, defense departments need to find further efficiencies in these areas. Ideally they want to have just purely operational people dedicated to the targets the governments have set—so they need to find new ways to optimize maintenance and repair, for example.

"It means at the end of the day we take responsibility for the aircraft always being ready to operate."

We believe we have a big point to prove in this area. We are now working with some governments to guarantee them dispatch reliability of mission success. What does this mean? It means at the end of the day we take responsibility for the aircraft always being ready to operate.

Do you have any figures showing how much improvement to operating costs this can mean?

Well, if you look at the multirole tanker transport aircraft ordered by the U.K., the future strategic tanker aircraft [FSTA], this is a pure mission success contract. We take care of absolutely everything on the ground, and the RAF just flies and operates the aircraft. We also guarantee dispatch reliability rates for some of our small and light aircraft—85% or 90% or whatever is needed.

But how can you do this—guarantee an exact dispatch reliability rate

Domingo Ureña-Raso was appointed chief executive officer of Airbus Military in February 2009. In this position, he serves on both the EADS and Airbus executive committees. Airbus Military products include the former CASA military transport aircraft CN-235, C-295, and C-212, the A400M, and all military derivatives, such as the A330 multirole tanker transport (MRTT).

Ureña-Raso was born in Camarena, Spain, in 1958. He graduated from the Polytechnic University of Madrid in 1982 with a degree in technical aeronautical engineering before obtaining an MBA from the International Board of Social Sciences (UNESCO), sponsored by CASA, in 1989. He earned a diploma in business management from the ESSEC of Paris in 1998.

Ureña-Raso started as an engineer at CASA in Spain in 1982, working in manufacturing quality engineering, then as F-18 and CN-235 program manager, and later as chief of tooling and methods. In 1989, he moved to Airbus in Toulouse.

In 1998, he was appointed CEO and member of the board of Aircelle's joint venture between Airbus Industrie and Snecma to develop, manufacture, and maintain the nacelle systems for the A340-500/600, in cooperation with EADS-CASA. After the Airbus share was sold to Snecma, he became president and CEO of the first privatized defense company in Poland, PZL (now Airbus Military Polska) in 2002, with the mission to restructure the company and develop a strategic investment program based on core business.

Upon completion of the mission, Ureña-Raso moved to Munich to become head of procurement and a member of the board for the Eurofighter program. In the spring of 2004 he joined the EADS defense division.

In 2006 he returned to Airbus in Toulouse as head of the new Airbus industrial strategy team. Since January 2007 he has been in charge of the 'Power 8' turnaround program and the Future EADS program.

when you don't know exactly what missions your customers are going to be flying?

With special missions like that we have some key drivers that we commonly agree to with the client; they involve guaranteeing dispatch reliability rates in particular areas. It's down to us to move all the people that we need into the area to guarantee that the customer has the dispatch reliability needed at all times. Of course it's a different kind of service to support the aircraft in a hostile environment than in a normal environment.

Part of the equation is that we are dealing with many customers. The U.K. case is a kind of ultimate example, because we take care of everything from financing of the aircraft to full maintenance, and we are paid by mission success. Between that and delivering an aircraft with some technical support, there is a wide band of requirements based within each country.

When you are selling a capability, increasingly it means dealing with international organizations like NATO, that want the capability—such as air-to-air refueling or surveillance—across a wide number of states. How does that work?

In the A400M, for example, we're working with France and the U.K. on guaranteeing a common standard of mission success to these two countries if they agree to share a lot of things at the operational level. Industry is starting to provide a common support service to a combined fleet—in this case the U.K. and France.

How do you plan to build on your success in the U.S. with its Coast Guard Ocean Sentry program?

We made a big effort in the U.S. with the tanker program. We lost—but we learned a lot, and we can now see how we can improve in this market. It's allowed us to know the customer much better, to become more familiar with the equipment. The U.S. is still one of the key targets. The CN-235 in service with the U.S. Coast Guard is a successful program, but we make other things we can offer. Some North American companies are already operating our C-212, and we believe we could have some success with our mission systems aircraft. After all, we are the world's number-one supplier of medium military transport aircraft such as the CN-235 and C-295.

What is meant by mission system?

Maritime patrol, search and rescue, antisubmarine warfare. And we are developing early warning system capabilities; I believe we have products that could fit the U.S. market. We see opportunities in homeland security and defense—our advantage is that life-cycle costs are very competitive.

How has your company been impacted by the financial troubles in Europe and elsewhere, and the general volatility of markets?

Governments are now dedicating much less money to defense and defense-related activities. The economic situation in Europe has meant the euro is extremely expensive. This means we can be less competitive than a product with costs in U.S. dollars. But that's given us an additional challenge, which has led to opportunities we have never seen before.

In difficult times new ideas are put on the table, and so far, despite the problems, we have not seen any reduction in turnover or requirements. We export worldwide; we have more than 70 countries as customers for the four aircraft we produce, and we try to balance work between those countries who want to reduce their fleets and those who have new requirements. Plus we have internal pressures to reduce our costs more and more.

But we are also facing tougher competition from some of the players who before were just producing for the domestic market and now are looking for international sales.

What countries are we talking about here—the emerging economies and China, for example?

China is not a market for us. But in emerging markets such as India, Brazil, Latin America, and Asia we are doing well. We have won recent business in Asia and the Pacific, with new customers in Australia and the gulf.

And Brazil is now also a competitor.

Brazil is a competitor and Embraer is an extremely good aircraft manufacturer. We have a lot of respect for all competitors.

Is the new KC-390 a worry for you, or will it be competing in different markets from the ones where you are operating?

We know little about the KC-390 but we do not consider it a threat, because from what we do know, and based on preliminary information that we have, it is not operating in the same range with the same payload or performance as the A400M or C-295. In principle, therefore, we do not think this aircraft is a threat. But if they continue to develop the concept and introduce a new aircraft into the market, that could become a competitor.

I see you have recently won some structures work on the new Airbus A320neo civil aircraft. How important is this kind of business to you?

We now have technologies within Airbus Military that can be used on the civil side. We want to continuously develop those for our own market and for potential civil customers.

Are you looking for other civil aircraft customers apart from Airbus?

Sure—we want to compete with anyone if it allows us to add value by developing these technologies.

In terms of the MRTT, where do you see new customers for this aircraft, and how do you see the aircraft evolving into new markets such as the special missions' aircraft sector?

We have two aircraft operating with the Royal Australian Air Force, and we will deliver another two this year to Australia. We will also deliver one to the U.K. and one to Saudi Arabia—so it's a busy year for us with entry-into-service for three different customers. They are starting to see the capabilities of this product; missions that before took three or four different types of aircraft they can now do with one. And the aircraft they have bought is also faster, and, with life-cycle costs close to an Airbus A330, costs are reduced to a minimum.

But I do not think our customers have yet explored all the possibilities of the aircraft. We are starting to talk with them on some new missions for which they could use it, but it will take some time for the customers to become comfortable with it,

In terms of the potential market, we are talking to our current customers about adding additional aircraft. We also are talking to potential new customers—in India, for example—and others in Europe and Latin America. I think when some countries see how the economics of the aircraft work, they will switch to our products. I think in the next two to three years we are going to have some pleasant surprises from customers we don't yet know about today.

What sorts of other applications—such as command/control and intelligence gathering—could you envision for your products, and how easy is it to identify what roles your customers might want in the future?

We are in a difficult economic situation, with multiple aircraft types still operating in the market. But little by little we are starting to see what sorts of platforms are going to be required in the future. For example, it appears that the U.K.'s future military transport platforms will be based on the C-17, A400M, and FSTA. So that starts to clarify what sorts of platforms are going to be used eventually, if they are compatible with future missions systems—but I wouldn't want to anticipate too much. The key driver is the customer. With the A330, however, you have a big platform with enough space and payload to cater for many different system types.

When it comes to looking at future markets, especially growth markets like the maritime patrol sector, are you in competition with unmanned air systems now?

It's too early to say. But if you are talking about providing platforms that best suit the maritime patrol role, then maybe you have to look more at aircraft like the Airbus A320 for an antisubmarine role. The big advantage we have at Airbus is that we can use our range of civil products to produce competitive platforms that can be suitably equipped and customized.

Are you currently offering the A320 as a military platform?

It could be feasible in the medium or long term, yes, with the medium term to around 2020, and the long term between 2020 and 2030.

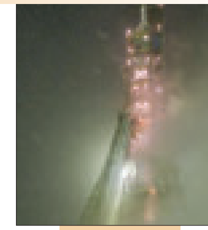
Looking at Airbus Military's global role, you recently announced a deal to further support PT Dirgantara in Indonesia. What other global partnerships are you pursuing?

We have been a partner with Indonesia since the early 1970s, and our CN-235 is still being produced there. Many companies arrived in Indonesia over the years, but most have left, and maybe we are one of the few companies who have stayed there during all these decades. We have a special relationship now with PT Dirgantara and the government, which has seen possibilities in improving cooperation. We are considering moving the C-212 assembly line there, and we continue with the joint production of the CN-235 and are now looking to expand this cooperation.

Do you have similar partnerships in other parts of the world?

We have another long-established partnership with ENAER in Chile, and have been working for decades with partners in Poland. We sold the C-295 to Poland and we now have a well established cooperation with the country through Airbus Military Polska. This is a new way, maybe, to engage with customers, especially in the defense area, by working with national companies and growing with them.

"We are in a difficult economic situation, with multiple aircraft types still operating in the market. But little by little we are starting to see what sorts of platforms are going to be required in the future."



Exploration in an uncertain decade

You won't find an ATM on the international space station. Not much call for cash in orbit—there's no place to spend it. No Hilton hotel lounge, no Apollo Room club 'high atop everything,' no Starbucks—yet. So, just before leaving crew quarters for each of my shuttle launches, I'd turn over my wallet to Olan Bertrand, heading up the Astronaut Office engineering support team. The Astrovan would drop Olan off at the launch control center, with his promise that he'd see us on the runway just after wheels stop. His was one of the first faces greeting us after landing, through the open orbiter hatch. Soon after, 'the government'–Olan—would hand back my money. How rare is that?

In November, the Congress handed NASA its 'wallet' for 2012, and the nation's fiscal troubles ensured it was thinner than last year's. With the president's signature on the 'mini-bus' appropriations bill, NASA's FY12 budget fell to $17.8 billion. That's down from $18.5 billion in FY11, a reduction of $648 million, and $924 million below the president's budget request.

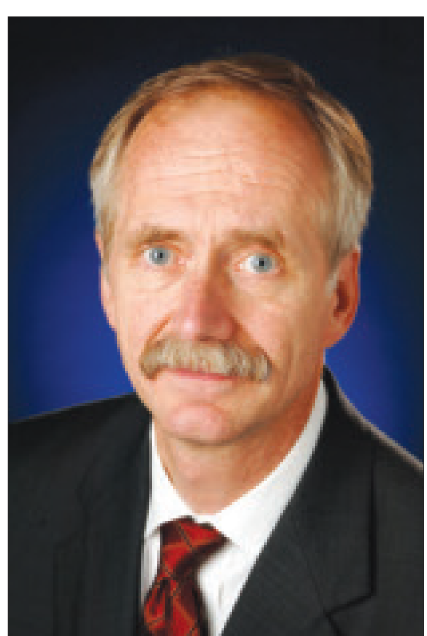
NASA Science received $5.1 billion, an increase of $155 million that continues development of the James Webb Space Telescope. Space Operations received $4.2 billion, down more than a billion dollars with shuttle retirement; those funds were reprogrammed to other NASA priorities. ISS operations were funded at $2.8 billion.

Human space exploration dropped $30 million from 2011. Most of its $3.8 billion will go to the Orion multipurpose crew vehicle ($1.2 billion) and the new Space Launch System ($1.86 billion). Congress has made clear that it expects NASA to move out smartly on both the deep-space Orion and the heavy lift booster.

The legislature, skeptical of industry progress and NASA's management of its commercial spaceflight program, cut the requested $850 million appropriation to $406 million. The commercial crew program is aimed at moving NASA astronauts off the Russian Soyuz and onto U.S.-built rockets and spacecraft by 2016.

Associate Administrator William Gerstenmaier, NASA chief of human exploration and operations, told Congress in October that those cuts would delay the advent of U.S. commercial crew transport to the ISS, and stretch U.S. reliance on the Soyuz to more than five years. His testimony warned that "NASA's initial analysis shows that an FY12 funding level of $500 million…would delay initial capability to ISS to 2017, assuming additional funding is available in the out-years. During that roughly one-year period of delay, NASA would be paying approximately $480 million to Russia for crew transportation services."

NASA received far less than that $500 million, so the agency must either extend its dependence on Russia or pump the remaining resources to one or two commercial suppliers in a bid to get rockets to the pad by 2016.



NASA Associate Administrator William Gerstenmaier.

Blending exploration into operations

Fate and funding have put Gerstenmaier in a key leadership role as NASA tackles major challenges in operations and exploration. He took over the helm of the new Human Exploration and Operations Mission Directorate (HEOMD) last fall.

His new organization combines the old Space Operations and Exploration Systems Mission Directorates; the latter lost its independent portfolio when the White House cancelled the Constellation program in 2009. The directorate, 'HEO' in NASA shorthand, manages space operations related to human exploration in and beyond low Earth orbit. Its responsibilities encompass operations at the ISS, crew and cargo transport to the outpost, and plans for exploration beyond the station. HEO's activities include commercial space, advanced exploration systems, human spaceflight capabilities, and space life sciences research. The directorate also manages launch services, space transportation, and space communications that support robotic as well as human exploration. Details are at http://www.nasa.gov/directorates/heo/home/index.html.

Gerstenmaier is well-suited to lead NASA's station operations in the coming decade, and to prepare its people and technologies for eventual human exploration in deep space. In 1977, he joined NASA at Glenn to conduct wind tunnel tests for the nascent space shuttle. He subsequently headed up the Space Shuttle/Space Station Freedom Assembly Operations Office, and by the mid-1990s was the Shuttle/Mir Program's operations manager out of NASA Johnson.

Russian support personnel help crew exit the Soyuz TMA-02M shortly after the capsule landed with Expedition 29 Commander Mike Fossum and Flight Engineers Sergei Volkov and Satoshi Furukawa in a remote area of Kazakhstan, on November 22. Photo: NASA/Bill Ingalls.

I met Bill in 1997 aboard a jetliner packed with NASA engineers and program managers on our way to Moscow to 'engage' our new ISS partners. He was one of the few people aboard who seemed optimistic about the outcome of our negotiations, certainly more confident than I was. In 2000, as ISS construction commenced in earnest, he became the station program's deputy manager.

He rose to ISS program manager, then in 2005 was named to head the Space Operations Mission Directorate, overseeing both the shuttle and space station programs. Last year, Gerstenmaier managed the safe closeout of the space shuttle program, and now aims to carry NASA's operations skills and ambitions well beyond the station's orbit–launch date TBD.

Post-shuttle pace quickens

The new directorate immediately faced a series of challenges in LEO. A Soyuz booster carrying the Progress 44 cargo ship failed to reach orbit on August 24 when a faulty gas generator on the Soyuz' third stage engine caused premature thrust termination. The failure grounded the Progress/Soyuz crew capsule booster, cutting off access to the space station.

By late August, Roscosmos, the Russian space agency, identified the contaminants that caused the generator failure. The Russians shared the failure investigation results with NASA, said Gerstenmaier in an October 12 congressional hearing, and agency engineers performed a follow-up review of the findings.

"They did kind of a background check to make sure that the conclusions the Russians were drawing were reasonable….We agree with the basic Russian findings," he said.

After inspecting Soyuz's third-stage engines, the Russians launched Progress 45 on October 30, clearing the way for the launch of the Expedition 29 crew to the ISS on November 13. Commander Dan Burbank and flight engineers Anton Shkaplerov and Anatoly Ivanishin, aboard Soyuz TMA-22, docked with the ISS three days later.

After an abbreviated handover lasting less than a week, Burbank assumed command from outgoing Expedition 29 commander Mike Fossum, who had been in orbit since last June with cosmonaut Sergei Volkov and Japanese astronaut Satoshi Furukawa. Fossum and Furukawa, with Volkov at the controls, returned to Earth safely on November 21.

The Soyuz grounding had forced the ISS partners to reduce the onboard crew size to three, but the planned December launch of Soyuz TMA-03M, with Oleg Kononenko, ESA astronaut Andre Kuipers, and NASA's Don Petit, would restore the complement to six. They comprise Expedition 30, whose tenure began formally when Fossum's crew returned to Earth in November.

Easing the Soyuz monopoly

Last year's Soyuz failure illustrated the risks to the ISS engendered by dependence on a single launch system. While dealing with the Soyuz investigation, a rapid-fire logistical analysis to assess crew habitability, and planning for possible unmanned ISS operations, HEO and Gerstenmaier have been trying to accelerate efforts to re-

Atlas V would serve as the launch vehicle for both the Dream Chaser and the CST-100.

store a U.S.-based crew launch-to-LEO capability.

The agency has been providing development funds to several commercial firms, with the goal of launching astronauts on U.S. vehicles by 2016. Last April, NASA gave $270 million to four companies to push development of rockets and spacecraft. (See "What's next for U.S. human spaceflight?," page 24).

Blue Origin is working on a reusable orbital spacecraft, a biconic capsule design recovered via parachute. Sierra Nevada is pursuing its Dream Chaser lifting body crew transport, modeled after NASA's HL-20 design. Atlas V would serve as the launcher; Dream Chaser would glide back for a runway landing. Space Exploration Technologies (SpaceX) is developing a launch escape system for a crewed version of its Dragon cargo capsule, and Boeing is designing its CST-100 capsule, also riding atop an Atlas V.

In October, Boeing announced it had signed a 15-year lease to use Kennedy Space Center's Orbiter Processing Facility-3 (OPF-3) to manufacture and test the CST-100. NASA had used the three OPFs to refurbish and maintain the shuttle orbiters. The Apollo-shaped CST-100 can carry up to seven crewmembers, or an equivalent combination of people and cargo, to the ISS or the proposed Bigelow space tourism habitat. Boeing says it is on track to provide services to the station by 2015, although funding shortfalls put that date in doubt.

SpaceX, another NASA Commercial Crew Development (CCDev) partner, has rescheduled Falcon 9 Flight 3, a cargo flight demonstration to the ISS, to February 7. Falcon 9 has achieved orbit twice; on Flight 3 the company hopes to demonstrate operation of its Dragon capsule and service module, the latter flying for the first time. With solar arrays and maneuvering thrusters, the Dragon/service module test should culminate with a grapple and berthing at the ISS. SpaceX attributed the delay partly to the November crew handover, and to lack of a full crew aboard the outpost; three astronauts would be stretched too thin to monitor the arrival and berthing of a new robotic vehicle. Testing of the booster software was also a factor. SpaceX hopes to launch Flight 3 before March.

The White House and NASA are gambling that commercial launch services could replace the canceled Constellation program's Ares I booster, and do so at lower cost. NASA will be under strong congressional pressure to show progress, even with reduced funding.

Beyond Earth orbit

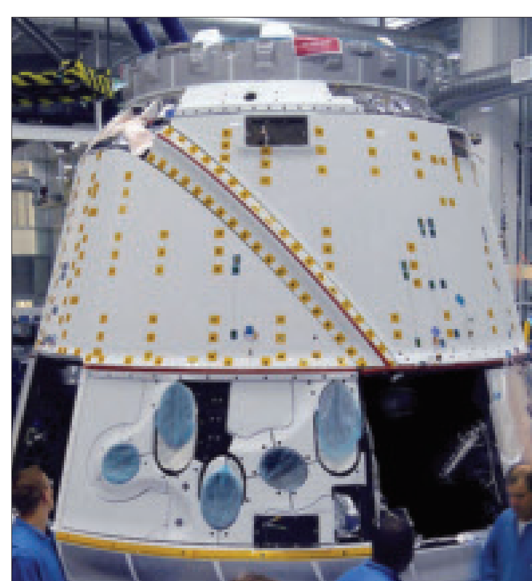
A flat or declining budget is also the major obstacle to HEO's plans for propelling humans beyond ISS. The new Space Launch System, unveiled by the agency in September after repeated delays, is a bid to provide the necessary rocket muscle. With a first launch goal of 2017, the new booster blends shuttle and Constellation technology to lift 70 metric tons to LEO. The design is capable of evolving to 130 metric tons of payload, a performance specification deemed so important by Congress that it was written into November's appropriations bill.

The booster core, resembling Constellation's Ares V concept, will use liquid oxygen and hydrogen as propellants. Shuttle main engines power the core, and a single J-2X engine, derived from the Saturn IB and Saturn V, will insert the upper stage into LEO. Two five-segment solid rocket boosters will help lift the early SLS; NASA will compete proposals for higher performance liquid-fueled boosters as SLS moves toward the 130-metric-ton goal.

Incorporating much flight-proven hardware and Constellation technology, the biggest unknowns facing SLS are its mission and costs. Its first mission is to back up commercial services in reaching the ISS, but a first launch in 2017 may be too late to help much.

SLS's deep-space mission remains nebulous. The generic heavy payload capability clearly includes the Orion MPCV, but what will be its destination? The administration has taken lunar exploration off the table, so NASA at present can shoot only for the distant goal of near-Earth asteroid missions in the 2020s.

Despite full 2012 funding, a flat or declining NASA budget over the next



With its next Falcon 9 flight, SpaceX hopes to demonstrate operations of its Dragon capsule.

five years will certainly squeeze the agency's ability to develop and fly a Saturn V-class booster. Then there are worries about operations costs. Critics point out that even when operational, an asteroid expedition would fly, on average, only every other year. With tepid White House support for the booster, and projected costs of a billion dollars or more per launch, will SLS even survive to see first flight?

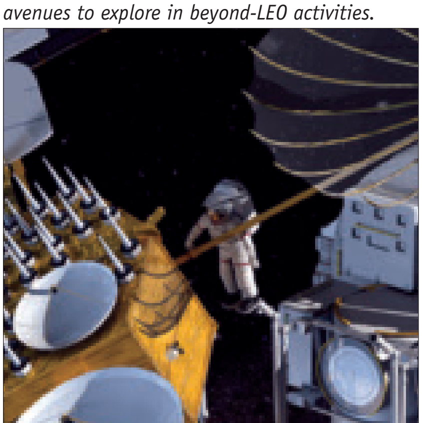
NASA should weigh alternatives like orbital propellant depots, touted by the agency last fall as a 'game-changing' technology. Despite their operational complexity and the cryogenic boil-off problem, depot economics with low-cost commercial rockets might be attractive in fueling heavy payloads for missions beyond Earth orbit.

Orion now appears much closer to actual flight. In November, Lockheed-Martin and NASA announced plans for an unmanned orbital mission, Exploration Flight Test-1. A Delta 4 will insert Orion into a high-apogee Earth orbit, resulting after two revolutions in a high-energy reentry designed to subject its heat shield to near-deep-space velocities, structural loads, and temperatures. Recovery would take place off the California coast. Target date for EFT-1 is early 2014.

Elevating relevance

If NASA is to keep human spaceflight from sliding further down the list of national priorities, it should propose and execute near-term achievements

GEO satillite servicing is one of the promising avenues to explore in beyond-LEO activities.



The configuration of NASA's new SLS was unveiled last September.

that build steadily toward lunar and asteroid exploration a decade hence. Sketchy outlines of using Orion and SLS in the 2020s are not sufficient. NASA should look to practical demonstrations within 5-10 years at the ISS and in cislunar space of how robotic and human exploration can open up new areas of commercial and industrial activity—exploration payback.

Examples include having astronauts experiment with promising commercial processes in space: GEO satellite servicing, solar power beaming demonstrations, and resource extraction from extraterrestrial materials. Crews can also test vital exploration technologies at ISS: inflatable habitats, new spacesuits, free-flying personal exploration craft, even shirt-sleeve assembly hangars. Both avenues would provide highly visible near-term evidence that human deep space presence is relevant to our national economic vitality.

These technologies are all demonstrable within the decade, and are modest enough to be affordable in an uncertain budget environment. Such commercial and technical successes could pave the way for the deep space expeditions of the 2020s, a subject best saved for the next column.

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Indigenous fighters make an unexpected return

The idea of indigenous combat aircraft—fighters designed and built by a new aerospace producer, to meet local requirements—has been around for decades. After a series of disasters and near-misses, the idea fell from favor over the last decade.

However, a combination of circumstances has revived the idea in the past few years. Both Turkey and South Korea have ambitions to create home-grown fighters, even if their budgets and road maps remain highly uncertain. Yet large obstacles to market entrance remain firmly in place.

The golden age of national fighters

In the 1980s and 1990s, numerous designs emerged for indigenous combat aircraft. Two were built; many more were canceled. One remains in a curious state of near-production limbo.

Taiwan's Aero Industry Development Center Ching Kuo Indigenous Defense Fighter (IDF) is a lightweight supersonic aircraft optimized for the air defense role. It is a twin-engine single-seat design which incorporates elements from Lockheed's F-16, Boeing's F/A-18, and Northrop's F-20. Initial operating capability was achieved in late 1994. Taiwan has taken delivery of all 121 production and 10 preproduction Ching Kuos to replace F-104s and F-5E/Fs in its air force inventory, with the last one delivered in January 2000. However, this represented a severe reduction from the original goal of 250-420 production aircraft.

The second indigenous fighter to enter production was Japan's F-2 (also known as the FS-X, or SX-3). The F-2 was designed jointly by Mitsubishi and Lockheed Martin as a major upgrade of the F-16. The F-2 replaced the Mitsubishi F-1 strike fighter in the Japan Air Self Defense Force. The single-seat version is the F-2A, while the twin-seat trainer is the F-2B.

After a great deal of controversy, the first prototype flew in October 1995. A production decision was made in July 1996, with first deliveries in September 2000. The first wing was activated in March 2001. Production totaled 94 planes, down from the original plan of 130, with the last aircraft delivered in September 2011.

While these two planes at least succeeded in entering service, there were several failed indigenous fighter proposals and concepts. The most advanced of these was Israel's Lavi, canceled in 1987 after two flying prototypes had been built. Other concepts include the former Yugoslavia's Novi Avion, South Africa's Cava, and Romania's IAR 95.

The grand survivor of the indigenous fighter generation is India's Light Combat Aircraft (LCA), currently being developed by Hindustan Aeronautics Ltd. (HAL). This is a lightweight single-engine, single-seat air superiority and light close air support aircraft. The LCA is intended to replace the MiG-21 in the Indian Air Force.

Japan's F-2

Taiwan's IDF

The LCA concept was first proposed in 1978. It was actually the second indigenous fighter built in India (in addition to numerous license production types). The first was HAL's HF-24 Marut, a Mach 1.4 multirole plane built in the 1960s and 1970s. Production of this plane, the first supersonic fighter designed by an Asian country, ended in 1977. While technically a success, the Marut was considered somewhat underpowered, owing to lack of suitable engines.

The LCA program was launched in July 1983 by the newly created Indian Aeronautical Development Authority. After numerous delays, the LCA made its first flight in January 2001. As of 2011 there were eight flying production LCAs, with (partial) initial operational clearance granted in January 2011.

But in 2009, HAL announced that it would develop a new Mk. II LCA after the first 40 production Mk. I planes were delivered. In addition to a new engine (General Electric's F414), the Mk. II will have a larger fuselage and wings. Plans call for procurement of 240 Mk. IIs.

India's LCA

Two new kids on the block

While LCA continues to defy the odds and hobble along, it spent the last decade or so as an oddity, the last survivor of the indigenous fighter era. However, the past few years have seen the unexpected reemergence of this concept.

The first new possible player is South Korea, with its KF-X. It had first mooted the KF-X concept in 2001, but quickly postponed the project for a variety of reasons. Instead, it imported Boeing F-15s. To develop combat aircraft skills, it also initiated production of the T-50, A-50, and FA-50, a supersonic trainer/attack aircraft/light fighter codeveloped by Korean Aerospace Industries and Lockheed Martin. With a single-engine design, the series has much in common with Northrop's F-20 Tiger-shark, a light fighter built in prototype form but canceled in the 1980s. The A/T-50 made its first flight in August 2002, and deliveries began in December 2005.

But in 2010 the South Korean government announced a revival of the KF-X concept, with plans for a $4.2-billion development program. Of this, 60% will be provided by the government, with the rest coming from industry partners and/or foreign governments. South Korea's internationalist approach to its indigenous fighter actually produced results in July 2010, when Indonesia agreed to fund 20% of KF-X, with plans to purchase about 50. South Korea plans to procure 100-150 KF-Xs, with the type expected to enter service around 2018. The country is now looking at foreign engines, including General Electric's F414 and the Eurojet EJ200.

At first, KF-X was expected to produce an F-16-class aircraft, but over the past year this has changed to more of a new stealth design, with development costs now estimated at $8 billion. There is no guarantee it will be an all-new design. The Surion, South Korea's 'indigenous' military transport helicopter, is being developed with assistance from Eurocopter, and its design appears to have a lot in common with that company's Super Puma transport. KF-X, similarly, could involve a local development of a foreign fighter design, perhaps analogous to Japan's F-2 program.

Similar uncertainty surrounds the other potential new fighter market entrant, Turkey. In 2010, Turkey's Undersecretariat for Defense Industries, its top defense procurement agency, announced that it would develop and manufacture the country's next fighter jet. But it also made it clear that this could be a joint venture with another country. In 2011, defense officials said that alternative options could include codevelopment of an existing platform, or even an off-the-shelf acquisition. At one point, Turkey discussed a partnership with South Korea, but decided that the KF-X project would not allow for an equal partnership.

Current plans call for some kind of decision to be made by late 2013. So far, the only progress made on a new fighter is a two-year feasibility study contract, awarded to Turkish Aerospace Industries. If Turkey really does


South Korea's KF-X

opt for an all-new indigenous fighter, it could arrive in 2023. However, plans to procure 116 F-35s are still in place. Also, the country has just started to take delivery of another batch of 30 F-16s, raising Turkey's total procurement of the fighter to 308 aircraft.

Israel's Lavi

Reasons why, and why not

National fighters are almost always part of a broader aerospace industrial strategy, one that typically aims to keep defense procurement dollars at home, enhance national prestige, develop local industry, and cultivate new technologies. Yet the result is always the same: a fighter plane that needs to be adapted for use by the national air services. These air services are effectively a captive market, and are being forced to buy this plane.

Since the amount of money and technology provided for an indigenous fighter hardly comes near the resources available to traditional manufacturers, the captive market air arms are forced to buy a plane that is likely inferior to, or more expensive than, one they could purchase from abroad. For example, the KF-X budget, $8 billion, is intended to develop a stealth fighter. F-35 development, of course, is about six times more expensive.

In short, when a country's government plans an indigenous fighter aircraft, it is effectively saying one of five things:

• "We intend to create a world-class fighter, as good as an F-35, or at least as good as an F/A-18 or Eurofighter. Here is $30-50 billion." This, of course, has never happened.

• "Even though we have less experience building planes than the established aircraft manufacturers, and even though labor costs have almost nothing to do with combat aircraft economics, we think we can build world-class jets for much less money. Here is $10 billion. Please make it happen." This has never been accomplished. Japan's F-2, for example, is about as technologically advanced as a late model F-16, but with more technical problems and with a price tag about three times larger than an F-16.

• "For reasons of economics, nationalism, or politics, we want to build something that's just not as good as a top-ranked fighter. Our pilots should only plan on engaging inferior enemies, and/or be prepared to suffer more casualties than they would have had with a world-class fighter."

• "We need to be self-sufficient for political and strategic reasons, and therefore we need our own plane." This is a common goal, frequently associated with diplomatic pariah status or a national nonalignment objective.

The problem with this rationale is that building an entire industrial base is considerably more expensive and difficult than merely building a national aircraft. In fact, nobody has achieved this goal, and of the traditional producers, only the U.S. and France retain the in-country industrial base needed to build modern fighters largely without imported components. Even when feasible, a purely national supply chain means designers have no ability to choose the best components and systems for the mission, almost guaranteeing a mediocre aircraft.

As a result, all indigenous combat aircraft designed so far have been forced to rely on significant levels of imported content. India's LCA, occasionally termed 'Last Chance Aircraft' (implying that it would be the only fighter India could get in the event of another arms embargo) once had a local engine and radar. Since developing these capabilities proved too expensive, it now has a GE engine and an Israeli Elta radar. Even stranger, Israel's Lavi, a program motivated in part by national self-sufficiency, relied heavily not only on U.S. components such as a Pratt & Whitney engine, but also U.S. funding to create the entire aircraft. It represented a tremendously dependent effort to achieve independence.

The only aircraft ever built that was purely motivated by self-sufficiency was Taiwan's Ching Kuo. Yet it, too, relied on heavy levels of imported components such as a Honeywell engine. Worse, it never offered the performance associated with a modern fighter, and production ended just after Taiwan finally got access to F-16s and Dassault Mirage 2000s. Today, Taiwan once again finds itself denied access to additional F-16s, and as a result has initiated a Ching Kuo upgrade program, with the first production upgraded aircraft delivered in June 2011. But the country has left no doubt that it would vastly prefer additional F-16s. An F-16 upgrade program for its current fleet, approved by the Obama administration in September, enjoys considerably greater funding prospects than the Ching Kuo update program.

• "We want to provide the low end of a high-low mix. Buy our indigenous combat aircraft for use in conjunction with a more capable imported plane, such as an F-15, Eurofighter, or F-35." Many countries have taken this approach. India's LCA is being procured in tandem with its Medium Multirole Combat Aircraft acquisition. This is one of the largest export fighter sales in history, covering at least 126 high-end fighters. Meanwhile, even though Turkey is looking at a medium or large indigenous fighter, it is meant to be interoperable with F-16s and F-35s.

There are several problems with this rationale. For one, relatively few countries are planning the kind of elaborate air force structure that allows for a true high/low mix. The majority of NATO countries, for example, deploy one class of combat jet. As combat aircraft are increasingly just 'nodes' in a broader network of offboard sensors and datalinks, the requirement for a complicated air fleet structure will further diminish.

Also, the ultimate point of a national fighter development strategy is to create something truly capable, something that actually requires high levels of technology and a sophisticated national industrial base. Creating a "low-mix" product, such as South Korea's T-/A-/FA-50 or the Italian/Brazilian AMX, is a relatively straightforward task that costs a lot of money but does not create much by way of national skills and capabilities. Nations with defense industry creation strategies seek to move upward in terms of capabilities and goals.

South Korea's KF-X is a good illustration of this dynamic. Over the past few years it transitioned from a mid-sized F-16 replacement to something stealthy and high end. In recent months, Korean officials have said the KF-X could be used to replace both the low-end F-5 and the high-end F-4. If KF-X becomes the largest procurement program in South Korea for the next decade—a likely scenario if it goes ahead—there could be an unpleasant political battle between government ministers eager for a prestigious program and air force officers and pilots who merely want the best plane to do their job.

Government planners considering an indigenous combat aircraft development program should contemplate which of these five rationales they are considering. They should also consider how they distinguish themselves from the many failed historical precedents. After all, the two countries that successfully built modern indigenous combat aircraft—Japan and Taiwan—now have no plans to repeat the experience, and are returning to procurement of imported aircraft.

Assuming the government planners behind them are honest, the odds are that South Korea's KF-X, Turkey's fighter study, and even India's long-suffering LCA, will follow history's path and go nowhere.

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What's next for U.S. human spaceflight?

Falcon 9, with Dragon, stands on the launch pad. Credit: SpaceX/Roger Gilbertson.

by **J.R. Wilson**
Contributing writer

With the demise of the shuttle, concerns over lack of U.S. access to space have grown even more intense. As controversy swirls in Congress, NASA, and the space community over the future of U.S. manned spaceflight, industry has mounted a surprisingly robust response to the need for filling the gap, with several candidate vehicles and related systems now in various stages of development.

Despite starting from behind, the U.S. manned space program surged past that of the old Soviet Union nearly a half-century ago, carrying the first human being to the Moon less than a decade after the Soviets put the first man into orbit.

Twelve U.S. astronauts walked on the Moon between 1969 and 1972. But in the ensuing four decades, no one from Earth has gone beyond LEO.

When the space shuttle first flew in 1981, NASA restored the nation's dominance in the arena of manned space activities, which had ceased in the U.S. after Apollo ended in the late 1970s. Although the shuttle never achieved the high launch rate originally envisioned, the fleet carried astronauts on a wide range of LEO missions for 30 years and played an essential role in the construction and manning of the ISS.

With the shuttle decommissioned and the Ares/Constellation follow-on canceled, NASA must rely on expensive seats in Russia's three-person Soyuz to take U.S. astronauts to the ISS. What NASA has planned for the future of manned space activities has been a matter of controversy and confusion for the past three years, especially since the shuttle's final flight.

Divergent views

On September 22 and again on October 12, the House Committee on Science, Space and Technology and its subcommittee on space and aeronautics held hearings on the future of human spaceflight. What lawmakers heard from former astronauts, spaceflight engineers, and NASA officials differed markedly, with the former sharply critical of the agency and President Barack Obama, and the latter painting a far rosier picture of continued NASA efforts and international cooperation.

"NASA, hobbled by cumbrous limitations, has been unable to articulate a master plan that excites the imagination and provides a semblance of predictability to the aerospace industry," former astronaut Neil Armstrong told lawmakers. "We will have no American access to, and return from, low Earth orbit and the international space station for an unpredictable length of time in the future. For a country that has invested so much for so long to achieve a leadership position in space exploration and exploitation, this condition is viewed by many as lamentably embarrassing and unacceptable.

"The uncertainties associated with the radical changes in space plans and policies of the last two years contributed to a substantial erosion of the United States' historically highly regarded space industrial base. Thousands of jobs have been lost, and the space component of the industry is perceived as unstable, discouraging students from considering preparing themselves for entry into this exciting but demanding career path," he continued.

Three weeks later, however, William Gerstenmaier, NASA associate administrator for the newly created Human Exploration and Operations Mission Directorate, assured the committee that NASA's commercial crew development (CCDev) and commercial crew program, among other efforts, do address the issues raised by critics.

"NASA investments have been aimed at stimulating efforts within the private sector to develop and demonstrate human spaceflight capabilities through the CCDev initiative. Since 2009, NASA has conducted two CCDev rounds, soliciting proposals from U.S. industry participants to further advance commercial crew space transportation system concepts and mature the design and development of elements of the system, such as launch vehicles and spacecraft," Gerstenmaier testified.

"On September 19, 2011," he continued, "NASA released a draft RFP that outlines a [commercial crew program] contract to provide a complete end-to-end design, including spacecraft, launch vehicles, launch services, ground and mission operations, and recovery....NASA's strategy has evolved into an overall hybrid structure over the life cycle of the program, building on the progress made by the SAAs [Space Act Agreements] and transitioning into a series of competitively awarded contracts."

INDUSTRY RESPONDS TO THE CALL

Several companies have responed to the administration's call for commercial participation in developing the next generation of human space transportation vehicles.

ATK Space Launch Systems *(Magna, Utah)*
- *Orion multipurpose crew vehicle (MPCV) launch abort system*
- *Liberty launch vehicle*
- *Space launch system (SLS) reusable solid rocket motors (RSRMs)*

Bigelow Aerospace *(Las Vegas, Nevada)*
- *Expandable orbital space platform*

Blue Origin *(Tacoma, Washington)*
- *Crew transportation system for LEO (CCDev2 proposal)*
- *Reusable booster system man-rated launcher for CTS*

Boeing Space Exploration Division *(Houston, Texas)*
- *Crew space transporation-100 (CST-100) manned LEO spacecraft (CCDev2)*
- *Man-rated launch vehicle (NASA SLS competitor)*

Lockheed Martin Space Systems
- *Orion MPCV*

Orbital Sciences *(Dulles, Virginia)*
- *Orion crew exploration vehicle launch abort system*

Scaled Composites *(Mojave, California)*
- *SpaceShipTwo (SS2) suborbital manned spaceship*
- *WhiteKnightTwo (WK2) carrier aircraft*

Sierra Nevada Space Systems *(Louisville, Colorado)*
- *Dream Chaser manned LEO spacecraft (CCDev2)*

SpaceX *(Hawthorne, California)*
- *Falcon 9 man-rated launch vehicle*
- *Dragon manned spacecraft (CCDev2)*

The Spaceship Company *(Mojave, California)*
- *SS2 suborbital manned spaceship*
- *WK2 carrier aircraft*

United Launch Alliance (ULA) *(Centennial, Colorado)*
- *Atlas V man-rated launch vehicle for CTS-100*

Virgin Galactic *(Spaceport America, New Mexico)*
- *SS2 suborbital manned spaceship*
- *WK2 carrier aircraft*

Industry responds

Following cancellation of Constellation, the shuttle follow-on program proposed by the Bush administration, and the president's announcement that future U.S. manned space efforts would rely on commercial spacecraft and launch vehicles, private industry responded far more vigorously than some had expected. By the start of FY12, more than a dozen companies had signed agreements with NASA or had announced plans to build manned spacecraft, human-rated launchers, or manned orbital platforms.

One of the key projects is the NASA-led MPCV (multipurpose crew vehicle), a continuation of the Ares/Constellation's Orion, with Lockheed Martin still the prime. It is meant to carry up to four astronauts on 21-day missions to LEO and the space station in a capsule resembling the old Apollo, but larger. As with Apollo, it will land in the ocean, but NASA claims it will be 10 times safer than the airplane-style shuttle during both ascent and reentry.

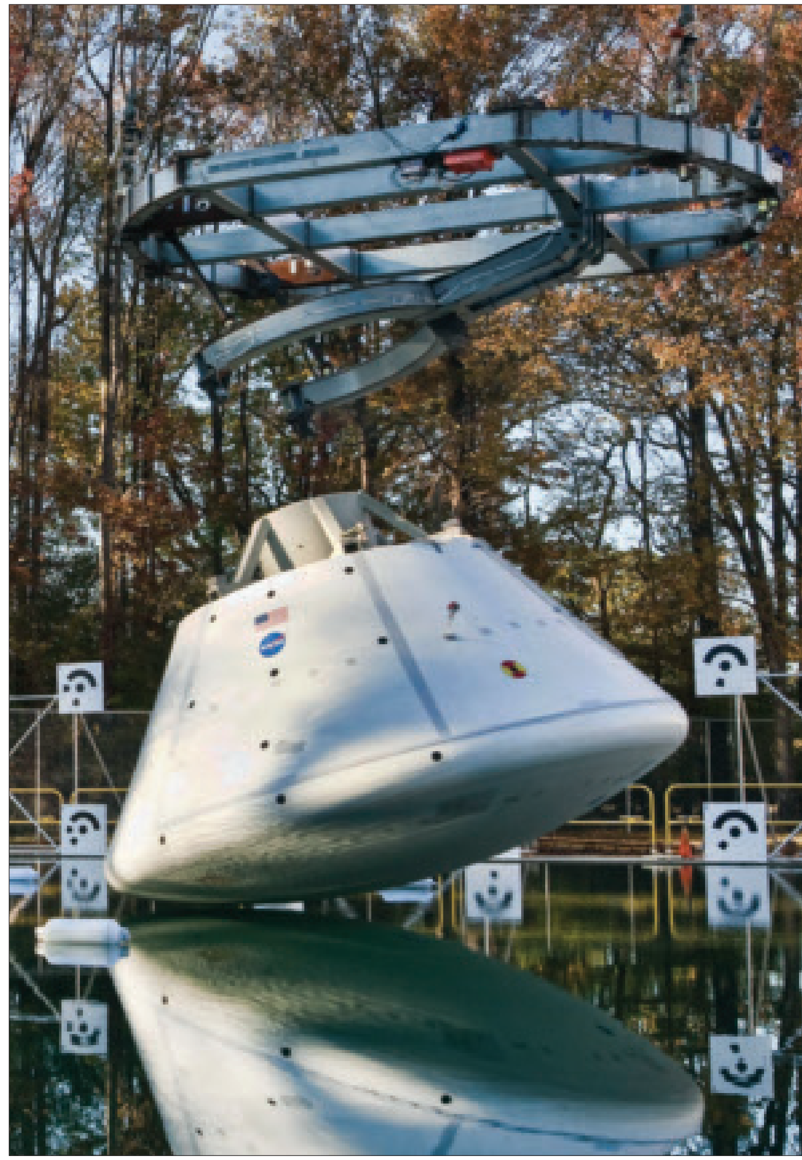
"In terms of human-rated spacecraft, NASA has chosen to go to the next generation of LEO access through commercial procurement," says Keith Reiley, Boeing's deputy program manager for commercial crew programs. "Building human-rated space systems is part of the business Boeing is in, from the shuttle to the ISS. There clearly are advantages to doing procurement in the way NASA has chosen, with reduced costs and overhead. And I think it's healthy there is now new, young startup competition that makes everybody better.

"Apollo happened very quickly, as did shuttle, which was a lot more complex than what we're doing here. The big difference now is how we are working with NASA, which is more of an investor. Our core business plan is based on the NASA missions and supporting the Bigelow missions, but if others need services, we will look at those. We also can take the Boeing commercial aircraft approach, which is the basic Boeing business model. If the market gets large enough, there are problems with being both a builder and an operator. But it would be good news if, in the future, we just become a platform provider."

Boeing (largely through its acquisitions of McDonnell Douglas and Rockwell) and Sierra Nevada (one of the world's largest manufacturers of small satellites) have solid backgrounds in building successful launch vehicles and spacecraft, as do Scaled Composites (the only private company to have launched humans into space), Lockheed Martin, ULA, and SpaceX. But some critics question whether private industry is truly prepared to take on all of the requirements of safe, efficient, and cost-effective manned spaceflight.

"Although I do believe and hope that someday they will succeed, I still assess that those entrepreneurs in the world of commercial space who continue their claims of being able to put humans in space in little more than three years for something less than $5 billion, today still 'don't yet know what they don't know,'" retired astronaut Eugene A. Cernan told Congress. "My statement [in 2010 testimony] that 'sole reliance on the commercial sector without a concurrent or backup approach could very well lead to the abandonment of our $100-billion, 25-year investment in the ISS' is now more prophetic than ever.

"It will be near the end of the decade before these new entrants will be able to place a human safely and cost effectively in Earth orbit. Should the development of the SLS [heavy-lift space launch system] go forward as mandated by Congress—along with the Orion spacecraft, as just announced by the administration—I believe we will have the best and perhaps only opportunity within reach to narrow the gap that now exists between the final shuttle flight and America's capability to regain access to Earth orbit and the ISS. Access to low Earth orbit should be our primary objective in



Engineers at NASA Langley conducted the third drop test of the Orion test article as part of Phase 1 water impact testing on November 8. The capsule was hoisted about 20 ft above the ground with a pitch of 17 deg. It reached a horizontal velocity of about 22 mph before splashing into the Hydro Impact Basin. Credit: NASA/Sean Smith.

SLS is a next-generation version of the Saturn V, which took astronauts to the Moon more than 40 years ago.

any plans in the evolutionary development of a new versatile lift vehicle, with future deep space missions as a follow-on," added Cernan, commander of Apollo XVII and the last man on the Moon,

NASA turns to heavy lift

In what is by now almost a tradition for NASA programs, the heavy lift SLS was born in controversy, with critics accusing the agency and the Obama administration of dragging their heels in meeting congressional mandates for a new government manned space system.

"The short-term solution is more complex in light of NASA and the present administration's now obvious agenda to dismantle a space program that has been five decades in the making," Cernan told the House committee. He called the grounding of the shuttle fleet, cancellation of the Constellation vehicle, and commercial turnover of future manned flight to LEO a "mission to nowhere." He said, "Although it is the intent that the 'full-up' SLS give us the capability of designing a variable set of missions, I firmly believe that the time for a well-thought-out, long-term initiative for our nation's role in space, with or without the SLS, is long overdue.

"My assessment of NASA's progress in the development of a heavy-lift launch system to enable exploration beyond Earth orbit, as well as provide a capability to service the ISS should a commercial market entrant or our international partners become unavailable, is that it has been deceptive, inadequate, and to date nonproductive. Now is the time to overrule this administration's pledge to mediocrity. Now is the time to be bold, innovative, and wise in how we invest in the future of America. Now is the time to reestablish our nation's commitment to excellence. Mr. Chairman, ladies and gentlemen, it is not about space—it's about the country."

The SLS essentially is a next-generation version of Saturn V, the most powerful rocket ever built, which carried astronauts to the Moon more than 40 years ago. According to NASA, its purpose will be to carry the Orion, cargo, equipment, and science experiments beyond LEO, "providing a safe, affordable, and sustainable means of reaching the Moon, asteroids, and other destinations in the solar system."

Beginning with a 70-metric-ton version, comprising only core stage and strap-ons, the SLS ultimately is to evolve into a 130-metric-ton rocket. It will use the shuttle's proven RS-25 engine for the core stage, a Rocketdyne J-2X upper stage, and two five-segment side-mounted solid rocket boosters. It builds on Saturn, shuttle, and Ares development efforts, but uses cutting-edge tooling and manufacturing technologies to reduce development and operations costs.

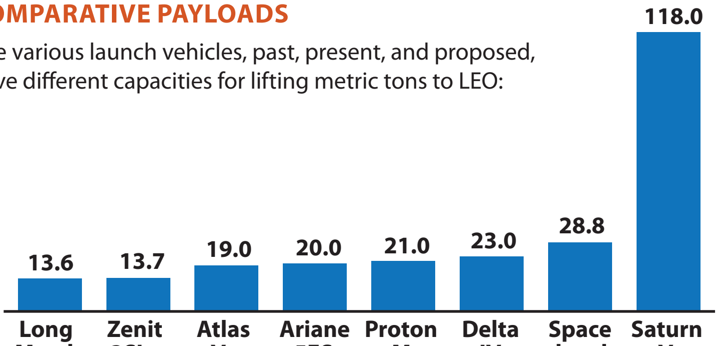
"Our vision is to have an interface that's generic, and we'll be able to carry potentially different boosters and change them out as needed," Gerstenmaier told the International Astronautical Congress, which met in South Africa in October 2011. "So we could go compete in the future, maybe downsize if something's easier for a mission that requires less thrust. We have some variability there, so if we do our job right, we'll have the ability to change the boosters that sit on the side. That's our ultimate goal. If we don't need an upper stage for certain missions, we don't have to fly an upper stage. We don't have to add a new plant, new facilities, and new tooling.

"We're not really ready to step up to the booster activity right away with a full-up competition. We think there's some technology that needs to get explored and understood as we go forward. We think we also need to define a little bit better the core interface with the solid rocket boosters or the liquid rocket boosters, so we have that as a design condition," he added. "We're going to have a kind of a study phase, with potentially multiple contractors participating in that study phase for a period of about 30 months or so; then we'll roll right into the actual competition. But the idea is to have the new booster system available, probably in about the 2019 time frame." (That is two years later than the date he was using three weeks earlier.)

Some experts, however, are question-

COMPARATIVE PAYLOADS

The various launch vehicles, past, present, and proposed, have different capacities for lifting metric tons to LEO:



ing why it is expected to take six to eight years and $18 billion for what is essentially an expansion of existing technology to reach first launch.

Former astronaut and Boeing aerospace executive Robert Springer, for example, echoes Reiley's comment about Apollo, but with a twist related to SLS: "NASA did the Apollo evolution faster—and it was pretty much new technology; even the proposed look at liquid boosters is hardly new." Springer also says NASA's procurement plan for the SLS "seems like a giant leap backward."

Boeing, Liberty, and ULA

Since about September 2011, NASA has announced several new manned space initiatives. Some of them, such as an unfunded SAA with ATK and EADS Astrium to develop the Liberty rocket for the CCDev program and a possible future ISS resupply contract, had previously been rejected or shelved indefinitely.

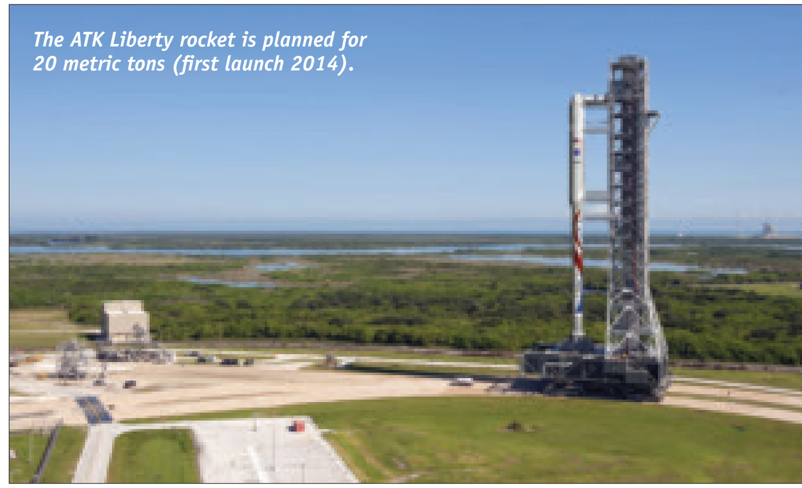
While most SAAs include NASA funding, the agency offered ATK only personnel—24 full-time and 50 part-time—and the use of NASA facilities, including a Kennedy Space Center launch pad. Following an earlier NASA decision not to fund Liberty in the second CCDev round, it also was the first SAA to include a foreign company.

Liberty incorporates five shuttle SRBs for its first stage and Ariane 5's Vulcain 2 as a second stage. Both are human-rated, but the Vulcain has never been used for a crewed spacecraft launch.

Boeing's CST-100, although currently scheduled to launch atop a human-rated Atlas V, could be a future Liberty user, as both spacecraft and launch vehicle companies work toward full interoperability. Boeing also is keeping options open for future evolutions, including a winged version, that could carry more than the CST-100's seven crewmembers. Even the CST-100, though, is being designed to service not only the ISS, but also other orbital platforms such as Bigelow's inflatable habitat.

An initial unmanned orbital test flight is scheduled for early 2015, with the second flight toward the end of that year, carrying two astronauts to the ISS, where it will dock for a week or so. The CST-100 is designed to make 10 flights before being retired.

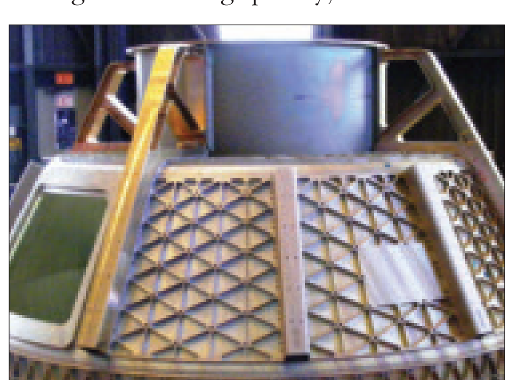
"If we were just servicing NASA with two flights a year, we would have three capsules—two flying and one spare. But if we also are servicing Bigelow or others, we would need to build more of those capsules," says Reiley.


The ATK Liberty rocket is planned for 20 metric tons (first launch 2014).

Sierra Nevada dreams big

While Boeing anticipates a commercial aircraft-style approach—building spacecraft for others to operate—Sierra Nevada is planning to both build and operate its seven-man Dream Chaser. This is a follow-on to the 10-man HL-20 ISS lifeboat that NASA mothballed after seven years of Sierra Nevada development. That design has been significantly updated, according to Mark Sirangelo, head of Sierra Nevada Space Systems, including the ability to carry all crew or a mixture of crew and cargo, or to operate as an unmanned cargo vessel. In addition to a $20-million CCDev1 award from NASA, Sierra Nevada put $30 million of its own money into that year-long effort.

"In April 2011, we were awarded a CCDev2 contract for $80 million, containing nine milestones. We have now completed the first four of those, on time and on budget, and will have completed the fifth by the time this is published. We expect to complete the remaining four on time by next May," he tells *Aerospace America.* "Things are moving quickly, and NASA de-




The pressure vessel of Boeing's CST-100 awaits testing. After an initial unmanned orbital test flight scheduled for early 2015; a second flight would carry two astronauts to the ISS later the same year.

Sierra Nevada's plans call for both building and operating its seven-man Dream Chaser.

cided to exercise four additional milestones, which was an option in our original plan, for an additional $25 million. Those would extend the program to August 2012."

An initial unmanned approach and landing test is scheduled for the summer of this year, with that same vehicle to be used for the first unmanned orbital test in 2014, but not operational missions.

"The first manned flight would be in early 2015; we believe it will conduct a station operation, but that is NASA's call," says Sirangelo. "We anticipate a multiple vehicle fleet for crew transfer and servicing missions, possibly including some autonomous. We believe LEO access enables a lot more than just space station operations, so we gave the potential markets a lot of thought, with NASA being only one of those.

"Our market is to provide competition to Soyuz and to be the primary supplier, or equal to the Russian program. We think by maintaining and driving those jobs and dollars into the U.S. instead of sending them to Russia, we can better evolve the future of the U.S. space program. We're not in competition with NASA, but with Russia, because we don't think it is good to have only one way into space. And if it is Americans flying, we believe those vehicles should be built in and flown from the U.S., with Soyuz as a backup, not primary."

The SpaceX Dragon capsule is recovered after two full orbits and a sea landing.

SpaceX steps forward

SpaceX's confidence in the future of the commercial launch market was demonstrated in mid-November 2011, when CEO Elon Musk announced the company was looking for a third launch site. SpaceX already launches from Cape Canaveral Air Force Station in Florida and has a second site under development at Vandenberg AFB.

"Our growing launch manifest has led us to look for additional sites. We're considering several states and territories," Musk says. "I envision this site functioning like a commercial Cape Canaveral."

At the time of the announcement, the company already had over 40 contracts for Falcon 9 missions through 2017, with 14 ordered in 2011. More than half are for commercial customers, a number SpaceX expects will grow rapidly in this decade.

While Falcon 9's initial missions involve cargo delivery to the ISS, it also is intended to carry astronauts—up to seven per flight—aboard SpaceX's human-rated, reusable Dragon spacecraft. The company received $1.6 billion from NASA in 2008 for a minimum of 12 Falcon 9/Dragon flights, with an option to nearly double the value of that order. The first cargo missions are scheduled for this year.

A follow-on Falcon Heavy, announced last April and scheduled for first flight this year, would be the most powerful launcher since the Saturn V that carried Apollo astronauts to the Moon. Its addition to U.S. lift capability would significantly increase both cargo and passenger capacity to LEO.

"Each milestone we complete brings the U.S. one step closer to once again having domestic human spaceflight capability," according to former astronaut Garrett Reisman, one of the program leads of DragonRider, the manned version of the spacecraft.

Growing urgency

The drive for new U.S. capability increased on August 24, 2011, when a Soyuz rocket carrying cargo to the ISS failed to achieve orbit. All Soyuz flights—cargo and manned—were suspended until an investigation by the Russian space agency, Roscosmos, determined the failure likely was caused by contamination in the rocket's fuel lines or stabilizer valve.

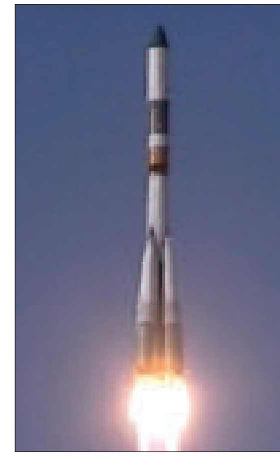
But U.S. efforts also suffered a setback at almost exactly the same time, when a Blue Origin spacecraft was destroyed during a test flight from the company's West Texas spaceport. The lost craft was a suborbital test vehicle, not the CCDev2 vehicle being developed for NASA.

While the *Wall Street Journal* said the failure "shines a spotlight on the risks of commercial space ventures," NASA said it would not affect any of its programs. Agency spokesman David Weaver added that NASA "will rely on multiple providers to ensure success...[and] has confidence in American industry to help our nation maintain its leadership in space and transport U.S. astronauts and their cargo."

Despite the failures of the two systems both Sirangelo and Reiley believe the commercial world is ready to take over Earth-orbital manned spaceflight. And in so doing, it will free NASA (with greater industry involvement than ever) to concentrate on returning to the Moon and beyond.

Those who made the first such voyages hope they are right.

"Public policy must be guided by the recognition that we live in a technology-driven world where progress is rapid and unstoppable. Our choices are to lead, to try to keep up, or to get out of the way. A lead, however earnestly and expensively won, once lost, is nearly impossible to regain," Armstrong concluded in his rare public appearance before Congress. "America cannot maintain a leadership position without human access to space." Å



A Russian Progress cargo ship was lost during a failed launch of a Soyuz rocket last August. Both the spacecraft and rocket crashed about five minutes after liftoff.

The international space station has turned the corner into its next phase, its stay in orbit having been extended by the president to at least 2020. In government, scientific, and industry circles, experts are planning myriad uses for the orbiting complex. Some even envision applications beyond its predicted life, including the possibility that it could serve as a base camp for future deep space exploration missions.

ISS
Dawn of a new era

Circling the Earth, the international space station is a technological tour de force, a global enterprise that is also the most politically complex space exploration program ever undertaken. Now it has entered a new phase of utilization, with planners envisioning myriad applications that might even extend beyond its predicted life.

The size and weight statistics of the station are striking. With its large solar arrays, it spans the area of a football field, including the end zones, and weighs some 400 tons. It is also the longest continuously inhabited spacecraft. Fifteen nations have provided modules and equipment over the years, with the U.S., Russia, Europe, Japan, and Canada the principal contributors. To date, more than 200 explorers have visited, lived in, and worked at the facility.

Now the station is set for an extended lifetime. President Obama's National Space Policy, issued in June 2010, calls for continuing the operation of the ISS—in cooperation with its international partners—"likely to 2020 or beyond," and for expanding efforts to "utilize the ISS for scientific, technological, commercial, diplomatic, and educational purposes; support activities requiring the unique attributes of humans in space; serve as a continuous human presence in Earth orbit; and support future objectives in human space exploration."

Even for a facility hundreds of miles high, this is a tall order. Nevertheless, the station is becoming a sort of space-based Rorschach test: Scientists, technologists, engineers, managers, commercial groups, and others envision it as a future wellspring of research, discovery, and innovation—and even as a way station to worlds beyond.

by Leonard David
Contributing writer

Study groups around the world are now assessing postassembly utilization possibilities for the ISS, which could include serving as a testbed platform or as a base camp to augment deep space exploration by humans. The station, including its solar arrays, spans the area of a U.S. football field including the end zones and weighs 861,804 lb. The complex now has more livable room than a five-bedroom house, with two bathrooms, a gym, and a 360° bay window. All images courtesy NASA.

The investment

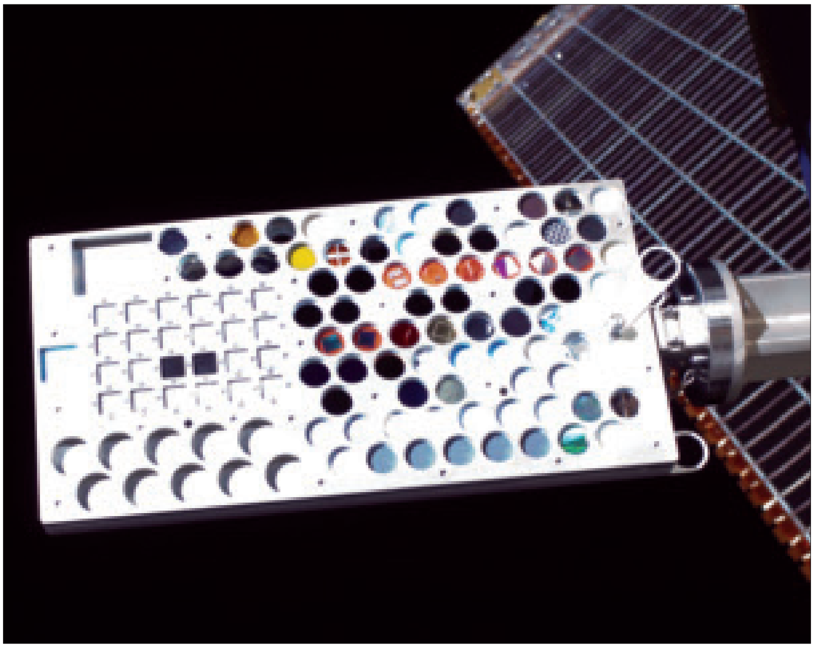
Former NASA Administrator Mike Griffin says that when he headed the agency, the best estimate of ISS costs was about $75 billion (in mid-2000 dollars), of which about $20 billion came from the project's partners.

"Some like to characterize the ISS as 'a $100-billion investment'…but I couldn't quite get to that level. Whatever the number, it is quite a large investment, as befits the completion of the most complex engineering project in human history. To fail to utilize that investment, for as long as we can reasonably do so, would be childishly short-sighted," Griffin says.

But putting more miles on the station, while keeping it safe for crews, is not an easy goal. "There are two ways you predict the age of a facility, or the age of its various components," says Mark Uhran, assistant associate administrator for ISS at NASA Headquarters. One is analytically, through engineering estimates. The other is through operational experience, he says.

As the ISS program accrues operating know-how, two key parameters are MTBF (mean time between failures) and MTTR (mean time to repair). "Originally we developed engineering estimates on MTBFs and MTTRs…and now we're trying to validate those estimates through actual operating experience," Uhran says. Engineers typically are conservative, as they should be, during the engineering estimates phase, he says, so MTBFs and MTTRs are turning out to be longer than originally projected.

"It's an extremely healthy, robust facility that in general is exceeding our predicted MTBFs and MTTRs," Uhran tells *Aerospace America*. Still, given the size and complexity of the station, he says, there are exceptions, statistically speaking.



The station has already enabled in-space evaluation of new materials and computing elements. MISSE-8, for example, is loaded with experiments to assess the effects of atomic oxygen, ultraviolet rays, direct sunlight, radiation, and extremes of heat and cold. MISSE results, which provide a better understanding of the durability of various materials and computing elements when they are exposed to the space environment, aid the design of future spacecraft.

For instance, there are troublesome control moment gyros. Then there is the facility's alpha rotary joint, which allows the solar arrays to track the Sun. And to a lesser degree, there are issues with the station's thermal radiator rotary joints. Accurately predicting lifetime is hardest for rotating mechanisms, notes Uhran, but operating these components "more gently" and using improved lubrication methods can extend life. Software changes also can change the limits and ranges at which components are energized, he adds.

Uhran says that any component necessary for making it to the 2020 milestone will be recertified. "We have high confidence we can do 2020. Then the question becomes, if there's a reasonable benefit-to-cost ratio, should we extend the operation even further…to 2028? It's too early to answer that question today. But we have formally checked with all of our partners…and the answer across the board is that we see no showstoppers to extending beyond 2020."

Safe passage

One set of experts, however, has weighed in on a host of concerns regarding the station's safe passage into the future.

The Aerospace Safety Advisory Panel, created in 1968, evaluates NASA's safety performance and advises the agency on ways to improve it. The panel's annual report for 2010 states that, as the ISS enters its second decade, lessons learned could carry human exploration to Mars and beyond—but there are challenges; for example:

• Until commercial cargo service is available, NASA must rely on a combination of vehicles from the international partners—Russia, ESA, and Japan. Cargo up-mass and volume capacity will be much more limited.

• Pending the availability of commercial crew services, NASA must rely solely on the Russian Soyuz vehicles to transport crews.

• During operations over the next decade, the nature of the safety risks is expected to change because of failures resulting from extended equipment usage in an extreme environment; hazards associated with unplanned repair, disconnect, and replacement procedures; longer exposure of the crews to space; and the 'new' environment created by termination of the shuttle.

• The biggest safety threat to the crew is from micrometeoroid and orbital debris—factors that grow worse every year.

Cost-benefit ratio

A fitting maxim for the ISS, suggests NASA's Uhran is, "We go up into space to learn what we can't learn on the ground."

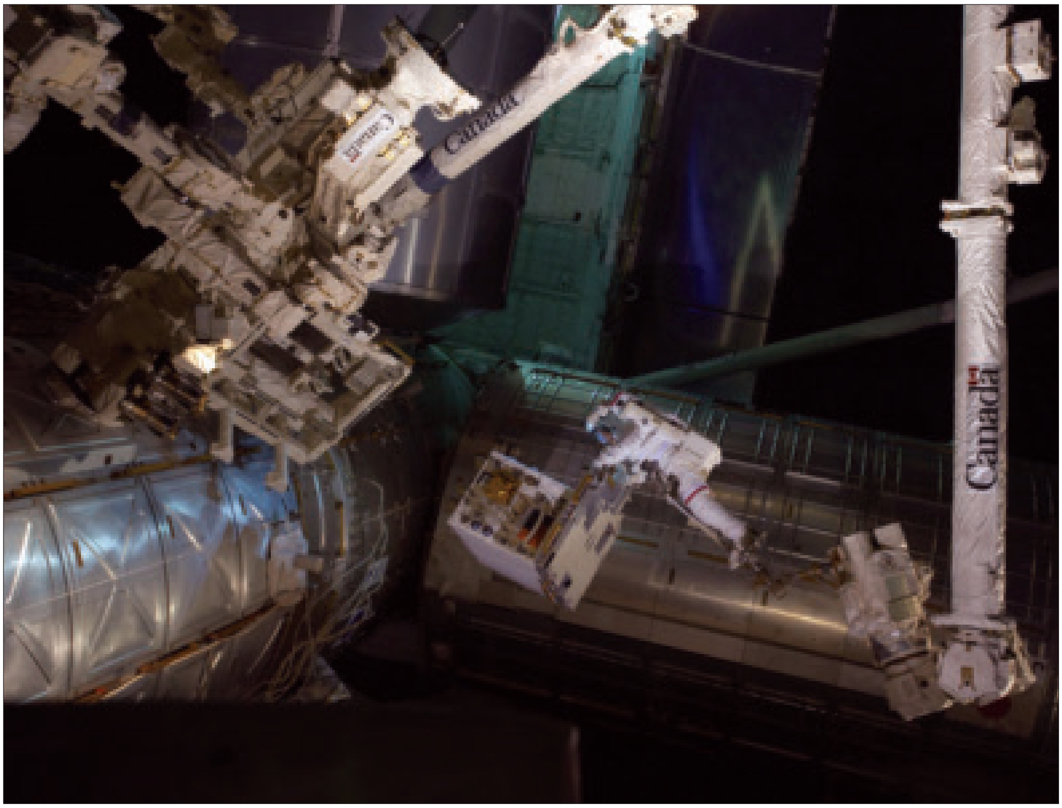
But just how ephemeral is any true ISS cost-benefit ratio? Without question, the station is a colossal engineering success story. Yet there are critics who have viewed the orbiting laboratory as a white elephant and questioned its output.

"Cost is cost, and you can audit that. Benefit is the hard one…as it comes in two flavors," Uhran responds. There are intangible benefits such as international cooperation, or stimulating young people's interest in science, technology, engineering, and math (STEM), as well as the human drive to explore, he says. These are all hard to measure but cannot be ignored.

The second category, tangible benefits, can be measured by accounting standards, says Uhran. For instance, what technologies can be developed to lower the costs of future missions? Then there are products of research such as equity agreements, licensing agreements, or patents that result from the research—all having auditable values.

"The important point is that we're just ending the assembly phase now. Everybody is trying to estimate the benefit. Well, the benefit is in the future," Uhran advises. "That's the work that's in front of us."

Uhran says he is very sensitive to people's continuing desire to know what has been discovered using the ISS. "My answer is that we've discovered how to assemble a very complex structure. Now our attention is focusing on the transition to utilization.



With his feet secured on a restraint on Canadarm2, astronaut Mike Fossum holds the robotics refueling mission (RRM) payload, the focus of a primary task accomplished on a 6.5-hr spacewalk. RRM is designed to demonstrate that robots can perform refueling tasks in orbit via ground commands. The first on-orbit attempt to test robotic refueling techniques for spacecraft not designed for on-orbit servicing, RRM is expected to reduce risks and lay the foundation for future robotic servicing missions.

It's the future of research that's going to be interesting as we turn this corner."

Technology testbed

Now that the ISS can support a full-time crew of six, a new era of utilization is beginning. While the station was being assembled, NASA officials contend, the potential benefits of space-based R&D were demonstrated—including advancement of scientific knowledge based on experiments conducted in space, development and testing of new technologies, and Earth applications derived from new understanding.

In the arena of technology testbed missions, Uhran teased out a number of ISS investigations: more work focusing on closed life-support systems, advancing humanoid robotics, and the use and deployment of next-generation structures like inflatables.

Other testbed items on the to-do list include:

•A kick-start for satellite servicing, already under way following installation of the RRM (robotics refueling mission) payload on the station. That hardware is designed to showcase the ability of remote-controlled robots to perform refueling tasks in orbit via ground command.

•Expanded use of the MIT Space Systems Lab's SPHERES (synchronized position hold, engage, reorient, experimental satellites) to provide DARPA, NASA, and other researchers with a long-term replenishable and upgradable testbed for validating high-risk metrology, control, and autonomy technologies. Such competence is crucial in formation flight and autonomous docking and rendezvous, and in developing reconfiguration algorithms.

•Enabling the communications, navigation, and networking reconfigurable testbed, or CoNNeCT, project to provide an on-orbit, adaptable, software-defined radio (SDR) facility on the ISS, along with the corresponding ground and operational systems. The growth of SDRs offers an oppor-

SPHERES, stowed inside the Destiny lab, were designed to test control algorithms for spacecraft by performing autonomous rendezvous and docking maneuvers inside the station. Their progressively more complex two- and three-body maneuvers include docking—to fixed, moving, and tumbling targets—as well as evaluating formation flying and prospective searching for lost satellites.

ISS: Abandon ship?

The reliance of the ISS on support crews was spotlighted in August when Russia's space freighter, Progress M-12M, suffered a launch failure. A Soyuz-U booster experienced an upper stage malfunction a little over 5 min into flight. The result was the loss of nearly 3 tons of cargo bound for the station—equipment, water, food, oxygen, and propellant. Progress nose-dived into South Siberia's Altai mountains.

"The cargo lost, although important, can be replaced. All of us are focused on determining the cause of the Soyuz booster anomaly so we can resolve it and get back to flying crew safely to the ISS," said NASA Administrator Charles Bolden. The third stage is common between the Soyuz U booster used for Progress cargo flights and the Soyuz F/G booster used for crew launches, he added.

A consequence of that commonality was that ISS might have to start operating without a crew this month if Russian engineers could not identify exactly what caused the rocket failure.

"The Russians will not launch another Soyuz booster until their investigation is complete and the rocket is revalidated," said Bolden. "The incident does remind us of the urgency of bringing on line U.S. transportation capabilities for both crew and cargo," the NASA chief stated. "Redundancy of systems has always been a fundamental consideration in sound spacecraft design. Redundancy is an equally important consideration at the vehicle level as we continue to operate and maintain the ISS, and as we take on increasingly complex exploration missions involving international cooperation."

However, on September 15 it was announced that a plan had evolved to assure that human operations aboard the ISS would continue uninterrupted. Russian space authorities were able to determine the root cause of the Progress failure, one that would allow for the booster's safe return to flight.

Then, on October 30, a Progress 45 lifted off from the Baikonur Cosmodrome for the ISS. Bill Gerstenmaier, associate administrator for Human Exploration and Operations, said, "We congratulate our Russian colleagues on Sunday's successful launch. ...Pending the outcome of a series of flight readiness meetings in the coming weeks, this successful flight sets the stage for the next Soyuz launch, planned for mid-November. The December Soyuz mission will restore the space station crew size to six and continue normal crew rotations."

tunity to improve the way missions develop and to operate space transceivers for communications, networking, and navigation.

•Continuation of the MISSE (materials ISS experiment) program, which allows for the placement of experiments externally on the station. This enables investigations of how long-term exposure to the harsh space environment affects materials and devices. MISSE evaluates the performance, stability, and long-term survivability of the systems that NASA, commercial companies, and the DOD plan to use on future space missions.

Use of the ISS for research and education has been a hallmark of the SPHERES effort, says David Miller, principal investigator of the venture and director of MIT's Space Systems Laboratory in Cambridge, Massachusetts.

"The SPHERES facility is analogous to a wind tunnel," Miller explains, "where technology, still in its formative stage, can be tested under operational conditions—microgravity—without incurring the cost and risk of actual flight if the technology fails."

Thanks to reconfigurable software, he adds, SPHERES is broadening its portfolio from formation flight to satellite inspection, robotic assembly, vision-based navigation, magnetic control, wireless power transfer, and even an international robotics STEM competition for middle- and high-school students, called Zero Robotics.

National lab

"Personally, I am absolutely convinced that the microgravity environment is unique, just as the vacuum environment was at the end of the 19th century," says Uhran. "We certainly have the capabilities on space station…and it's now time to ramp up the biology, chemistry, and physics research to demonstrate what kind of applications we can drive out of this unique environment."

Uhran says one new approach NASA is taking is to maximize use of the national lab portion of the ISS. The intention is to make it available to a cross section of the U.S. scientific, technological, and industrial communities.

In September NASA finalized a cooperative agreement with the Center for the Advancement of Science in Space (CASIS). This document authorizes the center to serve as the independent nonprofit entity for running the U.S. element of the ISS that will be operated as a national lab.

"It's intended to manage uses of the station, not just by commercial groups, but by other government agencies. It will be managing a mix of basic and applied research," Uhran says.

The NASA Authorization Act of 2010 directed NASA to establish this type of organization. The agreement initially will have a value of up to $15 million a year.

CASIS is located in the Space Life Sciences Laboratory at NASA Kennedy in Florida. Its national lab activities will entail developing and managing a diversified R&D portfolio based on U.S. needs for basic and applied research; establishing a marketplace to facilitate matching research pathways with qualified funding sources; and stimulating interest in using the national lab for research and technology demonstrations and for advancing education in science, technology, engineering, and mathematics.

Structural backbone

In both industry and NASA engineering circles, there is another emerging theme: turning the ISS into a departure point for deep space expeditions.

Uhran notes that the station "ultimately is going to reach an end of life, regardless of when it is. That is far enough in the future that any decision to scavenge pressurized elements or other portions of the station...is kind of over the horizon. We don't spend a lot of time looking at it. I think it's the kind of thing you would evaluate when you get closer in."

Caris Hatfield, manager of the Docking Systems Project at NASA Johnson, is assessing new ways to reuse existing equipment at ISS. These internal studies are not officially approved for implementation; but conceptually, the use of such hardware can help prepare for exploration beyond Earth, he explains. For example, residual components from the shuttle and ISS could house technology demonstration hardware. There is also a possibility they could be retasked and assembled into a spacecraft for operations beyond LEO.

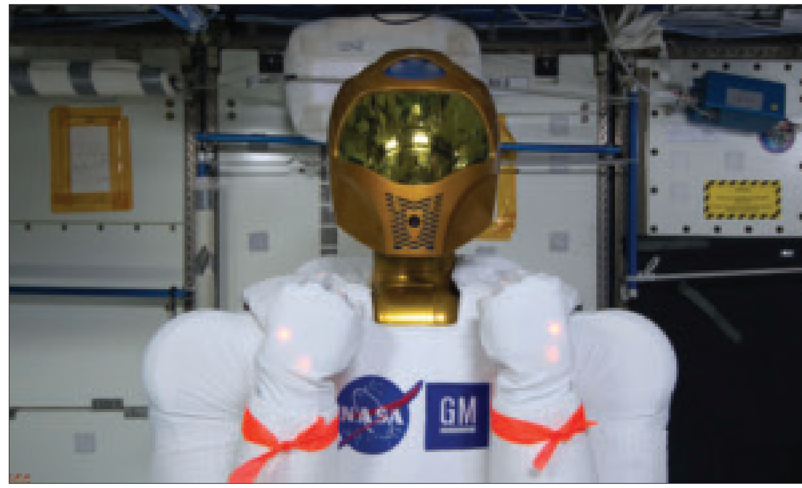
"Use of these elements is one of many options being considered as NASA develops a technology road map for future missions," says Hatfield. Using existing hardware could provide a means to save time and money in building new capabilities; a fully assembled, flight-proven pressure shell provides a foundation for building human habitation systems, he notes.

In the 'available hardware' department is the node structural test article (STA), originally built to be Node 2. In 2010, NASA inspected the STA and determined that it could be returned to flight status.

The STA could be used much as the ISS nodes are today, Hatfield says, as a central assembly point for additional test articles or modules. With a total of six port openings that can be configured for either common berthing mechanisms or NASA docking systems, a wide variety of attached systems are possible. The STA could host technology demonstrations within its pressurized volume, he adds.

Hatfield also notes that NASA has two multipurpose logistics modules in storage at Kennedy Space Center. These could be used as the shell of a habitation or lab module; each has a large interior volume that can accommodate a diverse array of equipment.

Lastly, Hatfield says that NASA has two external airlocks from the space shuttle. These are potentially very useful, since they have a docking interface on one end that could host a NASA docking system. They would also provide a structural backbone that was originally used for installation in the shuttle orbiters and could accommodate additional elements such as solar arrays and attitude control equipment.



Robonaut 2, tucked in the Destiny lab, is powered up for the first time in space by ground controllers.

Base camp

There are many ways in which the station could contribute to an international exploration program, said Michael Raftery, Boeing ISS deputy program manager, during a telecon hosted by NASA's Future In-Space Operations Working Group. This is a panel of senior engineers from within and outside the agency, scientists from NASA centers and academia, and space policy people.

"It's kind of a big idea," says Raftery, who envisions ISS as a physical platform for development and demonstration of the systems needed for missions beyond LEO. Such elements can be aggregated and thoroughly tested at ISS before departure. The station is a "logical location" for this activity, he adds, as it is accessible from all of the major launch sites around the globe.

Raftery says ISS could serve as a base camp, enabling a smaller 'high camp' fuel depot to be established at the L1 Earth-Moon Lagrange point. This depot could be built and tested first at the station, and then

Leftover hardware from the shuttle and space station programs could find new life to augment the ISS, enabling future deep space missions. This node structural test article was originally built to be Node 2 for the ISS. Photo courtesy Caris Hatfield/NASA.

boosted to its final location using either chemical or solar electric propulsion. Fuel depots at ISS and L1, he says, would dramatically reduce Earth-to-orbit boost mass requirements and enable a less costly approach to beyond-Earth destinations—a concept that reuses expensive human spaceflight-qualified hardware.

Sending humans into deep space also raises physiological questions. Here, again, the ISS might play a role.

"Artificial gravity is an idea whose time has come around...and around and around," says MIT's Larry Young, Apollo Program professor of astronautics and health sciences and technology. Decades of research studies show that space-made artificial gravity has the potential to be a single countermeasure for all physiological systems. Furthermore, he says, "the ISS affords a unique opportunity to test artificial gravity in orbit."

JAXA, the Japan Aerospace Exploration Agency, has proposed a centrifuge concept for studying human exposure to artificial gravity. However, there are implementation issues, such as what volume is available, the centrifuge radius, how to power the device, and gauging the transmission of vibration through the ISS.

"We should be able to use the ISS for the purposes we always had in mind—to lay the groundwork for long-duration space exploration," Young tells *Aerospace America*. "To protect astronauts against the debilitating effects of long-duration spaceflight, we need the unique capacity of the ISS to develop and test countermeasures."

Only by installing a human centrifuge on the ISS will we be able to check the feasibility of centrifuging astronauts for brief periods while in orbit, he says. And only then "will we be able to explore the physiological 'terra incognita' between 0 and 1*g*."

Perishable element

While there are those who view ISS as a 'torch passing' of technological know-how, there are others who see NASA as late, very late, in developing whatever will follow the station. Development of any major space facility is a 20-30-year task, so how likely is it that space agencies will have a follow-on ready, say, in the mid-to-late 2020s, when ISS will be getting pretty creaky?

A case can be made for building a long-duration (up to a few months) habitation system within a decade, drawing on the experience and capabilities developed in the ISS program and in terrestrial experiments. That is the belief of Harley Thronson, senior scientist for advanced concepts at the Astrophysics Science Division of NASA Goddard's Science and Exploration Directorate. He also leads the Future In-Space Operations Working Group.

Says Thronson, "Personnel and their experience, whether in management or engineering, are a perishable element of major successful human endeavors, perhaps nowhere more than in space exploration." He asks, "Will the next major 'stepping stone' into space after ISS be undertaken in time to use the hard-won talent of the ISS?"

Thronson says that, although important capabilities can be developed on ISS or in terrestrial labs, there is no duplicate for actual on-orbit experience with early versions of the types of habitats needed to carry humans deeper into space.

"The sooner a habitat is launched that is capable of operating beyond low Earth orbit for up to a few months," he says, "the sooner the lessons that can be learned only by doing in space can be incorporated by the designers of even longer duration human missions."

Holding a similar view is Dan Lester from the Dept. of Astronomy at the University of Texas in Austin. He stresses that one

Bringing down the house

It is a weighty proposition: How best to deorbit the massive International Space Station? It would be a fiery follow-on to the controlled reentries of the Skylab experimental facility in 1979 and Russia's Mir space station in 2001. NASA planners have begun studying this task as part of the agency's environmental impact responsibilities.

An ISS End-of-Life Disposal Plan has been prepared and briefed to the Aerospace Safety Advisory Panel (ASAP), an independent group of experts that evaluates NASA's safety performance.

As the plan takes shape, discussions have been initiated with ESA about a dedicated deorbit craft to help nudge the ISS into a selected watery grave. NASA has also begun conversations with Russian space program officials to assess the feasibility of modifying the current Progress supply craft to be part of the ISS deorbit plan. The vehicle is viewed as necessary for propulsive attitude control or additional thrust. On the table too is use of a combination of ESA's automated transfer vehicle and Russia's Progress.

Early looks at bringing down the ISS note that an estimated 9 tons of propellant would be needed. 'Optimal placement' of the ISS is targeted within a huge and remote stretch of ocean waters.

Another scenario for early termination has been scripted—to be set in motion only if this chain of events were to occur: A catastrophic event causes an early evacuation of the ISS, the ISS cannot still maintain control, and the event is also preventing additional vehicles to dock to ISS.

The first response to an early evacuation scenario would be to boost ISS to a higher altitude to allow time for addressing the problem. Additional vehicles can also be flown there, either to supply more propellant so that a plan to recrew it can proceed, or to execute the nominal end-of-life deorbit plan.

In reviewing the ISS deorbit plan, the panel responded early this year by stating, "NASA needs to move forward to determine the best option for performing the deorbit and to plan now for its implementation. The ASAP plans to increase its focus on the ISS topic in the coming year and will be examining the challenges the ISS will face in the coming decade."

Crews aboard the ISS are afforded spectacular views that enable them to monitor Earth's atmosphere. With the Moon at the center, the limb of Earth near the bottom transitions into the orange-colored troposphere (the lowest and densest portion of the Earth's atmosphere). It ends abruptly at the tropopause, which appears as the sharp boundary between the orange- and blue-colored areas. The silvery-blue noctilucent clouds extend far above the Earth's troposphere.

of the big uses of ISS is as a technology testbed for future deep space habitats. One concern, however, is that although loss of the station is not likely to occur any time soon, "what we *are* about to lose, now that ISS is complete, is the systems design engineering for such space habs."

"There will be lots of work doing upgrades and repairs, but no more work on new, complete system design and architecture for habs. In fact, that's one very good reason for near-term efforts on deep space habs," Lester says. "So while ISS is far from dying, it is entering an exciting new life. But the old life, as a system development platform, is indeed going away, and the skills that bear on that kind of work may well do the same."

25 Years Ago, January 1987

Jan. 21 Piloted by Lois McCallin and designed and built by MIT, the human-powered Michelob Light Eagle aircraft sets a distance record of 4.26 mi. for a flight by a woman in a straight line. The flight also sets a closed-course distance record of 9.6 mi. and an endurance record of 37 min 38 sec. *NASM Curatorial File*, "Michelob Light Eagle."

Jan. 22 Pilot/powerplant Glenn Tremml flies the Michelob Light Eagle to an absolute closed-course distance record of 36.452 mi. *NASM Curatorial File*, "Michelob Light Eagle."

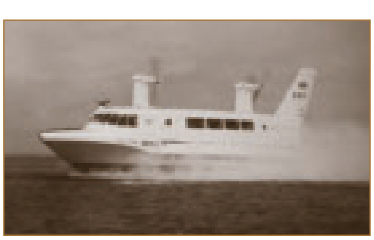
50 Years Ago, January 1962

Jan. 4 A balloon called Jambo flies from Zanzibar to the African mainland as the start of a series of flights commemorating the centenary of Jules Verne's classic novel, *Five Weeks in a Balloon*. Leading the expedition is Anthony Smith, science reporter for *The Daily Telegraph*, the British newspaper sponsoring the venture. Accompanying Smith are photographers Douglas Botting and Charles Paul of Cape Town University. *Flight International*, Jan. 11, 1962, p. 38.

Jan. 4 The Swiss minister of defense signs a contract with British Aircraft for the Mk. 2 Bloodhound guided antiaircraft missile. This is Switzerland's largest overseas procurement of military equipment to date. *The Aeroplane*, Jan. 11, 1962, p. 48.

Jan. 5 Australia's naval minister announces that the Royal Australian Navy will purchase two guided-missile destroyers from the U.S. Both are from the Charles F. Adams class, which deploys solid-fuel Tartar ship-to-air missiles. *Flight International*, Jan. 11, 1962, p. 104.

Jan. 8 The *Voice of America* begins transmitting a series of weekly lectures on space science. The series features talks such as "International Communications and Space" by a leading pioneer in communications satellites, John R. Pierce of Bell Telephone. *Flight International*, Jan. 18, 1962, p. 105.



Jan. 8 The Saunders-Roe S.R. N2 hovercraft makes its first run on the Solent River, off the Isle of Wight, England. The craft weighs 27 long tons and has four 815-hp Blackburn Nimbus turbine engines that drive two lift fans and Viscount-type propellers. *Flight International*, Jan. 18, 1962, p. 97.

Jan. 9 The first short- to medium-range three-engined de Havilland DH-121 Trident jet transport makes its initial flight at Hatfield, England, with chief test pilot John Cunningham at the controls. British European Airways has ordered 24 Tridents with an option for a dozen more. Witnessing the maiden flight are more than 1,000 DH staff, including Sir Geoffrey de Havilland. The Trident's pioneering avionics enable it to become the first airliner to make fully automatic approaches and landings. *Aviation Week*, Jan. 15, 1962, p. 39; *Flight International*, Jan. 18,

1962, p. 76; *The Aeroplane*, Jan. 11, 1962, p. 29.

Jan. 9 Soviet aircraft designer Artem Mikoyan is quoted in the Soviet newspaper *Red Star* as stating that the intermediate link between aircraft and rockets would be a "cosmoplane" for flights girdling Earth. This is close to foreseeing the need for the reusable space shuttle. *The Aeroplane*, Feb. 8, 1962, p. 137.

Jan. 10 Following its release from a B-52 carrier aircraft at 45,000 ft, X-15 No.1 is forced to make an emergency landing because of its XLR-99 rocket engine's failure to ignite. Navy Cmdr. Forrest Petersen lands the plane safely at Mud Lake, Calif. This is the first ignition failure in the history of the highly successful X-15 rocket research airplane program. *The Aeroplane*, Jan. 18, 1962, p. 71.

Jan. 11 An Air Force B-52H Stratofortress claims some 11 speed and distance records when it lands at Torrejon AFB, Spain, after a 12,532-mi. unrefueled flight from Kadena Air Base, Okinawa. The flight is made in 22 hr 10 min at an average speed of 575 mph and top speed of 662 mph.

This record, which stands for almost 25 years, is broken in 1986 by Dick Rutan with his unrefueled round-the-world flight in the Voyager aircraft, now on exhibit in the National Air and Space Museum. *The Aeroplane*,

Past

An Aerospace Chronology
by **Frank H. Winter, Ret.**
and **Robert van der Linden**

Jan. 18, 1962, p. 57; D. Baker, *Flight and Flying*, p. 378.

Jan. 15 Retired Air Force Lt. Gen. James H. Doolittle, who commanded the Doolittle raiders on B-25 bombers against Tokyo during WW II, retires as chairman of the board of Space Technology. The legendary pilot and aeronautical engineer is famed for a wide variety of contributions to aviation history. *Aviation Week*, Jan. 22, 1962, p. 29.

Jan. 26 The Ranger 3 lunar probe is lofted from the Air Force Missile Test Center at Cape Canaveral, Fla., by an Atlas-Agena-B launcher. But the top stage burns longer than expected, causing an excessive increase in the speed of the spacecraft. The probe misses its target by 22,862 mi. and enters an orbit around the Sun. This is the ninth unsuccessful U.S. attempt to send a spacecraft near, around, or to the surface of the Moon. The Ranger was to have crash-landed on the lunar surface, taking photos and measurements as it descended. *Aviation Week*, Feb. 5, 1962, p. 30.

And During January 1962

—Britain's Royal Aircraft Establishment at Farnborough, England, establishes a Space Dept. "to meet changes in emphasis in Britain's scientific program." *The Aeroplane*, Jan. 4, 1962, p. 2.

—NASA selects Aerojet General of Azusa, Calif., to develop the 1.2-million-lb-thrust M-1 liquid oxygen/liquid hydrogen rocket engine. This will be the largest LOX/hydrogen rocket engine ever developed. The initial plan is for the engine to power the second stage of the contemplated Nova lunar launch vehicle, in which the stage is to use a cluster of four of the engines. However, the Nova superbooster is later canceled. The M-l reaches its early hardware stage, but it too is canceled. *Aviation Week*, Jan. 29, 1962, p. 27.

—The Pratt & Whitney RL-10 LOX/hydrogen rocket engine, of about 15,000 lb thrust, is successfully test fired at the company's Florida R&D Center. Two RL-10s subsequently power the Centaur upper stage. *Aviation Week*, Jan. 29, 1962, p. 87.

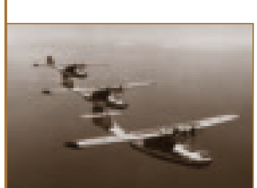
75 Years Ago, January 1937

Jan. 1 Construction of a physiological research laboratory, the first designed to study and alleviate distressing symptoms that occur in flight, is completed at Wright Field in Dayton, Ohio. E. Emme, ed., *Aeronautics and Astronautics 1915-60*, p. 35.

Jan. 4 Frank Sinclair, test pilot for Seversky Aircraft, sets a new record between New York and New Orleans when he completes the 1,200-mi. flight in exactly 5 hr, averaging 240 mph in a new Cyclone-powered Seversky aircraft. *Aero Digest*, February 1937, p. 26.

Jan. 12 Benito Mussolini qualifies as a service pilot, although he has been a private pilot for some years. He takes off from the Littorio Airport, Rome, in a trimotor Savoia Marchetti S.81 and flies for 1 hr 35 min. During the flight he performs standard military tests, including climbing to at least 3,500 m. Since Mussolini is himself the air minister, his certificate and Regia Aeronautica pilot's emblem are presented by the undersecretary for air. *The Aeroplane*, Jan. 20, 1937, p. 57.

Jan. 20 Howard Hughes, flying his specially designed and built H-1 racer, smashes the transcontinental record with a time of 7 hr 28 min 25 sec from Burbank, Calif., to Newark, N.J., averaging 332 mph. This sensational speed breaks Hughes' previous record of 9 hr 26 min 10 sec between these cities, made in a Northrop Gamma. *NASM Library*, "Hughes H-1" file.



Jan. 28-29 In a nonstop mass flight from San Diego to Honolulu, 12 Navy PBY-1 planes cover the 2,553-mi. distance in 21 hr 43 min. Powering each PBY are two Pratt & Whitney Twin Wasp engines. *Aircraft Year Book, 1938*, p. 408.

100 Years Ago, January 1912

Jan. 10 Lt. Charles Samson takes off in a Short S.38 biplane from a wooden runway on the fore-gun turret of the Royal Navy warship HMS Africa. It is the first British airplane flown by a British pilot from a British warship. D. Baker, ed., *Flight and Flying: A Chronology*, p. 54; B. Gunston, ed., *Aviation Year by Year*, p. 96.

MLPC Inc.
Mound Laser & Photonics Center

WRIGHT STATE UNIVERSITY

MECHANICAL ENGINEERING – WRIGHT STATE UNIVERSITY

Wright State University (WSU) invites applications for a tenure-track faculty position in the Department of Mechanical and Materials Engineering (MME). The position requires that the candidate initially allocate 50% of time in support of the MME Department and 50% of time working with Mound Laser & Photonics Center, Inc. (MLPC www.mlpc.com), a small business that combines research and development and contract manufacturing in laser materials processing. This novel and revolutionary concept of a joint position between small business and university has the full support of the Ohio Board of Regents. It is designed to expose students to manufacturing at an early stage in their education and accelerate the transition of technology from the research and development laboratory to the commercial market place. The faculty member will work closely with MLPC personnel to further develop the concept, which involves shared facilities and joint publications between WSU and MLPC.

The position is at the associate professor level, however exceptional candidates can be considered for the rank of full professor. The successful candidate will be expected to develop a funded research program in collaboration with MLPC and teach courses in the Mechanical and Materials Engineering Department at both the undergraduate and graduate levels. Additional educational activities will take place with MLPC's research and development team.

Applicants must have a doctoral degree in Mechanical Engineering or related discipline along with several years of academic or industrial experience that demonstrates propensity for scholarship, developing a research program, and teaching. Examples of the research areas include laser processing, additive manufacturing, direct part manufacturing, rapid prototyping, processing and manufacturing applications at the micro and nano levels, and green/sustainable manufacturing. The anticipated start date is September 1, 2012.

Applicants for the position must apply to https://jobs.wright.edu. Please include a resume, statement about teaching philosophy and research interests, as well as the names and contact information of three references.

Review of applications will begin April 2, 2012.

WSU is a public institution of over 20,000 students located in a technologically rich region of southwestern Ohio adjacent to Wright-Patterson Air Force Base. The MME Department has active research centers in the areas of Advanced Power and Energy Conversion, Micro Air Vehicles, and Computational Design and Optimization.

WRIGHT STATE UNIVERSITY is an Affirmative Action/Equal Opportunity employer.

UNIVERSITY OF WASHINGTON
Department of Aeronautics and Astronautics
Tenure-Track Faculty Position

The Department of Aeronautics and Astronautics (A&A) at the University of Washington invites applications for a full-time faculty position at the Associate Professor level in the area of controls; exceptional junior candidates at the Assistant Professor level with a significant record of scholarship and teaching will also be considered. The successful candidate will complement our existing research strengths, interact with various research groups within the Department and provide a bridge both between the disciplines of A&A and between A&A and other fields. The Department is committed to excellence in research and teaching. The successful candidate will be expected to build and lead a vigorous and innovative externally-funded research program and provide high-quality teaching that integrates research with instruction at both the undergraduate and graduate levels. An earned doctorate degree in an appropriate engineering or related discipline is required.

Applications should include a letter of application, a CV with a list of publications, concise statements of research and teaching interests and goals, the names and contact information of five professional references, and a statement of specific plans for securing extramural funding, including contacts already made with funding agencies. The research statement should include current and potential interdisciplinary aspects of the applicant's work. All application materials must be submitted via our faculty search website:

https://www.engr.washington.edu/facsearch/apply.phtml?pos_id=107

The application deadline is February 15, 2012. For any administrative issues related to this search, please contact the AA Department Search Committee, at search@aa.washington.edu. For information about the department, please visit http://www.aa.washington.edu.

The University of Washington is an Equal Opportunity, Affirmative Action Employer and is responsive to the needs of dual-career couples. The University is the recipient of a 2006 Alfred P. Sloan Award for Faculty Career Flexibility and a 2001 National Science Foundation ADVANCE Institutional Transformation Award to increase the advancement of women faculty in science, engineering, and mathematics (www.engr.washington.edu/advance). University of Washington faculty engage in teaching, research, and service. Applications from women, minorities, individuals with disabilities, and covered veterans are strongly encouraged. All positions are contingent on the availability of funding.

Faculty Position in Computational Combustion: Mechanical and Aerospace Engineering The Ohio State University

THE OHIO STATE UNIVERSITY — DEPARTMENT OF MECHANICAL AND AEROSPACE ENGINEERING

The Department of Mechanical and Aerospace Engineering at The Ohio State University invites applications from outstanding individuals for a tenure-track faculty position at the junior level in the area of computational combustion. The successful candidate may have specialization in one or more of the following areas: direct numerical simulation or large-eddy simulation of turbulent combustion; application of modeling approaches (e.g., large-eddy simulation and/or RANS-based approaches) to complex engineering problems including power-generation or propulsion systems; multi-phase reactive flows including spray combustion; combustion instability; advanced/alternative fuels and chemical kinetics. Outstanding candidates with expertise in other aspects of combustion also will be considered. The successful applicant for the faculty position will complement and augment our significant strengths in the areas of energy, fluid, and thermal sciences, which include research expertise in turbulence and turbulent combustion, chemical kinetics, heat transfer, plasma-assisted combustion, high-speed flows and propulsion, plasma physics, fuel cells, flow control, aero-optics, microfluidics and micro-scale power generation, and gas turbine research. The Department of Mechanical and Aerospace Engineering is housed within Scott Laboratory, a new 240,000 ft2 complex equipped with modern teaching and research resources, including state-of-the art computing facilities and access to the Ohio Supercomputer Center.

Qualifications:

Candidates must have earned a doctoral degree in mechanical engineering, aerospace engineering, or in a closely related field by the start date. The new faculty member will be expected to teach core undergraduate and graduate courses in his/her discipline, develop new graduate courses related to his/her research expertise, develop and sustain active sponsored research programs, and become a recognized leader in his/her research field. The anticipated start date is fall 2012. Screening of applicants will begin immediately and continue until the position is filled. Interested candidates should upload complete curriculum vitae, statements of research and teaching goals, and the names, address, and e-mail addresses of four references. The website link is http://www.mecheng.osu.edu/faculty_positions.

To build a diverse workforce Ohio State encourages applications from individuals with disabilities, minorities, veterans, and women. Ohio State is an EEO/AA Employer. Columbus is a thriving metropolitan community, and the University is responsive to the needs of dual career couples.

For more information about the Department of Mechanical and Aerospace Engineering at OSU, please visit http://mae.osu.edu/.

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The Department of Aerospace Engineering at Embry Riddle Aeronautical University in Daytona Beach, Florida

Invites applications for several tenure-track faculty positions at the ranks of Assistant or Associate Professor. The positions commence in August 2012. The department offers bachelors and masters degrees in Aerospace Engineering. The undergraduate program is the nation's largest and has been ranked at the top of its category by U.S. News and World Report for twelve straight years. There are over 100 masters degree students. An Aerospace Engineering PhD program will begin in fall of 2013.

Successful candidates will be expected to be deeply committed to teaching at both the undergraduate and graduate levels, and be expected to obtain external funding for their research. They will be expected to make a steadily growing contribution to the PhD program.

An earned doctorate in Aerospace Engineering or a closely related field is required. Industrial experience and design experience are highly desirable. Rank and salary will be commensurate with qualifications.

Applicants must submit a cover letter, curriculum vitae, a detailed research plan and the names of at least three references to: www.erau.edu/jobs, and reference Faculty jobs in Daytona Beach, IRC41407, IRC41408.

EMBRY-RIDDLE
Aeronautical University
DAYTONA BEACH, FLORIDA

FACULTY POSITION AVAILABLE
DEPARTMENT OF AEROSPACE ENGINEERING
UNIVERSITY OF MARYLAND, COLLEGE PARK

The Department of Aerospace Engineering at the University of Maryland, College Park (http://www.enae.umd.edu) is a vibrant and growing department with 23 faculty, five named faculty professorships and an annual research expenditure budget of approximately $20M. The Department is seeking highly qualified tenure-track faculty to compliment its core research areas, which include aerodynamics and propulsion, smart and composite structures, space systems, rotorcraft, autonomous vehicle systems and small smart aerospace systems. Towards this goal, the department is seeking candidates with demonstrated competency and academic leadership in the areas of space systems and human factors, as well as satellite design. Additionally, candidates working in the areas of micro- and nano- air vehicles; morphing aircraft systems; V/stol systems; human factors; green aviation; wind turbines; and hypersonic aerodynamics and propulsion are also encouraged to apply.

Candidates should have an earned doctorate in aerospace engineering or a related degree appropriate to the research themes listed above at the time of the appointment. Applicants are being sought at the Assistant Professor or Associate Professor level, though highly-qualified candidates for Full Professor will be considered as well. Candidates must demonstrate a proven record, or have high potential, for excellence in both teaching and research.
For best consideration, a cover letter, curriculum vitae, research and education plan, and the names of at least four references should be submitted online by February 1, 2012 to: **jobs.umd.edu.**

It is anticipated that two positions will be filled as a result of this search. Information on the Department is available at the following website: www.aero.umd.edu.

The University of Maryland, College Park, actively subscribes to a policy of equal employment opportunity, and will not discriminate against any employee or applicant because of race, age, sex, color, sexual orientation, physical or mental disability, religion, ancestry or national origin, marital status, genetic information, or political affiliation. Minorities and women are encouraged to apply.

Department Head and Professor
Department of Aerospace Engineering
College of Engineering
University of Illinois at Urbana-Champaign

The College of Engineering of the University of Illinois at Urbana-Champaign, which is among the world's most prestigious and largest engineering institutions, with undergraduate and graduate programs consistently rated among the best both nationally and internationally, invites applications and nominations for the position of Head of the Department of Aerospace Engineering (AE). The AE department offers comprehensive educational and research programs in aerospace engineering and related engineering disciplines. It currently has 18 full-time faculty members with a goal of growing to 25, an average enrollment of 375 undergraduate students, and 150 graduate students. More information on the Department can be found at http://www.ae.illinois.edu/. Please visit http://jobs.illinois.edu to view the complete position announcement and application instructions. The closing date for this position is March 01, 2012.

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ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

University of Colorado Boulder

Aerospace Engineering Sciences

The Department of Aerospace Engineering Sciences at the University of Colorado Boulder invites applications for a tenure-track faculty position in the Bioastronautics focus area. Applicants are sought with expertise in the field of human spaceflight research including, but not limited to, human spacecraft design and analysis, life support systems, spacesuit technologies, and biomedical countermeasures for long duration spaceflight. Familiarity with NASA and international space programs, as well as with the emerging commercial spaceflight sector under the purview of the FAA, is desired.

The position is targeted for candidates with outstanding academic and professional credentials at the associate professor level; however, applicants at the full or assistant professor level will also be considered. Applicants should demonstrate the potential for establishing a robust research program, excelling at teaching aerospace engineering courses, and mentoring undergraduate and graduate students.

Opportunities for collaboration exist with the BioServe Space Technologies Center and the FAA Center of Excellence for Commercial Space Transportation, both housed in the Aerospace department. Applicants are also encouraged to pursue multidisciplinary interests across the department, college and campus, and to establish interactions with the various space-related companies in the Boulder/Denver area and across the nation.

The duties of this position include teaching, research and service to the university and professional community. A Ph.D. in an appropriate engineering or science field is required. For more information about the department, please visit http://www.colorado.edu/aerospace.

Applicants should electronically submit their application to job posting #815811 on www.jobsatcu.com , including their Curriculum Vitae, statements of research and teaching interests, and the names and contact information of four references. Address the cover letter to Prof. David Klaus, Search Committee Chair, Department of Aerospace Engineering Sciences, University of Colorado, Boulder, CO 80309-0429. Applications will be considered starting January 31, 2012.

The University of Colorado is an Equal Opportunity Employer.

AIAA Bulletin

Long-time *Journal of Aircraft* Editor-in-Chief Thomas Weeks was recognized for his 32 years of service at the AIAA Dayton-Cincinnati December luncheon. The luncheon program featured comments by AIAA VP-Publications Michael Bragg and new *Journal of Aircraft* Editor-in-chief Eli Livne as well as Weeks' reflections on being an editor. Bragg recognized Weeks' service with a commemorative plaque while six members of Weeks' family looked on. Pictured left to right: AIAA Dayton-Cincinnati chair Marc Polanka, Eli Livne, Tom Weeks, Mike Bragg, and AIAA Director Region III Sivaram Gogineni.

JANUARY 2012

AIAA Directory

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* Also accessible via Internet. Use the formula first name last initial@aiaa.org. Example: megans@aiaa.org.

† U.S. only. International callers should use 703/264-7500.

Addresses for Technical Committees and Section Chairs can be found on the AIAA Web site at **http://www.aiaa.org**.

We are frequently asked how to submit articles about section events, member awards, and other special interest items in the *AIAA Bulletin*. Please contact the staff liaison listed above with Section, Committee, Honors and Awards, Event, or Education information. They will review and forward the information to the *AIAA Bulletin* Editor.

Meeting Schedule

DATE	MEETING (Issue of *AIAA Bulletin* in which program appears)	LOCATION	CALL FOR PAPERS (*Bulletin* in which Call for Papers appears)	ABSTRACT DEADLINE
2012				
9–12 Jan	**50th AIAA Aerospace Sciences Meeting Including the New Horizons Forum and Aerospace Exposition**	Nashville, TN	*Jan 11*	**1 Jun 11**
23–26 Jan†	**The Annual Reliability and Maintainability Symposium (RAMS)**	Reno, NV (Contact: Patrick M. Dallosta, patrick.dallosta@dau.mil; www.rams.org)		
24–26 Jan	**AIAA Strategic and Tactical Missile Systems Conference** **AIAA Missile Sciences Conference** (Oct) **(SECRET/U.S. ONLY)**	Monterey, CA	*Jun 11*	**30 Jun 11**
29 Jan–2 Feb†	**22nd AAS/AIAA Space Flight Mechanics Meeting**	Charleston, SC Contact: Keith Jenkins, 480.390.6179; keith@jenkinspatentlaw.com; www.space-flight.org	*Apr 11*	**3 Oct 11**
15–16 Feb	**15th Annual FAA Commercial Space Transportation Conference**	Washington, DC		
3–10 Mar†	**2012 IEEE Aerospace Conference**,	Big Sky, Montana Contact: David Woerner, 626.497.8451; dwoerner@ieee.org; www.aeroconf.org		
21–23 Mar†	**Nuclear and Emerging Technologies for Space 2012 (NETS-2012) held in conjunction with the 2012 Lunar & Planetary Sciences Conference**	The Woodlands, TX Contact: Shannon Bragg-Sitton, 208.526.2367, shannon.bragg-sitton@inl.gov, http://anstd.ans.org/NETS2012.html		
26–28 Mar†	**3AF 47th International Symposium of Applied Aerodynamics**	Paris, France (Contact: Anne Venables, 33 1 56 64 12 30, secr.exec@aaaf.asso.fr, www.aaaf.asso.fr)		
23–26 Apr	**53rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference** (Jan) **20th AIAA/ASME/AHS Adaptive Structures Conference** **14th AIAA Non-Deterministic Approaches Conference** **13th AIAA Gossamer Systems Forum** **8th AIAA Multidisciplinary Design Optimization Specialist Conference**	Honolulu, HI	*Apr 11*	**10 Aug 11**
14–18 May†	**12th Spacecraft Charging Technology Conference**	Kitakyushu, Japan Contact: Mengu Cho, +81 93 884 3228, cho@ele.kyutech.ac.jp, http://laseine.ele.kyutech.ac.jp/12thsctc.html		
22–24 May	**Global Space Exploration Conference (GLEX)**	Washington, DC	*Oct 11*	**1 Dec 11**
22–25 May†	**5th International Conference on Research in Air Transportation (ICRAT 2012)**	Berkeley, CA Contact: Andres Zellweger, 301.330.5514, dres.z@comcast.net, www.icrat.org		
4–6 Jun	**18th AIAA/CEAS Aeroacoustics Conference (33rd AIAA Aeroacoustics Conference)**	Colorado Springs, CO	*Jun 11*	**9 Nov 11**
4–6 Jun†	**19th St Petersburg International Conference on Integrated Navigation Systems**	St. Petersburg, Russia Contact: Prof. V. Peshekhonov, +7 812 238 8210, elprib@online.ru, www.elektropribor.spb.ru		
18–20 Jun†	**3rd International Air Transport and Operations Symposium (ATOS) and 6th International Meeting for Aviation Product Support Process (IMAPP)**	Delft, the Netherlands Contact: Adel Ghobbar, 31 15 27 85346, a.a.ghobbar@tudelft.nl, www.lr.tudelft.nl/atos		
19–21 Jun	**AIAA Infotech@Aerospace Conference**	Garden Grove, CA	*Jun 11*	**6 Dec 11**
25–28 Jun	**28th Aerodynamics Measurement Technology, Ground Testing, and Flight Testing Conferences including the Aerospace T&E Days Forum** **30th AIAA Applied Aerodynamics Conference** **4th AIAA Atmospheric Space Environments Conference** **6th AIAA Flow Control Conference** **42nd AIAA Fluid Dynamics Conference and Exhibit** **43rd AIAA Plasmadynamics and Lasers Conference** **44th AIAA Thermophysics Conference**	New Orleans, LA	*Jun 11*	**17 Nov 11**
27–29 Jun†	**American Control Conference**	Montreal, Quebec, Canada Contact: Tariq Samad, 763.954.6349, tariq.samad@honeywell.com, http://a2c2.ort/conferences/acc2012		

DATE	MEETING (Issue of *AIAA Bulletin* in which program appears)	LOCATION	CALL FOR PAPERS (*Bulletin* in which Call for Papers appears)	ABSTRACT DEADLINE
11–14 Jul†	**ICNPAA 2012 – Mathematical Problems in Engineering, Aerospace and Sciences**	Vienna, Austria Contact: Prof. Seenith Sivasundaram, 386/761-9829, seenithi@aol.com, www.icnpaa.com		
14–22 Jul	**39th Scientific Assembly of the Committee on Space Research and Associated Events (COSPAR 2012)**	Mysore, India Contact: http://www.cospar-assembly.org		
15–19 Jul	**42nd International Conference on Environmental Systems (ICES)**	San Diego, CA	*Jul/Aug 11*	**15 Nov 11**
30 Jul–1 Aug	**48th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit Future Propulsion: Innovative, Affordable, Sustainable**	Atlanta, GA	*Jul/Aug 11*	**21 Nov 11**
30 Jul–1 Aug	**10th International Energy Conversion Engineering Conference (IECEC)**	Atlanta, GA	*Jul/Aug 11*	**21 Nov 11**
13–16 Aug	**AIAA Guidance, Navigation, and Control Conference** **AIAA Atmospheric Flight Mechanics Conference** **AIAA Modeling and Simulation Technologies Conference** **AIAA/AAS Astrodynamics Specialist Conference**	Minneapolis, MN	*Jul/Aug 11*	**19 Jan 12**
11–13 Sep	**AIAA SPACE 2012 Conference & Exposition**	Pasadena, CA	*Sep 11*	**26 Jan 12**
11–13 Sep	**AIAA Complex Aerospace Systems Exchange Event**	Pasadena, CA		
17–19 Sep	**12th AIAA Aviation Technology, Integration, and Operations (ATIO) Conference** **14th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference**	Indianapolis, IN	*Oct 11*	**7 Feb 12**
23–28 Sept†	**28th Congress of the International Council of the Aeronautical Sciences**	Brisbane, Australia Contact: http://www.icas2012.com		**15 Jul 11**
24–27 Sept†	**30th AIAA International Communications Satellite Systems Conference (ICSSC) and** **18th Ka and Broadband Communications, Navigation and Earth Observation Conference**	Ottawa, Ontario, Canada Contact: Frank Gargione, frankgargione3@msn.com; www.kaconf.org	*Nov 11*	**31 Mar 12**
24–28 Sep	**7th AIAA Biennial National Forum on Weapon System Effectiveness**	Ft. Walton Beach, FL	*Nov 11*	**15 Mar 12**
1–5 Oct	**63rd International Astronautical Congress**	Naples, Italy (Contact: www. iafastro.org)		
5–8 Nov†	**27th Space Simulation Conference**	Annapolis, MD Contact: Harold Fox, 847.981.0100, info@spacesimcon.org, www.spacesimcon.org		
2013				
7–10 Jan	**51st AIAA Aerospace Sciences Meeting Including the New Horizons Forum and Aerospace Exposition**	Dallas/Ft. Worth, TX	*Jan 12*	**5 Jun 13**

To receive information on meetings listed above, write or call AIAA Customer Service, 1801 Alexander Bell Drive, Suite 500, Reston, VA 20191-4344; 800.639.AIAA or 703.264.7500 (outside U.S.). Also accessible via Internet at www.aiaa.org/calendar.

†Meetings cosponsored by AIAA. Cosponsorship forms can be found at http://www.aiaa.org/content.cfm?pageid=292.

AIAA **Courses** and **Training Program**

DATE	COURSE	VENUE	LOCATION
2012			
22–23 Jan	**Missile Design and System Engineering**	StratTac Conference	Monterey, CA
21–22 Apr	**Fundamentals of Composite Structure Design**	SDM Conferences	Honolulu, HI
21–22 Apr	**Introduction to Bio-Inspired Engineering**	SDM Conferences	Honolulu, HI
21–22 Apr	**Aeroelasticity: State-of-the-Art Practices**	SDM Conferences	Honolulu, HI
21–22 Apr	**Introduction to Non-Deterministic Approaches**	SDM Conferences	Honolulu, HI

**Courses subject to change*

To receive information on courses listed above, write or call AIAA Customer Service, 1801 Alexander Bell Drive, Suite 500, Reston, VA 20191-4344; 800.639.2422 or 703.264.7500 (outside the U.S.). Also accessible via the internet at www.aiaa.org/courses.

From the **Corner** Office

NEW DIRECTIONS

As I draft this article in mid-November, two major thoughts keep running through my mind. First, I'm entering my final year as your Executive Director. I asked the Board to have my replacement on-board no later than the end of 2012; the Executive Committee has met twice to identify the many factors that should be considered in the selection and President Brian Dailey has asked President-Elect Mike Griffin to chair the search committee. I joined the AIAA staff in February 2005. At the time I was interviewed, I indicated that I thought 7–8 years was as long as I'd plan to serve, and also a good timeframe for a change in staff leadership. I am very comfortable that the timing of my retirement is right for me and my family, and also for AIAA.

Second, I believe that AIAA needs to change in some very fundamental ways, and I want to spend the next year focused on supporting the volunteer leadership as we move down this path. I hope you had a chance to read Mike Griffin's article in this space last month. He returned from the International Astronautical Congress with almost exactly the same impressions that I and several others that attended share: we have to build on our role as the premier technical society of the aerospace professional, but we need to be more than that. What Mike didn't say, but I will, is that I believe the very existence of AIAA as a professional society depends on making this evolution.

Let me give a few examples where we have been torn between our traditional strengths and ways of doing business, and what I think needs to be done to reverse our slow decline and become "THE" premier aerospace society that we were fifty years ago—and much more.

Over the past several months, the Technical Activities Committee has been looking at various models for a realignment of our conferences. To oversimplify a complex situation, one end of the spectrum is to move to a small number of conferences focused on products and missions—perhaps aerospace sciences, aviation, space, defense, etc. All relevant technical domains would be brought into these much larger events, along with much greater attention to systems engineering, integration, program management, and the many other things that aerospace professionals "do" that aren't addressed very well today at our events. At the other end of the spectrum is our current structure with conferences focused on technical specialty domains: Guidance, Navigation, and Control; Propulsion; Aeroacoustics; Structural Dynamics; Fluid Dynamics; Missile Sciences, and many more. In recent years, several of these conferences have collocated, but the emphasis remains on the relevant technical domains rather than their application. Over the past six years, I've attended most of our events at least once. I understand the attractiveness of getting together with the professionals working in "your" area. But by not focusing on the applications, we miss the very things that the larger community and the public really care about. That is part of the reason that we have a difficult time getting non-aerospace professionals to see the value of our chosen field—we are not addressing what the users care about. I believe that we must move toward a more integrated applications focus and the skills, technologies, and processes needed to accomplish that integration. I hope that we can find a way to do that without losing either the technical rigor or the interpersonal relationships that are a hallmark of much of what we do today. Ideally, this change in focus would expand our relationships while retaining our standards of excellence.

At the International Astronautical Congress (IAC), more than a third of the attendees were "young professionals"—35 or younger. They were involved in panels at all levels, from Plenary to highly technical. They had separate and integrated sessions, many opportunities for networking, were fully involved in the planning, and were a very visible part of almost every aspect of the Congress. At many of our events, we have "add-on" receptions and similar activities for young professionals, but it seems that our mindset is that young people have to "pay their dues" before they are considered full players. In contrast, the IAC has embraced them as the future—for the Congress and for the profession. As I look around AIAA, at either our conferences or our Technical Committees and Section activities, I can't help but question whether our membership among young professionals couldn't change *enormously* if we paid more attention to what's important to them, and worked consciously toward making young professionals a centerpiece of everything we do. They ***ARE*** our future.

More than 1/6 of our members are from outside the United States—student and professional. As I've travelled over the past six years, I've seen AIAA's substantial influence in the established global aerospace community—*but that isn't enough*! At NPO Energomash in Russia, AIAA journals are on the engineer's desks. The Chinese societies for aviation professionals and aerospace professionals both initiated contact with AIAA about establishing agreements between us. Japan has the largest single-country membership outside the United States. These are recognized aerospace industrial powers—we are well known everywhere there is a long-established aerospace community. But the growth area in aerospace, whether measured in numbers of new people involved in the industry or in the change in output of that industry, won't be in these countries; eventually it will be in the developing world. It's a brand new market, and if we want to be a player with our professional counterparts in these nations, we need to move quickly and change how we think about our relationships. I've heard two major arguments against providing some kind of tailored access to AIAA services in these burgeoning aerospace areas: they can't afford to pay our dues and to charge less will mean it costs us more than our revenue; and our international (and domestic) members will consider it unfair if they have to pay the full dues and others get the same services for much less. To which I say, let's acknowledge that we *WANT* to expand into these countries, and figure out how to solve the problems. Almost every product we provide is available electronically. If we can't figure out how to provide tailored service to new international members at very little cost, shame on us. I agree that people making a comparable salary should pay comparable dues. But when my dues are less than a meal for my wife and me at a good restaurant, and the same dues create disproportionate personal sacrifices in a developing nation, I don't care that I pay more, anymore. One approach would be to "franchise" groups in these nations—one membership that would allow any member of a local foreign aerospace-oriented society to receive tailored AIAA benefits.

One of the things that AIAA does very well is recognize technical achievement. We have over fifty Technical Excellence awards, in addition to lectureships, service awards, and many more related to publications. The technical excellence awards range from Aerodynamic Measurement Technology to Thermophysics, and every technical discipline in between. Only two, the Hap Arnold Award for Excellence in Aeronautical Program Management and the von Braun Award for Excellence in Space Program Management even mention management in the title; not one specifically recognizes Systems Engineering. To be sure, many managers and system engineers have been recognized, but given the importance of these capabilities (and a host of "integration" skills) to a successful aerospace project or program; I can't help but think we're failing to see the forest for the trees.

This list only scratches the surface of the kind of things we can and should be doing to put AIAA in the position of the premier aerospace technical society (again). That will be my focus over the next year. As Mike wrote last month, that's his goal also. And as he concluded: "I invite your thoughts as we go forward together." I'm at **bobd@aiaa.org**.

SPECIAL SECTION: AIAA'S CONTINUING COLLABORATION WITH CHINA

The AIAA International Strategic Plan shows heavy emphasis on partnering with other international associations. AIAA strives to be the primary society representing U.S. aerospace professional and technical interests in a collaborative global and technical forum. Consequently, AIAA is working carefully to leverage and enhance activities with both established and emerging aerospace societies worldwide for the common benefit to the profession.

Building on a strong foundation of collaboration that occurred during 2009–2010, this year has seen AIAA's collaboration with China grow. While continuing our established partnerships in publications and interactions with the Chinese Society of Astronautics, most of the collaboration this past year has focused on initiating interactions and establishing new partnerships on the aviation side.

AIAA Membership in China

- 113 Professional Members (*5 Associate Fellows, 50 Senior Members*)
- 70 Student Members
- 2 Educator Associates
- 2 Student Branches (*Northwester Polytechnical University, Hong Kong University of Science and Technology*)

AIAA SIGNS MOU WITH CHINESE SOCIETY OF AERONAUTICS AND ASTRONAUTICS

AIAA recently signed a memorandum of understanding with the Chinese Society of Aeronautics and Astronautics (CSAA). The signing ceremony took place on Tuesday, 25 October, at the headquarters of the CSAA in Beijing, China, during the AIAA Delegation visit of aviation executives.

The agreement was signed by AIAA Vice President-Elect, International, Dr. Susan Ying, and CSAA Secretary General, Professor Song Wu. In their remarks, both Dr. Ying and Professor Wu heralded the historic nature of the signing, and expressed confidence that the memorandum would "strengthen the contact and friendships between both societies," while creating many opportunities for technical and scientific exchanges between Chinese and American engineers and scientists working in aerospace.

AIAA Vice President-Elect, International, Dr. Susan Ying (left forefront), and CSAA Secretary General, Professor Song Wu (right, forefront) celebrate the MOU signing between their organizations. From left to right in the back row: Jeffrey Nadaner, Dr. Robert Yancey, Patrick Liu, Merrie Scott, Dr. Kevin Kremeyer, Dr. John Langford, Dr. Weinong Chen, Prof. Jun Hua, Dr. Song Fu, Prof. Yongling Fu, Xue Zhang, and Ce Yu.

AIAA Executive Director Robert S. Dickman stated: "The signing of this memorandum with the CSAA enhances the ability of our organizations to create meaningful scientific exchanges in the fields of aeronautics and astronautics. Such exchanges will help lay the critical groundwork for cooperation as both the U.S. and China work to find solutions to some of the greatest problems facing the aerospace community."

Established in 1964, CSAA is an academic, nonprofit membership organization serving scientists and engineers working in aeronautics in China. CSAA's objectives are to promote the development and dissemination of aeronautic and astronautic science and technology, to promote the development of talents in these fields, and to serve its members and other professionals working in scientific and technological fields. The activities of CSAA include organizing technical symposia and other events, publishing scientific periodicals, providing training programs, and conducting activities to increase scientific knowledge in the young.

AIAA CORPORATE MEMBERS VISIT CHINA

In October, an AIAA delegation of senior U.S. aviation industry executives visited China, stopping in Beijing, Xi'an, and Shanghai. The trip, part of AIAA's Corporate Member program, was intended to encourage interaction between the commercial aviation sectors of the two countries and develop business relationships in China for AIAA corporate members.

The group started its series of meetings at the U.S. Embassy in Beijing. The delegation was fortunate to meet with the Deputy Political Minister Counselor and the Federal Aviation Administration Senior Representative in China, in addition to various officers serving at the Embassy. This session afforded the delegates the opportunity to learn about the current economic environment in China and the state of aviation industry there. The overall message of the discussion was that there were complex relationships of cooperation and competition and that there were tremendous growth opportunities in China's aerospace industry.

During the rest of the trip, the delegation met with numerous high-level representatives from Chinese industry and visited many of the institutes and facilities that are responsible for the research, design, production, test, integration, and operations of Chinese aircraft.

The Aviation Industry Corporation of China (AVIC) was founded in 1951 as the Bureau of Aviation Industry and AVIC, a consortium of aircraft manufacturers. The focus of AVIC is to develop indigenous military technologies and to compete in the civilian airline industry. Its product base is military aircraft, commercial aircraft, information technology, and non-aviation products such as logistics, assets management, finance services, and automobiles. Since 2008, AVIC has maintained double-digit growth. AVIC is ranked 310 among the published Fortune Top 500 enterprises and has been on the Fortune 500 list for three consecutive years. AVIC is comprised of more than 200 member companies (subsidiaries) and has over 400,000 employees in 24 provinces, autonomous regions, and municipalities.

The AIAA Corporate Member delegation met with Dr. Xinguo Zhang, Executive Vice President of the Aviation Industry Corporation of China (middle forefront). From left to right, the front row: Dr. Kevin Kremeyer, Merrie Scott, Dr. Xinguo Zhang, Dr. Susan Ying, Patrick Liu. From left to right, the back row: Prof. Song Wu, Prof. Jun Hua, Dr. John Langford, Dr. Robert Yancey, Jun Zhou, Dr. Weinong Chen, Steve Legensky, and Jinzhong Wei.

The Chinese Society of Aeronautics and Astronautics (CSAA), a professional society similar to AIAA, is part of the AVIC organization. Other organizations within the AVIC structure that the delegation visited were:

- *AVIC Beijing Institute of Aeronautical Materials*
  – Established in 1956.
  – Focused on research in advanced materials processing and testing for aircraft, aircraft engines, and helicopters.
- *AVIC Aircraft Research & Design Institute (Xi'an)*
  – Established in 1961.
  – Includes 12 research departments, 2 development centers.
- *AVIC Xi'an Aircraft Industry Group*
  – Established in 1958.
  – Develops and manufactures 30+ types of commercial and military aircraft
  – First company in the Chinese aviation industry to work with the international market in 1980, and currently cooperates on numerous programs with partners such as Boeing, Airbus, Air Canada, and Air Italy.
- *AVIC Aircraft Strength Research Institute (Xi'an)*
  – Focuses on advanced research, provides analysis methods and software, conducts ground tests, its main function being to solve structural strength problems in aviation industry.
  – Offer ground-test service for not only aviation customers but also space, energy, transportation, and more.
- *AVIC Xi'an Flight Automatic Control Research Institute*
  – Established in 1960.
  – Focuses on advanced research and development; design and production of guidance, navigation, and control systems for aircraft, helicopter, UAV, and weapons.
- *AVIC Xi'an Aero-Engine Group*
  – Established in 1958.
  – Develops and manufactures turbo engines, turbo generator installations, turbo fan engines, and gas turbines.
- *China National Aeronautical Radio Electronics Research Institute (Shanghai)*
  – Established in 1957.
  – Focuses on avionic systems, and organized in three centers (R&D, Production, and Management and Business).

At the end of the visit, the delegation was in agreement that the trip was a productive one. Their observations were that China's aviation market is very large; China's aerospace (aeronautics) industry has made great strides and begun to win global recognition and partnerships in research and development as well as manufacturing; institutes in China cover R&D through production and are not like the academic, nonprofit U.S. institutes; and there are opportunities for potential collaboration in areas such as composites, avionics (hardware and software), general aviation, "Next Gen" Air Traffic Management, and universities (training). The group also identified some opportunities for AIAA in continued collaboration with China and in using the same model with other countries targeted in the strategic plan.

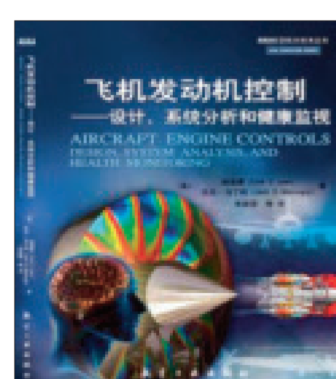
This trip would not have been successful without strong support and cooperation from AVIC, CSAA, the U.S. Department of State Office of Space and Advanced Technology, and the U.S. Embassy in Beijing. Without the support of our corporate members, the trip would not have been possible. AIAA would like to thank all of these groups for making this trip worthwhile and productive.

AIAA Delegation Members

- Dr. Weinong Chen, Professor, Purdue University
- Dr. Kevin Kremeyer, CEO, PM & AM Research
- Dr. John Langford, President, Aurora Flight Sciences
- Mr. Steve Legensky, Founder and General Manager, Intelligent Light
- Mr. Patrick Liu, Manager, Marketing Research, AIAA
- Mr. Jeffrey Nadaner, Director of Strategy, Lockheed Martin Corporation
- Ms. Merrie Scott, Manager, Industry Partnerships, AIAA
- Dr. Robert Yancey, Executive Director Global Aerospace, Altair Engineering
- Dr. Susan Ying, Director, Boeing Research & Technology (Delegation lead)

AIAA PUBLICATIONS COLLABORATION CONTINUES WITH CHINA

The AIAA Technical Publications department continues to develop a fruitful partnership with China Aviation Publishing & Media Co. Ltd. Three Chinese translations of AIAA books have already been published and eleven more are in various stages of translation and production, with most of these titles expected to publish during 2012. Earlier this fall, Managing Director of Technical Publications Rodger Williams and Acquisitions Editor David Arthur met with General Manager of China Aviation Publishing & Media Xin Liu and Vice-Chief Editor of Books Ning Liu to discuss agreements that will allow work to begin on translation of additional titles in 2012 and beyond.



AIAA ANNOUNCES 2012 ASSOCIATE FELLOWS

AIAA is pleased to announce that its Associate Fellows Selection Committee has selected the Associate Fellows class of 2012. The Membership Committee approved all selected. To be selected for the grade of Associate Fellow an individual must be an AIAA Senior Member with at least twelve years professional experience in their field, and have been recommended by a minimum of three AIAA members who are of the grade Associate Fellow or higher.

The 2012 Associate Fellows will be honored at the AIAA Associate Fellows Dinner on Monday, 9 January 2012, at the Gaylord Opryland Resort & Convention Center, Nashville, TN, in conjunction with the 50th AIAA Aerospace Sciences Meeting and Exhibit. By AIAA Region and Section, the 184 AIAA members selected to become Associate Fellows are:

REGION I

Central Pennsylvania
Ralph W. Noack, Pennsylvania State University

Connecticut
Med B. Colket, United Technologies Research Center
Nathan S. Hariharan, CREATE-AV
Om P. Sharma, Pratt & Whitney Rocketdyne
Brian E. Wake, United Technologies Research Center
Allen Witkowski, Pioneer Aerospace Corporation

Greater Philadelphia
Brahmanand Panda, Boeing Defense, Space & Security
David W. Yoel, American Aerospace Advisors, Inc.

Hampton Roads
John K. Anderson, Triumph Aerospace Systems—Newport News
Boris Diskin, National Institute of Aerospace
Ronald Krueger, National Institute of Aerospace
Zigmond V. Leszczynski, Virginia Commercial Space Flight Authority
Lee R. Rich, NASA Langley Research Center
Isam S. Yunis, NASA Langley Research Center

Mid-Atlantic
Ronald S. Fry, The Johns Hopkins University Chemical Propulsion Information Analysis Center
Yanping Guo, The Johns Hopkins University Applied Physics Laboratory
Edmund K. Liu, The Johns Hopkins University Chemical Propulsion Information Analysis Center
Jim V. McAdams, The Johns Hopkins University Applied Physics Laboratory
Brian E. McGrath, The Johns Hopkins University Applied Physics Laboratory
Robert J. Niewoehner, Jr., United States Naval Academy
David M. Phillips, Carnegie Mellon University Software Engineering Institute
Sidra I. Silton, United States Army Research Laboratory

National Capital
James H. Babcock, Northrop Grumman Technical Services
Peter S. Bernard, University of Maryland
Paul E. Damphousse, United States Marine Corps
J. Paul Douglas, ASRC Aerospace Corporation
Rand H. Fisher, The Aerospace Corporation
Terence A. Ghee, Naval Air Systems Command
Michael W. Hawes, NASA Headquarters
Stephane L. Mondoloni, The Mitre Corporation
Richard Ohlemacher, Northrop Grumman Information Systems
Scott Pace, George Washington University
Gopal Patnaik, United States Naval Research Laboratory
Glenn F. Roberts, The Mitre Corporation
Steven S. Scott, NASA Goddard Space Flight Center
Lynette D. Wigbels, RWI International Consulting Services
Jeffrey J. Wilcox, Lockheed Martin Corporation
Raymond A. Young, III, Saab Sensis Corporation
Andrew D. Zeitlin, The Mitre Corporation

New England
Eric D. Evans, Massachusetts Institute of Technology
Nikolaos A. Gatsonis, Worcester Polytechnic Institute
Thomas H. Kerr, III, TeK Associates
Sanjay N. Patel, Ignition technologies

Northeastern New York
Huageng Luo, GE Aviation

Northern New Jersey
Raymond S. Trohanowsky, Armament Research, Development and Engineering Center

REGION II

Atlanta
Wassim M. Haddad, Georgia Institute of Technology
Thomas Mensah, Georgia Aerospace Corporation
Bo Song, Jiangsu Chinfan Compressor, Inc.

Cape Canaveral
Laurent Sibille, ASRC Aerospace Corporation

Carolina
Tarek Echekki, North Carolina State University
Michimasa Fujino, Honda R&D Company, Ltd.
Stephanie C. TerMaath, Applied Research Associates, Inc.
Håvard Vold, ATA Engineering, Inc.
Mark J. Wagner, GE Aviation

Central Florida
Glenn A. Gebert, Lockheed Martin Electronic Systems
Nam Ho Kim, University of Florida
Clinton Plaisted, A.I. Solutions, Inc.
Gecheng Zha, University of Miami

Greater Huntsville
Robert B. Adams, Marshall Space Flight Center
Chien P. Chen, The University of Alabama in Huntsville
Yang Cheng, Mississippi State University
James Hulka, Jacobs Engineering

Tennessee
Amrutur V. Anilkumar, Vanderbilt University
Sankaran Mahadevan, Vanderbilt University

REGION III

Dayton/Cincinnati
Erik P. Blasch, Air Force Research Laboratory
Haibo Dong, Wright State University
Rick E. Graves, Ohio Aerospace Institute
Waruna D. Kulatilaka, Spectral Energies, LLC
Gregory H. Parker, United States Air Force
Ravi C. Penmetsa, Wright State University
Ajit K. Roy, Air Force Research Laboratory
Joe Sciabica, Air Force Research Laboratory

Illinois
Joanna M. Austin, University of Illinois at Urbana-Champaign
Jonathan B. Freund, University of Illinois at Urbana-Champaign
Carlos Pantano, University of Illinois at Urbana-Champaign
Boris S. Pervan, Illinois Institute of Technology

Northern Ohio
Jih-Fen Lei, NASA Glenn Research Center
George Williams, Ohio Aerospace Institute

Wisconsin
Martin J. Chiaverini, Orbital Technologies Corporation

REGION IV

Albuquerque
Ryan B. Bond, Sandia National Laboratories
Moriba Jah, Air Force Research Laboratory
Marc W. Kniskern, Sandia National Laboratories

Houston
Theodore J. Bartkowicz, Boeing Defense, Space & Security
Edward J. Fitzgerald, The Boeing Company
Curtis E. Larsen, NASA Engineering and Safety Center

North Texas
Ben A. Calloni, Lockheed Martin Corporation
Eric F. Charlton, Lockheed Martin Corporation
Lloyd M. Landry, Jr., Lockheed Martin Corporation
Michael D. Packer, Lockheed Martin Corporation
Kamesh Subbarao, The University of Texas at Arlington
Paul S. Zink, Lockheed Martin Corporation

Oklahoma
M. Keith Hudson, The University of Arkansas

Southwest Texas
Daniel N. Riahi, The University of Texas–Pan American

REGION V

Iowa
Kenneth M. Bryden, Iowa State University
Atul Kelkar, VSI Aerospace, Inc.
Xinwei Wang, Iowa State University

Rocky Mountain
Indranil Dandaroy, Lockheed Martin Corporation
Kenneth E. Jansen, University of Colorado at Boulder
George F. Sowers, United Space Alliance
Catherine J. Steele, The Aerospace Corporation
Edward Tomme, Sci-Ops Consulting

St. Louis
Daniel E. Groneck, Boeing Engineering Operations & Technology
James Guglielmo, Boeing Defense, Space & Security
James L. Paunicka, Boeing Engineering Operations & Technology
Bradley W. Sexton, Boeing Engineering Operations & Technology

Twin Cities
Andrew A. Carlson, Goodrich Corporation

REGION VI

Antelope Valley
Michael T. Huggins, Air Force Research Laboratory

Los Angeles
Julian A. Domaradzki, University of Southern California
Jeff D. Grant, Northrop Grumman Corporation
Gary N. Henry, Northrop Grumman Corporation
Peter C. Lai, The Aerospace Corporation
Rongsheng Li, Boeing Defense, Space & Security
Elon R. Musk, SpaceX
Satoshi Nagano, The Aerospace Corporation
Dennis K. Van Gemert, The Aerospace Corporation
Margot L. Wasz, The Aerospace Corporation

Orange County
Robert P. Ley, Boeing Defense, Space & Security

John C. Rose, Boeing Defense, Space & Security

Pacific Northwest
Douglas E. Chappelle, Boeing Defense, Space & Security
Michael P. Delaney, Boeing Commercial Airplanes
Ron Hinderberger, Boeing Commercial Airplanes
Livingston L. Holder, Jr., Holder Aerospace
Keith Leverkuhn, The Boeing Company
Mark E. Liffring, Boeing Commercial Airplanes
Vera A. Martinovich, Boeing Commercial Airplanes
Michael K. Sinnett, The Boeing Company
Robert S. Wegeng, Battelle Memorial Institute
Todd Zarfos, The Boeing Company
Shanying Zeng, Boeing Engineering Operations & Technology

Phoenix
Dennis E. Barbeau, InnSol, Inc.

San Diego
Dario H. Baldelli, Northrop Grumman Aerospace Systems
Satchi Venkataraman, San Diego State University

San Fernando Pacific
John R. Brophy, Jet Propulsion Laboratory
Grant Carichner, Lockheed Martin Aeronautics
James G. Maser, United Technologies Corporation
Harold B. Schall, Boeing Defense, Space & Security

San Francisco
Terrence W. Fong, NASA Ames Research Center
Celeste V. Ford, Stellar Solutions, Inc.
Gianluca Iaccarino, Stanford University
Arif M. Karabeyoglu, Space Propulsion Group, Inc.
Kenton R. Lietzau, Lockheed Martin Space Systems
Fady M. Najjar, Lawrence Livermore National Laboratory
Laurel L. Stell, NASA Ames Research Center

San Gabriel Valley
Mark Adler, Jet Propulsion Laboratory
Dominique Fourguette, Michigan Aerospace Corporation
Richard R. Hofer, Jet Propulsion Laboratory
Steven E. Matousek, Jet Propulsion Laboratory

Tucson
Thomas R. Bussing, Raytheon Missile Systems
Alfred M. Luckau, Raytheon Missile Systems

Utah
Wenbin Yu, Utah State University

REGION VII

Australia
Cees Bil, Royal Melbourne Institute of Technology
Russell R. Boyce, University of Queensland
Carlo Kopp, Monash University

Canada
Pascal J. Hubert, McGill University
Krishna D. Kumar, Ryerson University
Hugh H. Liu, University of Toronto
David G. Zimcik, National Research Council

China (PRC)
Jinsong Leng, Harbin Institute of Technology

Czech Republic
Jiri Cecrdle, Aeronautical Research and Test Institute

Egypt
Ahmed F. Abdel Gawad, Zagazig University

Germany
Robert Luckner, Technische Universitaet Berlin

India
Radhakant Padhi, Indian Institute of Science
Bhaskar Roy, Indian Institute of Technology, Bombay
Comandur Venkatesan, Indian Institute of Technology, Kanpur

Iran
Mahmoud Mani, Amirkabir University of Technology

Israel
Azriel K. Lorber, Consultant

Italy
Chiara Bisagni, Politecnico Di Milano
Francesco Nasuti, University of Rome La Sapienza

Russia
Alexander V. Fedorov, Moscow Institute of Physics and Technology

Singapore
Hua-Shu Dou, National University of Singapore

South Korea
Chongam Kim, Seoul National University

Sydney
Gordon P. Briggs, Ausralian Reaction Motors
Gordon H. Pike, National Broadband Network

Taiwan
YenSen Chen, National Space Organization
AnShik Yang, National Taipei University of Technology

The Netherlands
Luisella Giulicchi, European Space Agency
Shufan Wu, European Space Research and Technology Centre

Ukraine
Nina F. Yurchenko, National Academy of Sciences

United Kingdom
KwingSo Choi, The University of Nottingham
John J. Doherty, University of Surrey
J. Stephen Lingard, Vorticity Ltd.
Justin D. Paines, Qinetiq Boscombe Down
Nicholas D. Sellars, BAE Systems
Jian Wang, Kingston University

APPLICATION DEADLINE EXTENDED

Important Announcement

New Editor-in-Chief Sought for the *Journal of Aerospace Computing, Information, and Communication*

AIAA is seeking an outstanding candidate with an international reputation to assume the responsibilities of editor-in-chief of AIAA's *Journal of Aerospace Computing, Information, and Communication* (*JACIC*). The chosen candidate will assume the editorship at an exciting time as AIAA relaunches its electronic library with new features and functionality. Originally envisioned as an electronic-only, rapid-review journal, the new editor-in-chief will be able to take advantage of the new platform's capabilities to enhance *JACIC's* reputation and fulfill its mission.

The Editor-in-Chief is responsible for maintaining and enhancing the journal's quality and reputation as well as establishing a strategic vision for the journal. He or she receives manuscripts, assigns them to Associate Editors for review and evaluation, and monitors the performance of the Associate Editors to ensure that the manuscripts are processed in a fair and timely manner. The Editor-in-Chief works closely with AIAA Headquarters staff on both general procedures and the scheduling of specific issues. Detailed record keeping and prompt actions are required. The Editor-in-Chief is expected to provide his or her own clerical support, although this may be partially offset by a small expense allowance. AIAA provides all appropriate resources including a web-based manuscript-tracking system.

Interested candidates are invited to send letters of application describing their reasons for applying, summarizing their relevant experience and qualifications, and initial priorities for the journal; full résumés; and complete lists of published papers, to:

Rodger Williams
American Institute of Aeronautics and Astronautics
1801 Alexander Bell Drive, Suite 500
Reston, VA 20191-4344
Fax: 703/264-7551
E-mail: rodgerw@aiaa.org

A minimum of two letters of recommendation also are required. The recommendations should be sent by the parties writing the letters directly to Mr. Williams at the above address, fax number, or e-mail. To receive full consideration, applications and all required materials must be received at AIAA Headquarters by **30 January 2012**, but applications will be accepted until the position is filled.

A selection committee appointed by the AIAA Vice President–Publications Michael B. Bragg will seek candidates and review all applications received. The search committee will recommend qualified candidates to the AIAA Vice President–Publications, who in turn will present a recommendation to the AIAA Board of Directors for approval. This is an open process, and the final selection will be made only on the basis of the applicants' merits. All candidates will be notified of the final decision.

AIAA CORPORATE MEMBERS

AIAA is pleased to announce our latest Corporate Members:

- **Arkyd Astronautics, Bellevue, WA**, is a privately funded Seattle-based startup developing technologies for conducting commercial robotic space exploration of the solar system.
- **Frontier Wind, Rocklin, CA**, is the preeminent supplier of smart blade technology that redefines the wind industry.
- **VanRSpace, West Palm Beach, FA**, is an aerospace consulting company formed to provide technical and management and strategic support of space mission in the design, development, test and flight operations of scientific and human space flight.

For information about AIAA's Corporate Membership Program, contact Merrie Scott at merries@aiaa.org or 703.264.7530.

ROHATGI HONORED AS SME FELLOW

The Society of Manufacturing Engineers (SME) has elected **Professor Pradeep Rohatgi** to the SME Class of Fellows for his "world leadership in research, education, institution building, and development of manufacturing technology of cast metal matrix composites which are widely manufactured and used by industry." This award is given to those who have made outstanding contributions to the manufacturing profession.

Dr. Rohatgi received his bachelor's degree in Metallurgical Engineering in 1961 from Banaras Hindu University and the degree of Doctor of Science in Metallurgy from the Massachusetts Institute of Technology in 1964. He founded the Center for Advanced Materials Manufacture and the Center for Composite Materials at the University of Wisconsin-Milwaukee College of Engineering and Applied Science.

Dr. Rohatgi is a pioneer and world leader in research on the manufacturing of new metal matrix composites. He has characterized their physical, mechanical, and tribological properties, and conducted technology and product development that resulted in the widespread use and manufacture of these composites in the transportation sector, electromechanical machinery, and thermal management applications. Dr. Rohatgi has also been a pioneer in starting materials policy research for the developing world, including India. He has written and edited several books and articles on technology forecasting and technology advancement to examine the interactions between emerging materials technologies and societies.

Dr. Rohatgi is an AIAA Senior Member, a Fellow of the Institution of Engineers (India), the Institute of Ceramics (India), American Society of Metals (ASM International), Institute of Metals and Materials (London), American Association for Advancement of Arts and Sciences, Third World Academy of Science (Italy), American Society of Mechanical Engineers, Society of Automotive Engineers, and Society of Manufacturing Engineers. He has been recognized with the Engineer of the Year Award from Engineers and Scientists of Milwaukee.

AIAA ANNOUNCES STUDENT WINS GOLD MEDAL AT 2011 INTERNATIONAL ASTRONAUTICAL CONGRESS

AIAA is pleased to announce that **Rex Bair**, Fayetteville, AR, has won the gold medal in the undergraduate category at the 2011 International Astronautical Congress' (IAC) Student Paper Competition. Bair was one of two students sponsored by the AIAA Foundation to attend the 2011 International Astronautical Congress, represent the United States, and participate in the IAC annual Student Paper Competition. Twenty students who have won national competitions come together for the IAC Student Paper Competition and compete against each other for an international prize. There is both a graduate and an undergraduate division.

Bair was selected to represent the United States in the undergraduate division through the Abe M. Zarem Award for Distinguished Achievement. The Abe M. Zarem Award was established by AIAA Honorary Fellow Dr. Abe M. Zarem.

The Zarem Award was established to recognize master-level students that have written exceptional technical papers. The award also recognizes an undergraduate student that has participated in the AIAA Foundation Regional Student Paper Conferences and has also written an outstanding technical paper on a space-related topic. Winners receive the opportunity to present their work at an international conference and compete in an international student paper competition.

For more information on the Abe M. Zarem Award for Distinguished Achievement, please contact Stephen Brock at 703.264.7536, or stephenb@aiaa.org.

ACADEMY PROFESSOR EARNS STATE TEACHING HONORS

On 17 November, the Council for Advancement and Support of Education honored Air Force Academy instructor **Dr. Thomas Yechout** as Colorado's Professor of the Year. Dr. Yechout was recognized for writing an engaging flight mechanics textbook (*Introduction to Aircraft Flight Mechanics: Performance, Static Stability, Dynamic Stability, and Classical Feedback Control*, Yechout et al., AIAA, 2003) and for inspiring the Academy's cadets to become part of national-level aeronautics research projects such as NASA's Return to Flight effort and Orion Multi-Purpose Crew Vehicle.

Yechout consistently receives the highest ratings from cadets. He also received the Heiser Award from the Academy's Class of 2005, recognizing him as the outstanding senior faculty educator for that year. Dr. Yechout is an AIAA Associate Fellow and he and his co-authors won the 2006 Summerfield Book Award for their *Introduction to Aircraft Flight Mechanics*.

To submit articles to the *AIAA Bulletin*, contact your Section, Committee, Honors and Awards, Events, Precollege, or Student staff liaison. They will review and forward the information to the *AIAA Bulletin* Editor. See the AIAA Directory on page **B1** for contact information.

OBITUARIES

AIAA Associate Fellow Schlieben Died in October

Ernest W. Schlieben, 96, died on 2 October 2011. Mr. Schlieben received his Bachelor of Science degree at the Daniel Guggenheim School of Aeronautics, New York University, in 1935, with postgraduate training at Johns Hopkins University, Baltimore, MD.

After a tour of duty in 1935–1936 as an aviation cadet at the Naval Air Training Center, Pensacola, FL, Mr. Schlieben became active in aircraft design at the Glenn L. Martin Company in Middle River, MD. Later, he became Vice President of York Research, an aeronautical design and development firm in New York City; and Director of Engineering for the Special Devices Center of the U.S. Navy at Sands Point, Long Island, NY, designing and building training aids for the Navy, Air Force, and NATO. In later years, he held management positions at Sylvania in Waltham, MA; Perkin-Elmer in Norwalk, CT; and RCA in Hightstown, NJ, where he managed projects involving a continental ballistic missile device, scientific satellites, and related projects.

Mr. Schlieben held a number of patents for inventions including one of the earliest prototypes of a supermarket checkout counter, a self-positioning buoy for intelligence gathering (known as SKAMP), and low altitude atmospheric sensing satellites.

After retiring in 1978, Mr. Schlieben engaged in real estate development and building restoration. He was an Associate Fellow of the Institute of the Aeronautical Sciences (now the American Institute for Aeronautics and Astronautics) for over 70 years.

AIAA Associate Fellow Purvis Died in November

Carolyn Purvis, one of the world's foremost spacecraft charging experts, passed away on 1 November 2011.

Dr. Purvis had a B.S. from Cornell University, an M.S. from the University of Washington, and a Ph.D. from Case Western Reserve University. She served as the Chief of the NASA Lewis Research Center's Space Environment Effects Branch for over 15 years and worked on SDIO, the Space Shuttle, the International Space Station, Galileo, and the PIX and SPEAR spaceflight projects.

She was one of the originators of the Spacecraft Charging Technology Conference, which is now the world's premier conference in the field. Dr. Purvis was also one of the early supporters and most avid users of the U.S. defacto standard spacecraft charging code, NASCAP, the NASA AirForce Spacecraft Charging Analysis Program.

Dr. Purvis was the 1999 recipient of the AIAA Losey Award, "For a lifetime of work culminating in the elevation of Space Environment Effects to the status of a respected discipline in spacecraft design." She was also a recipient, in 1997, of the NASA Exceptional Scientific Achievement Medal for her pioneering work analyzing spacecraft charging on the amazingly successful Galileo mission to Jupiter. Dr. Purvis was a member of the American Geophysical Union, the American Physical Society, and an Associate Fellow of AIAA. Within the space scientific and engineering community, she is perhaps best known as a co-author of the 1984 document NASA-TP-2361, "Design Guidelines for Assessing and Controlling Spacecraft Charging Effects," which still serves as one of the bibles of spacecraft design.

53rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference
20th AIAA/ASME/AHS Adaptive Structures Conference
14th AIAA Non-Deterministic Approaches Conference
13th AIAA Gossamer Systems Forum
8th AIAA Multidisciplinary Design Optimization Specialist Conference

23–26 April 2012
Sheraton Waikiki
Honolulu, HI

53rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference

The 53rd Structures, Structural Dynamics, and Materials Conference (SDM) is sponsored by AIAA, ASME, ASCE, AHS, and ASC. This established annual conference is a widely acknowledged event that provides a unique forum dedicated to the latest developments in the collective disciplines of structures, structural dynamics, materials, design engineering, and survivability. Plenary presentations by recognized, forward-thinking invited speakers will be a special feature of the conference. This year's presentations will be organized around the potential applications of structures, structural dynamics, and materials in the next generation of aircraft. The 53rd Conference will also host the 20th AIAA/ASME/AHS Adaptive Structures Conference, the 14th AIAA Non-Deterministic Approaches Conference, the 13th AIAA Gossamer Systems Forum, and the 8th AIAA Multidisciplinary Design Optimization Specialist Conference.

20th AIAA/ASME/AHS Adaptive Structures Conference

Bringing together basic and applied researchers from diverse disciplines in academia, government, and industry, this is the premier conference focused on the advancement of adaptive structures technology and its application to aerospace systems.

14th AIAA Non-Deterministic Approaches Conference

The aerospace industry increasingly recognizes the need for non-deterministic approaches (NDA) to manage uncertainty. These approaches include both probabilistic and non-probabilistic methods, and provide treatment of high consequence of failure events associated with the development and operation of aerospace systems.

13th AIAA Gossamer Systems Forum

An emerging class of large-scale, lightweight structures is enabling a paradigm shift in design, launch, and operation of spaceflight systems. Spacecraft with structural characteristics optimized for operation in space and for the ability to collapse into small packages for launch yield order-of-magnitude reductions in mass, launch volume, and life-cycle cost, as compared to large spaceflight systems.

8th AIAA Multidisciplinary Design Optimization Specialist Conference (MDO)

Multidisciplinary design optimization (MDO) focuses on optimizing the performance and reducing the costs of complex systems that involve multiple interacting disciplines, such as those found in aircraft, spacecraft, automobiles, industrial manufacturing equipment, and various consumer products, as well as on the development of related methodologies. MDO is a broad area that encompasses design synthesis, sensitivity analysis, approximation concepts, optimization methods and strategies, artificial intelligence, and rule-based design—all in the context of integrated design dealing with multiple disciplines, and interacting subsystems or systems of systems.

1st AIAA Aeroelastic Prediction Workshop (AePW-1)

The 1st AIAA Aeroelastic Prediction Workshop (AePW-1) will be held in conjunction with the 53rd SDM Conference, taking place on 21–22 April 2012, the weekend just prior to the conference. The purpose of the AePW series is twofold: 1) to provide a forum for code-to-code comparisons to assess the current state of the art in computational aeroelasticity (CAe) methods and 2) to stimulate upgrades for existing codes and the development of new codes. The intent is for the workshops to proceed in a building-block manner, increasing the complexity of both the aeroelastic phenomena of interest and the model geometry as we progress in the evaluation of our computational aeroelastic tools.

The first workshop will focus on the prediction of unsteady aerodynamic pressures due to forced modal oscillations. Comparative computational studies will be performed on the three configurations that have been selected to serve as test cases: 1) the NASA Rectangular Supercritical Wing (RSW), 2) the NASA Benchmark Supercritical Wing (BSCW), and 3) the RWTH Aachen University/DFG High Reynolds Number Aero-Structural Dynamics (HIRENASD) model. The RSW and BSCW configurations are "rigid," geometrically-simple, rectangular planforms with supercritical airfoils. Testing of these configurations involved static and/or forced motion boundary conditions with attached, fully-separated, and transiently-separated flows at transonic conditions. Use of the HIRENASD configuration will extend the unsteady aerodynamic prediction to weakly coupled aeroelastic test cases involving a more complex transport-type wing geometry. Specific details of these models, the flow phenomena of interest, and the test cases selected for analysis can be found at the AePW website: **https://c3.nasa.gov/dashlink/projects/47**. Please note that there are no mandatory test cases/configurations established for participation in the workshop; everyone is welcome. Intended outcomes of this workshop are 1) to identify errors and uncertainties in current CAe methods, 2) to identify gaps in existing aeroelastic databases, and 3) to provide a roadmap for the CAe path forward. Please join us and attend the initial workshop to help kick off the Aeroelastic Prediction series of computational studies.

The workshop registration cost is $200 (early bird), $250 (standard), or $300 (on-site). The deadline for submittal of computational results is: **20 March 2012**.

Special Events

Monday, 23 April 2012

SDM Keynote (0800–0900 hrs)
"Composites Safety and Certification Initiatives"—Dr. Larry Ilcewicz, Chief Scientific and Technical Advisor for Advanced Composite Materials, Federal Aviation Administration, Renton, WA

SDM Lecture (1330–1430 hrs)
"Tailoring of Composite Structures Using Spatially Varying Fiber Orientations"—Professor Michael Hyer, N. Waldo Harrison Professor Emeritus of Engineering Science and Mechanics, Virginia Polytechnic Institute and State University, Blacksburg, VA

Welcome Reception (1800–1930 hrs)

Tuesday, 24 April 2012

MDO Keynote (0800–0900 hrs)
"Multidisciplinary Design Optimization: What Remains to Be Done"—Dr. Natalia Alexandrov, Senior Research Scientist, NASA Langley Research Center, Hampton, VA

NDA Keynote (1330–1430 hrs)
"Uncertainty Quantification in System Risk Assessment and Decision-Making"—Professor Sankaran Mahadevan, John R. Murray Sr. Chair in Engineering, Vanderbilt University, Nashville, TN

Wednesday, 25 April 2012

ASC Keynote (0800–0900 hrs)
"Adaptive Structures: The Journey to Flight"—George A. Lesieutre, Professor and Head, Aerospace Engineering, Pennsylvania State University

Awards Luncheon (1200 hrs)
Speaker: Mr. David W. Trop, Chief Engineer—Structures, Product Development and Technology, Boeing Commercial Airplanes, Seattle, WA

Join fellow attendees at the AIAA Awards Luncheon. The prestigious Walter J. and Angeline H. Crichlow Trust Prize, along with other AIAA awards, will be presented. The luncheon is included in the registration fee where indicated. Additional tickets may be purchased for $48 via the registration form found at www.aiaa.org/events/sdm or on site at the AIAA registration desk, based on availability.

A limited number of students will receive recognition for their papers at the Wednesday awards luncheon, at which the Jefferson Goblet Award, The Harry H. and Lois G. Hilton Award, The Lockheed Martin Award, and The American Society of Composites Award will be presented.

ASME Lecture (1800–1900 hrs)

Thursday, 26 April 2012

GSF Keynote (0800–0900 hrs)
"Gossamer Systems for Satellite Deorbiting: The CUBESAIL and DEORBITSAIL Space Missions"—Professor Vaios Lappas, University of Surrey, Guildford, United Kingdom

53rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference

General Chair
Steven G. Russell
Triumph Aerostructures

Technical Program Chair
Stephen B. Clay
Air Force Research Laboratory

Student Papers Technical Chair
Robert M. Taylor
Lockheed Martin Aeronautics Company

20th AIAA/ASME/AHS Adaptive Structures Conference

General Chair
Edward V. White
The Boeing Company

Technical Program Chair
David F. Voracek
NASA Dryden Flight Research Center

14th AIAA Non-Deterministic Approaches Conference

General Chair
Thiagarajan Krishnamurthy
NASA Langley Research Center

Technical Program Chair
Gianluca Iaccarino
Stanford University

13th AIAA Gossamer Systems Forum

General Chair
Professor Sergio Pellegrino
California Institute of Technology

Technical Program Chair
James D. Moore
ManTech Nexolve

8th AIAA Multidisciplinary Design Optimization Specialist Conference (MDO)

General Chair
Vladimir O. Balabanov
The Boeing Company

Technical Program Chair
Karen Willcox
Massachusetts Institute of Technology

AIAA Programs

Cyber Café Hours

Computers with complimentary Internet access will be available for conference attendees during the following hours:

Sunday, 22 April	1500–2000 hrs
Monday, 23 April	0700–2000 hrs
Tuesday, 24 April	0700–2000 hrs
Wednesday, 25 April	0700–2000 hrs
Thursday, 26 April	0700–1700 hrs

Pre-Conference Publications Sale—Save An Extra 15% Off

Conference attendees can save an extra 15% off any books* prior to the conference. Details about how to participate are posted on the conference Web site under Publications Sale, on the right-hand side of the page. (**Exclusions Apply*)

SDM 2012 Registration Information

All participants are urged to register online at **www.aiaa.org/events/sdm**. Registering in advance saves conference attendees up to $200. A check made payable to AIAA or credit card information must be included with your registration form. A PDF registration form is also available on the AIAA Web site. Print, complete, and mail or fax the form with payment to AIAA. Address information is provided.

All early-bird registration forms must be received by **26 March**, and standard registration forms will be accepted until **30 April 2012**. Preregistrants may pick up their materials at the advance registration desk at the conference. All those not registered by **21 April 2012** may do so at the AIAA on-site registration desk.

Cancellations must be in writing and received no later than **9 April 2012**. There is a $100 cancellation fee. Registrants who cancel beyond this date or fail to attend the conference will forfeit the entire fee. For questions, please contact Lynne David, AIAA conference registrar, at 703.264.7503 or lynned@aiaa.org.

Registration fees are as follows:

	Early Bird By 26 Mar	**Standard** 27 Mar–20 Apr	**On-Site** 21–26 Apr
Option 1: Full Conference with Online Proceedings			
AIAA Member	$720	$820	$920
Nonmember	$875	$975	$1075

Includes sessions Monday–Thursday, Monday evening reception, Wednesday awards luncheon, and single-user access to the online conference proceedings.

	Early Bird	**Standard**	**On-Site**
Option 2: Full-Time Undergraduate Student			
AIAA Member	$20	$30	$40
Nonmember	$50	$60	$70

Includes conference sessions only.

	Early Bird	**Standard**	**On-Site**
Option 3: Full-time Undergraduate Student Plus Networking			
AIAA Member	$153	$163	$173
Nonmember	$183	$193	$203

Includes sessions Monday–Thursday, Monday evening reception and Wednesday awards luncheon (excludes conference proceedings).

	Early Bird	**Standard**	**On-Site**
Option 4: Full-Time Graduate or Ph.D. Student			
AIAA Member	$60	$70	$80
Nonmember	$90	$100	$110

Includes conference sessions only.

	Early Bird	**Standard**	**On-Site**
Option 5: Full-Time Graduate or Ph.D. Student Plus Networking			
AIAA Member	$193	$203	$213
Nonmember	$223	$233	$243

Includes sessions Monday–Thursday, Monday evening reception, and Wednesday awards luncheon (excludes conference proceedings).

	Early Bird	**Standard**	**On-Site**
Option 6: Full-Time Retired AIAA Member			
AIAA Member	$40	$50	$60

Includes sessions Monday–Thursday, Monday evening reception, and Wednesday awards luncheon (excludes conference proceedings).

	Early Bird	**Standard**	**On-Site**
Option 7: Discounted Group Rate			
	$648 per person	$648 per person	N/A

Advance only. 10% discount off early-bird member rate for 10 or more individuals from the same organization who register and pay at the same time with a single form of payment. Includes all catered events and online proceedings. A complete typed list of registrants, along with completed individual registration forms and a single payment, must be submitted by the preregistration deadline of **20 April 2012**. No substitutions.

	Early Bird	**Standard**	**On-Site**
*Option 8: Continuing Education Fees**			
AIAA Member	$1260	$1360	$1460
Nonmember	$1338	$1438	$1538

*Includes course and course notes; full conference participation: admittance to technical and plenary sessions; receptions, luncheons, and online proceedings.

	Early Bird	**Standard**	**On-Site**
*Option 9: 1st AIAA Aeroelastic Prediction Workshop (AePW-1)***			
AIAA Member	$200	$250	$300

**Does not include conference.

Extra Tickets

Monday Evening Reception	$85
Wednesday Awards Luncheon	$48
Online Proceedings	$170

On-Site Registration Hours

Sunday, 22 April	1500–1900 hrs
Monday, 23 April	0700–1700 hrs
Tuesday, 24 April	0700–1700 hrs
Wednesday, 25 April	0700–1700 hrs
Thursday, 26 April	0700–1700 hrs

Hotel Information

AIAA has made arrangements for a block of rooms to be held at: Sheraton Waikiki Beach, 2255 Kalakaua Ave, Honolulu, HI 96815; Phone: 888.488.3535 or direct 808.921.4611. Rates are $200 plus applicable taxes for city/mountain view or $225 plus applicable taxes for ocean view, for single or double occupancy. Rooms will be held until **8 March 2012** or until the block is full. Please make your reservations early to avoid missing the discounted rate. In addition, please mention AIAA when you make your reservations to be included in this block. A direct booking URL is listed on the AIAA Web site for your convenience in booking your hotel rooms. Please visit **aiaa.org/events/sdm**.

Attention Federal Government Employees: A limited number of rooms have been blocked at the current federal per diem rate at the hotel. Please ask for the AIAA Government Block when making your reservations, as there may not be rooms available at that rate outside the AIAA block. A direct booking URL is listed on the AIAA Web site for your convenience in booking your hotel rooms. Please visit **aiaa.org/events/sdm**.

Conference Sponsorship Opportunities

When your brand is on the line, AIAA sponsorship can raise the profile of your company and put you where you need to be. Available packages offer elevated visibility, effective marketing and branding options, and direct access to prominent decision makers from the aerospace community. Contact Cecilia Capece at ceciliac@aiaa.org or 703.264.2570 for more details.

AIAA Continuing Education Courses

Let AIAA Continuing Education courses pave the way to your continuing and future success! As the premier association representing professionals in aeronautics and astronautics, AIAA has been a source for continuing the aerospace professional's education for more than seventy years. AIAA is committed to keeping aerospace professionals at their technical best. AIAA offers the best instructors and courses to meet the professional's career needs.

On 21–22 April at the Sheraton Waikiki, AIAA will be offering Continuing Education courses* in conjunction with the AIAA SDM Conferences. Please check the SDM Conference Web site for more information regarding the current list of courses.

Fundamentals of Composite Structure Design

(Instructor: Rikard Heslehurst, Senior Lecturer, School of Aerospace, Civil and Mechanical Engineering of the University College, UNSW at the Australian Defense Force Academy)

This seminar has been developed specifically for engineers who require some fundamental understanding of the structural design requirements for composites. The application of composite materials is discussed initially in terms of the constituent component material properties and manufacturing processes based on the design requirements analysis. The tailoring of structural properties through lamination and fiber orientation placement are discussed in relationship to strength of materials issues and load/deformation response. The design development of the laminate is based on design outcomes and how fiber/resin systems and ply orientation is determined to achieve these design outcomes. This seminar briefly will cover the design requirements of stress analysis for the design detail such as joints, structural stiffening against instability, and other structural discontinuities. Other aspects of the seminar to be covered include environmental and longevity aspects, certification and in-service support issues.

Introduction to Bio-Inspired Engineering

(Instructor: Chris Jenkins, Head of Mechanical & Industrial Engineering, MSU, Bozeman, MT)

The primary purpose of this course is to inform engineers and other technical professional in the use of bio-inspired engineering (BiE) to expand the design space of possible solutions to technical problems. We do that by first understanding how nature solves problems. Then, and at least as important, is learning how to translate biological knowledge into engineering practice. Even though the domain of biology is vast and new discoveries occur daily, much is known about biological solutions. Turning this knowledge into technical solutions is the challenge we face—it is also the focus of considerable attention in modern BiE, and hence this course as well.

Aeroelasticity: State-of-the-Art Practices

(Instructors: Dr. Thomas W. Strganac, Texas A&M University, College Station, TX; Dr. Carlos E. S. Cesnik, University of Michigan; Dr. Walter A. Silva, NASA Langley Research Center; Dr. Jennifer Hegg, NASA Langley Research Center; Dr. Rick Lind, University of Florida; Dr. Paul G. A. Cizmas, Texas A&M University; Dr. Gautam SenGupta, The Boeing Company; John Lassiter, NASA Marshall Space Flight Center)

In recent years, there has been a renewed interest in aeroelasticity arising from high performance aerospace systems, multiple control surface configurations, and pathologies associated with nonlinear behavior. This course provides a brief overview of aeroelasticity and examines many new "fronts" currently being pursued in aeroelasticity that include reduced-order models, integrated fluid-structural dynamic models, ground vibration testing, wind tunnel tests, robust flutter identification approaches for wind tunnel and flight test programs, aeroservoelasticity, and aeroelasticity of very flexible aircraft. The course will emphasize current practices in both analytical and experimental approaches within industry and government labs, as well as advances as pursued by these organizations with the support of university research.

Introduction to Non-Deterministic Approaches

(Instructor: Dr. Ben H. Thacker, Director, Materials Engineering Department, San Antonio, TX; Dr. Michael P. Enright, Principal Engineer, Materials Engineering Department, San Antonio, TX; Dr. Sankaran Mahadevan, Professor, Civil, Environmental and Mechanical Engineering, Vanderbilt University, Nashville, TN; Dr. Ramana V. Grandhi, Professor, Department of Mechanical and Materials Engineering, Wright State University, Dayton, OH)

This course is offered as an introduction to methods and techniques used for modeling uncertainty. Fundamentals of probability and statistics are covered briefly to lay the groundwork, followed by overviews of each of the major branches of uncertainty assessment used to support component and system level life cycle activities, including design, analysis, optimization, fabrication, testing, maintenance, qualification, and certification. Branches of Non-Deterministic Approaches (NDA) to be covered include Fast Probability Methods (e.g., FORM, SORM, Advanced Mean Value, etc.), simulation methods such as Monte Carlo and Importance Sampling, surrogate methods such as Response Surface, as well as more advanced topics such as system reliability, time-dependent reliability, probabilistic finite element analysis, and reliability-based design. An overview of emerging non-probabilistic methods for performing uncertainty analysis will also be presented.

**Courses are subject to change*

Program-at-a-Glance

Aeroelastic and Aerodynamic Optimization
Aeroelastic Testing
Aeroelasticity and Flutter
Aeroelasticity I
Aeroelasticity II
Aerospace Materials Applications
Aerospace System Applications I
Aerospace System Applications II
Aerostructural and Aeroelastic Optimization
Aerothermal Dynamics
Air and Space Survivability
Air Vehicle Structural Dynamics I
Air Vehicle Structural Dynamics II
Aircraft Design
Aircraft Optimization
Aircraft/Engine Optimization
Analysis and Design
ASC Keynote
ASME Keynote
Award Lunceon

Beam Analysis
Beam Dynamics I
Beam Dynamics II
Buckling
Buckling of Composites

Characterization of Composite Materials
Composite Damage and Delamination
Composite Processes and Characterization
Composite Structures Applications
Composites Modeling
Composites Structures
Computational Aeroelasticity I
Computational Aeroelasticity II
Controls
Damping and Vibration Supression
Deployable Apertures – Optics
Deployable Apertures – RF
Deployable Structures
Design
Design and Optimization Under Uncertainty
Design Engineering
Design Process
Design, Advanced Aircraft
Design, Composite Structures
Design, Micro/Unmanned Aircraft
Developing the Next Generation of Shell Buckling Design Factors and Technologies Part I - Testing
Developing the Next Generation of Shell Buckling Design Factors and Technologies Part II - Analysis and Design Technology
Development of Non-Deterministic Methods I
Development of Non-Deterministic Methods II
Dynamics of Composites
Dynamics of Fuel Slosh and Tanks
Dynamics of Micro-Aircraft

Engineering Applications of Non-Deterministic Approaches I
Engineering Applications of Non-Deterministic Approaches II
Experimental Dynamics Techniques

Failure Analysis and Prediction I
Failure Analysis and Prediction II
Failure Analysis and Realability Assessment
Fatigue and Creep in Materials
Fatigue and Fracture Mechanics I
Fatigue and Fracture Mechanics II
Fatigue and Fracture Mechanics III
Fatigue and Fracture of Composites
Flutter I
Flutter II

GSF Keynote

Health Monitoring
Hybrid Materials for Hypersonic Vehicles (MURI)

Impact Damage
Impact Dynamics
Inflatable Structures
Integrated Computational Materials Engineering (ICME) I
Integrated Computational Materials Engineering (ICME) II
Integrated Computational Materials Engineering (ICME) III

Materials and Testing
Materials Model Development and Applications
Mesh Dependence of Failure Predictions
Micro Air Vehicle Aeroelastics
Modeling
Modeling and Simulation
Multi-Objective and Multi-Level Optimization Methods
Multidisciplinary Design Optimization: What Remains to be Done
Multifunctional Materials
Multiscale Modeling of Damage in Composites

Nanostructured Materials I
Nanostructured Materials II
Nanostructured Materials III
Nanostructured Materials IV
NDA Keynote
Non-Deterministic Approaches Applied to Wind Energy
Non-Deterministic Approaches for Aerospace Systems I
Non-Deterministic Approaches for Aerospace Systems II
Non-Deterministic Approaches to Structural Health Management I
Non-Deterministic Approaches to Structural Health Management II
Non-Deterministic Design and Optimization
Nonlinear Dynamics
Nonlinear Dynamics and Aeroelasticity I
Nonlinear Dynamics and Aeroelasticity II
Novel Applications and Innovations

Opening Keynote
Optimization Applications I
Optimization Applications II

Optimization Frameworks
Optimization Methods
Optimization of Composites

Plate and Shell Dynamics
Plates and Panels
Pre-Decision/Session Withdrawals

Rotorcraft Applications
RotorCraft Dynamics

Sandwich Structures
SDM Lecture
Semi-Span Supersonic Transport
Shells and Pressure Vessels
Solar Sails
Space Structures Dynamics
Special Session I in Honor of Professor Michael W. Hyer
Special Session II in Honor of Professor Michael W. Hyer
Special Session: MDO Past, Present, Future
Structural and Thermal Interactions of Aerospace Systems
Structural Joints

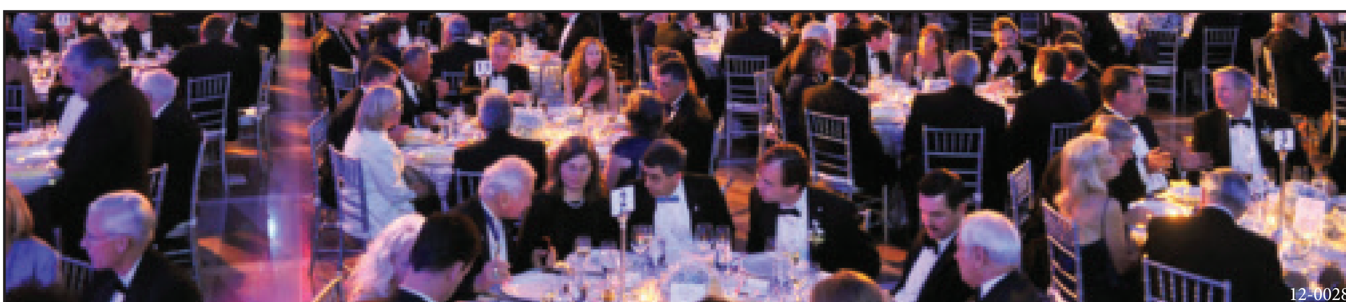
Structural Optimization
STS-133/ET-137 Intertank Stringer Cracks
Surrogate-based and Multi-fidelity Optimization Methods
Systems and System Designs

Test and Analysis
The Digital Twin Concept
Topology Optimization
Turbine Blade Dynamics

Uncertainty Quantification in Verification and Validation I
Uncertainty Quantification in Verification and Validation II

VibroAcoustics

Wind Turbine Aeroelasticity
Wind Turbine Blade Design, Analysis, and Optimization
Wind Turbine Composite Material Analysis
Wind Turbine Composite Material Testing
Wind Turbine Dynamics, Loads, and Control
Wind Turbine Structural Dynamics
Wrinkling and Non-Linear Effects



AIAA Foundation Associate Fellows Dinner

184 Institute members have recently been elected to the grade of Associate Fellow. These new Associate Fellows will be formally inducted at the Associate Fellows Dinner, to be held Monday, 9 January 2012, in Nashville, TN. Each year, the Institute recognizes exemplary professionals for their accomplishments in engineering or scientific work, outstanding merit, and contributions to the art, science, or technology of aeronautics or astronautics.

Please support your colleagues, and join us for the induction of the 2012 Associate Fellows. Tickets to this celebrated event are available on a first-come, first-served basis, and can be purchased for $92 via the 50th AIAA Aerospace Sciences Meeting registration form, or on site based on availability. Business attire is requested.

AIAA
The World's Forum for Aerospace Leadership

51st AIAA Aerospace Sciences Meeting Including the New Horizons Forum and Aerospace Exposition
Advancing the Science of Flight Technology

7–10 January 2013
Gaylord Texan Resort and Convention Center
Dallas/Ft. Worth, TX

Abstract Deadline: 5 June 2013

Executive Chair
Ray O. Johnson
Chief Technology Officer
Lockheed Martin Corporation

Aerospace Sciences Meeting Chair
Rob Vermeland
Manager—Aerodynamics and Acoustics
Lockheed Martin Aeronautics Company

New Horizons Forum General Chair
Lt. General John T. (Tom) Sheridan, USAF (Ret.)

AIAA Aerospace Sciences Meeting

The AIAA Aerospace Sciences Meeting is the first major multidisciplinary event of the year for aerospace scientists and engineers from around the world. It provides an ideal forum for scientists and engineers from industry, government, and academia to share and disseminate scientific knowledge and research results with a view toward new technologies for aerospace systems.

This meeting is built around excellent technical paper presentation sessions. Plenary sessions that focus attention on program areas of current interest will start some sessions, followed by technical papers providing additional discussion of these topics. Distinguished lectures and evening networking events fill out the remainder of the program throughout the week.

New Horizons Forum

The New Horizons Forum, held in conjunction with the Aerospace Sciences Meeting, will feature keynote speakers from industry and government who will share their perspectives on the new challenges, future opportunities, and emerging trends in aerospace education, research, and programs. The New Horizons Forum will also feature panel discussions in which leaders from industry, government, and academia will address current issues and trends in aerospace technology research and development.

Aerospace Exposition

The Aerospace Exposition will showcase exhibits from government, industry, and small businesses, allowing one-on-one discussions with exhibitors, hardware and software demonstrations, and opportunities for side meetings with these organizations throughout the week.

Abstract Submittal Guidelines

Abstract submissions will be accepted electronically through the AIAA website at **www.aiaa.org/events/asm**. The website will open for abstract submission on **1 February 2012**. The electronic submission process is as follows:

The electronic submission process is as follows:

1) Access the AIAA Website at **www.aiaa.org/events/asm**.
2) On the right-hand side click the ‘Submit Paper’ button.
3) To access the submission site, you must be logged in to the AIAA Web site.

a. If you already have an account with AIAA, enter your User Name and Password in the “Login” box on the left-hand side and hit the arrow button.

b. If you do not have an account with AIAA, complete the steps for “Create Account”.

4) Once logged in, you will be provided an active link for “Begin a New Submission or View a Previous Draft/Submission”. Click the link to be directed to the Welcome page of the submission site.
5) Click the Submission tab at the top of the page to begin your submission.
6) Once selected, you will be provided with general information on the conference’s abstract submission requirements and policies. To begin the submission, click the “Create a New Submission” link on the left-hand side. ***Note***: If you have previously visited the site and begun a draft submission, click the “View Submissions” link on the left-hand side to resume your submission.

STEP 1: Type or paste the title of your abstract into the Title field and the presenting author’s biography (if requested by the conference) into the Presenter Biography field. Upload your abstract/draft manuscript file. Accepted file types are .pdf (preferred), .doc, and .docx. Scroll down to read through the Rules and Reminders section and check the box noting you agree. Click “Save & Continue” to proceed to the next step.

STEP 2: Select your Presentation Type and the Topic Area of your abstract.

STEP 3: In this system, affiliations are added before author information. The information will be filled in for the person logged in to the site. Add additional author affiliations, if necessary, by clicking the “Add” button after each new affiliation. Click “Save & Continue” to proceed to the next step.

STEP 4: To create a list of co-authors for this submission, click the “Add Author” button. Search for your co-authors with the boxes provided and click the “Add” button next to the correct person. If no record is found for your co-author, you may add that person by clicking the link at the bottom of the page. Click “Save” after entering each one and then associate each author with their respective affiliation by entering the appropriate reference number from the drop down boxes to the right of each name. When you have finished entering all authors ***YOU MUST*** put them in the order they should appear on the abstract and program. Use the drop-down boxes in the far left column of the list to do this. Failure to properly order the authors will result in them being incorrectly listed when the submission is published. After you have reordered the authors, click the “Save” button at the bottom of the list. Click “Save & Continue” to proceed to the next step. *The author designated as the presenter will be the only person given access to upload the final manuscript for accepted submissions.*

STEP 5: Select at least one key word that best represents your work. While only one selection is required, you may list up to six for your submission. Click “Save & Continue” to proceed to the next step.

STEP 6: If you have no errors or omissions in your abstract a “Submit” button will appear at the end of the proof. If the Error Box appears you must correct all errors before the abstract can be submitted. Once the errors have been resolved the “Submit” button will appear at the bottom. If you exit the system without submitting the abstract, it will be logged in the system as a draft and will appear in the “Draft” section of your “View Submissions” page when you reenter the system. After you submit the abstract, you will receive a confirmation email.

Special Notes

1) If authors wish to revise an abstract that has already been submitted, they must go to "View Submissions" and select "Return to Draft" to make any corrections. This removes the abstract from the organizers' view. Authors then need to submit the abstract again for it to be considered. An abstract cannot be returned to draft if it has been reviewed.

2) Once the abstract submission deadline passes, authors will no longer be able to submit new submissions or return previous submissions to draft for revisions. Be sure that all of your submission data—authors, keywords, title, and abstract file—are accurate before finalizing your submission as no modifications can be made to this data after the submission site closes.

Authors having trouble submitting abstracts electronically should contact ScholarOne Technical Support at **ts.acsupport@thomson.com**, or at 434.964.4100 or (toll-free, U.S. only) 888.503.1050. Questions about the manual abstract submission or full draft manuscript themselves should be referred to the appropriate Technical Chair.

The deadline for receipt of abstracts via electronic submission is **5 June 2012, 2359 hrs Eastern Daylight Time, USA**.

Abstracts should have a total length of 5–10 pages including figures and tables. Draft papers are encouraged. The extended abstract or draft paper should clearly describe the purpose and scope of the work to be included in the final manuscript, methods used, key results, and contributions to the state of the art. The submittal should include illustrations and data that support the results and contributions asserted.

Both abstracts and final manuscripts must adequately address the accuracy of results. Abstracts will be reviewed and selected based on technical content, originality, importance to the field, clarity of presentation, accuracy validation, and the potential to result in a quality final manuscript. Note that all abstracts are chosen by a competitive process based on anonymous peer review using these criteria. The review and acceptance process will be weighted in favor of authors submitting more relevant documentation of their proposed papers. The length of the final manuscript should be appropriate for a conference paper, not a major project, final report, or final thesis.

The abstract should not be submitted to more than one technical topic. If an author is unsure which topic is most appropriate, it is the author's responsibility to communicate with the technical topic organizers in question well before the abstract deadline to determine the topic area under which the abstract best fits. There will be too little time in the review process for an abstract rejected by one topic to be considered for review under another. Questions pertaining to the abstract or technical topics should be referred to the corresponding technical topic chair.

Authors will be notified of paper acceptance or rejection on or about **22 August 2012**. Instructions for preparation of final manuscripts will be provided by AIAA for accepted papers only.

There will be "No Paper, No Podium" and "No Podium, No Paper" policies in effect. If a written paper is not submitted by the final manuscript deadline, authors will not be permitted to present the paper at the conference. It is the responsibility of those authors whose papers or presentations are accepted to ensure that a representative attends the conference to present. If a paper is not presented at the conference, it will be withdrawn from the conference proceedings. These policies are intended to eliminate no-shows and to improve the quality of the conference for attendees.

Publication Policy

AIAA will not consider for presentation or publication any paper that has been or will be presented or published elsewhere. Authors will be required to sign a statement to this effect.

Final Manuscript Guidelines

An Author's Kit containing detailed instructions and guidelines for submitting papers will be made available to authors of accepted papers. Authors must submit their final manuscripts via the conference website no later than **20 December 2012**.

Warning—Technology Transfer Considerations

Prospective authors are reminded that technology transfer guidelines have considerably extended the time required for review of abstracts and completed papers by U.S. government agencies. Internal (company) plus external (government) reviews can consume 16 weeks or more. Government review, if required, is the responsibility of the author. Authors should determine the extent of approval necessary early in the paper preparation process to preclude paper withdrawals and late submissions. The conference technical committee will assume that all abstracts, papers, and presentations are appropriately cleared.

International Traffic in Arms Regulations (ITAR)

AIAA speakers and attendees are reminded that some topics discussed in the conference could be controlled by the International Traffic in Arms Regulations (ITAR). U.S. nationals (U.S. citizens and permanent residents) are responsible for ensuring that technical data they present in open sessions to non-U.S. nationals in attendance or in conference proceedings are not export restricted by the ITAR. U.S. nationals are likewise responsible for ensuring that they do not discuss ITAR export-restricted information with non-U.S. nationals in attendance.

Call for Papers Procedure

The contributed papers for this meeting are chosen by a competitive selection process based on peer review. In addition, invited papers of the highest quality review major trends and accomplishments within or across various aerospace disciplines. To facilitate simultaneous sessions, papers will begin on the hour and half-hour. Six to eight 30-minute paper presentations per session are planned (20 minutes for presentation and 10 minutes for audience questions and discussion), but session organizers are encouraged to include one-hour survey papers where appropriate.

Listed in this call for papers are the AIAA Technical Committees sponsoring this meeting, the areas in which papers are being solicited, and the names and addresses of the topic organizers to whom questions should be addressed. Every effort will be made to provide uniformly rigorous evaluations and acceptance rates for all sessions.

General inquiries concerning the program, conference format, or policies, and suggestions for special high-interest sessions or presentations should be directed to:

Aerospace Sciences Meeting Chair
Rob Vermeland
Manager—Aerodynamics and Acoustics
Advanced Development Programs
Lockheed Martin Aeronautics Company
1011 Lockheed Way
Palmdale, CA 93599-1104
661.572.3776
Email: rob.vermeland@lmco.com

Aeroacoustics

Papers are solicited that address computational, experimental, and analytical results and techniques in all areas related to aeroacoustics and structural acoustics. Specific areas of interest include, but are not limited to:

- Jet noise (subsonic and supersonic, flight effects)
- Shock-associated noise

- Jet noise suppression
- Cavity tones and their suppression
- Computational aeroacoustics
- Turbomachinery noise; core noise
- Combustion noise
- Propeller noise
- Fan noise
- Open rotor noise
- Rotorcraft noise
- Airframe noise
- Sound-structure coupling, sonic fatigue
- Duct acoustics
- Atmospheric sound propagation/sonic boom
- Statistical energy analysis methods
- Modal analysis and synthesis
- Community noise and metrics
- Interior noise
- Active noise control
- Vibration control techniques

Please direct questions to:

Naval Agarwal
The Boeing Company
425.965.7920
Email: naval.k.agarwal@boeing.com

Aerodynamic Measurement Technology

Papers are solicited on topics related to advanced and novel aerodynamic measurement techniques for ground-test or flight-test applications. Submissions are encouraged for all types of flows, including all speeds from incompressible to hypersonic, all thermodynamic conditions including plasmas and combustion, all scales from microfluidics to geophysical flows, and all diagnostic techniques from surface sensors to laser-based imaging. Topics of interest include, but are not limited to:

- Flow velocimetry
- Spectroscopic methods including laser-induced fluorescence, absorption, Rayleigh, and Raman techniques
- Planar and volume flow visualization and temporally-resolved imaging
- Surface measurements including boundary-layer transition, skin friction, heat transfer, and surface temperature and pressure (including temperature- and pressure-sensitive paint techniques)
- Techniques for microfluidics
- Sensors based upon microelectromechanical systems (MEMS) and sensor miniaturization
- Techniques for acquiring multiple properties, property correlations, or space-time derivatives
- Aeroacoustic diagnostics including microphone arrays or pressure/density measurements
- Measurement of species concentration or thermodynamic state
- Aerodynamic data acquisition, processing, and display
- Diagnostics for harsh environments such as gas turbine engines, fires, cryogenic, high-G, or in-flight applications
- Application to production-scale testing
- Uncertainty quantification and error analysis of advanced diagnostics
- Novel calibration and data processing methodologies

To be included in an Aerodynamic Measurement Technology session, papers should emphasize advancements or innovations in the measurement technique itself or its implementation, rather than the particular fluid dynamic problem to which the technique is applied.

Please direct questions to:

Brian S. Thurow
Auburn University
334.844.6827
Email: thurow@auburn.edu

Air Breathing Propulsion Systems Integration

Papers are sought that discuss the science and technology of propulsion innovations including air-vehicle propulsion optimization, power systems, and propulsion system/subsystem integration. Of high interest this year are papers concerning:

- Hypersonic engine-vehicle integration and combined-cycle engines
- Supersonic inlet aerodynamics, flow control, and integration
- Inlet-fan integration for fixed-wing and V/STOL aircraft
- Fuel efficient propulsion: open rotors/unducted fans, geared turbofans, and variable cycle engines
- Military and civilian aircraft power/thermal systems integration:
  – More electric/hybrid electric aircraft vehicle systems, including power generation, distribution and management, thermal management, etc.
  – Advanced aircraft thermal management system design for high energy intensity military applications—combat, Directed Energy Weapons, hypersonic, morphing aircraft
  – System-level modeling and simulation
  – Platform-level systems integration
  – Aircraft energy optimization of integrated propulsion/power/thermal management/mission systems

Other topics of interest for these sessions include, but are not limited to:

- Alternative fuel cycle and subsystem design and integration
- Sonic boom-mitigating inlets and nozzles for supersonic aircraft
- Propulsion systems engineering: propulsion architecture definition; requirements, schedule, cost, and risk; total system performance responsibility
- Installed performance and controls: steady-state, dynamic, MDO, and real-time models; integrated flight/propulsion control; hardware/software integration
- Propulsion aerodynamics (experimental, computational, and flight test): inlet/nozzle analysis, integration, installed performance; engine/inlet compatibility; inlet and nozzle flow control; thrust vectoring; secondary air systems and bay ventilation; throttle-dependent drag and jet effects
- Engine physical integration: performance-based specification development, interface control, and associate contractor/supplier management
- Propulsion operations: reliability and maintainability; field support; removal and installation; overhaul and maintenance; prognostics and health maintenance
- Flight certification: validation and verification; FAA compliance/regulations
- Environmental factors: corrosion, icing, noise, bird strike, safety zone, etc.
- Full range of systems: V/STOL, UAV, transport, fighter, missile, lighter-than-air, propeller-driven, and non-turbine (reciprocating/rotating) systems

Please direct questions to:

Dyna Benchergui
Bombardier Aerospace
514.855.5001
Email: Dyna.Benchergui@aero.bombardier.com

Calls for Papers

Aircraft Design

Papers are sought on all aspects of aircraft design, including, for example, configuration design, aerodynamic design, and systems design. Topics such as design methodologies and processes, design integration, technology developments, innovative designs, and case studies are all welcome. Review papers on recent developments and trends in aircraft design are also sought. Design considerations such as electric powered flight, environmental issues, energy optimization, noise reduction, electric aircraft systems, biomimetics, etc., are also important topics of interest. Applications to aircraft of all types are welcome including fixed and rotary wing, subsonic through hypersonic, micro air vehicles to jumbo jets, and manned or unmanned aircraft. Papers on design education are also solicited. Example categories of interest include:

- Design processes and tools
- Design optimization for reduced cost/weight
- Design for reduced environmental impact (e.g., noise, emissions, fuel consumption)
- Innovative aircraft design and design case studies
- Micro air vehicle and unmanned aircraft design
- Aircraft design education

Please direct questions to:

Gil Crouse Jr.
Auburn University
334.844.6843
Email: crousgl@auburn.edu

Applied Aerodynamics

Papers are solicited that advance the field of Applied Aerodynamics in the areas of aerodynamic design, vehicle aerodynamics, and aerodynamic phenomena. Topics that span the flight regime from subsonic to hypersonic speeds are solicited. These topics may include, but are not limited to:

- Applied CFD with correlation to experimental data
- Innovative aerodynamic concepts and designs
- Unmanned aerial vehicle designs/tests
- Missile/projectile/guided-munition aerodynamics
- Drag estimation and reduction methodologies
- Propeller design, test, and optimization
- Rotorcraft aerodynamics
- Wind turbine aerodynamics
- Aerodynamic design methodologies
- Optimization methods in applied aerodynamics
- Weapons carriage and store separation
- Ground-to-flight scaling methodology and wind tunnel correlations
- Icing or roughness effects on vehicle aerodynamics
- Bio-inspired aerodynamics
- Low-speed, low-Reynolds number aerodynamics
- Active flow control
- Unsteady aerodynamics
- Vortical/vortex flow
- High angle-of-attack and high lift aerodynamics
- Aerodynamic-structural dynamics interaction
- VSTOL/STOL aerodynamics
- Aerodynamic design and enabling technologies for environmentally friendly and efficient aircraft
- Other topics in applied aerodynamics

Authors should indicate under which of the above topics they prefer their paper to be included and are highly encouraged to include experimental comparisons when applicable and possible.

Please direct questions to:

Lamar M. Auman
U.S. Army AMRDEC
256.876.5201 (DSN: 746) • 256.955.9411 (DSN: 645) FAX
Email: lamar.auman@us.army.mil

Atmospheric and Space Environments

Papers are sought that provide the aerospace community (ground operations, aviation, rockets, launch vehicles, and spacecraft) with scientific and technical information concerning interactions between aerospace systems and the atmospheric/space/planetary environment. In addition, papers are solicited that provide new or refined information improving the basic understanding of the atmosphere or of space, or of their applications to aviation and aerospace vehicle design and operations issues. Atmospheric and Space Environments (ASE) includes the areas of:

- Atmospheric environment
- Impacts of aerospace on the environment
- Aircraft wake vortex science, applications, and technology
- Aviation weather and atmospheric dynamics
- Meteorological applications to aerospace operations
- Satellite and ground-based measurement systems
- Environment standards
- Space environments
- On-orbit spacecraft-environment interactions
- Laboratory simulation of the space environment
- Spacecraft charging
- Space weather
- Meteoroid and debris environment

Potential ASE contributors are reminded that these and additional topic areas such as aircraft icing will also be represented at the 5th Atmospheric and Space Environments Conference, planned for June 2013.

Please direct questions to:

Nelson Green
Jet Propulsion Laboratory
818.393.6323 • 818.393.0351 FAX
Email: Nelson.W.Green@jpl.nasa.gov

Atmospheric Flight Mechanics

Papers are solicited that present new theoretical, computational, or experimental results in atmospheric flight mechanics. Topics of interest include recent simulation and flight test evaluation of a variety of vehicle configurations, including X-vehicles, unmanned aerial vehicles, and missiles. Papers covering advanced technologies to meet challenging atmospheric flight problems during ascent/abort and reentry flight phases of launch vehicles are welcome also. Interesting and novel flight mechanics problems or lessons learned during the development and testing of these vehicles would be of particular interest as well. Specific areas of relevancy include, but are not limited to, the following.

Aerodynamic Prediction Methods: This technology area covers the prediction of aerodynamic forces and moments acting on all types of atmospheric flight vehicles. Of particular interest is the integration of a variety of methods such as computational aerodynamics, advanced dynamic testing techniques, and unique flow-field measurement methods into unified approaches for the prediction of aerodynamic loads. Also of interest is flight simulation in subsonic, transonic, supersonic, and hypersonic flight environments, at steady and unsteady conditions, and at low and high angles of attack.

Aircraft Flight Dynamics, Handling Qualities, and Performance: This topic area includes aircraft stability, control response, handling qualities, and response to atmospheric disturbances. Subtopics of interest include determination of stability and control derivatives, manned and unmanned vehicle handling qualities, high-angle-of-attack control, nonlinear modeling, rotorcraft handling qualities with and without slung loads, trajectory optimization, effects of icing and turbulence on flight dynamics and control, aeroelastic and aeroservoelastic dynamics, flow-field effects, departure prevention, and spin characteristics.

Launch Vehicle, Missile, and Projectile Flight Dynamics: This area pertains to the application of analytical or experimental methods for the analysis and prediction of the flight dynamics of expendable and reusable launch vehicles, missiles, and projectiles. The advanced technology areas include performance, stability, and control; adaptive guidance, control reallocation, and re-configurable flight control methods during ascent/abort and reentry phases of the mission to improve safety and operability of second-generation reusable launch vehicles. Topics of interest include high-angle-of-attack aerodynamics, determination of dynamic stability derivatives, component and store-to-store interference effects, projectile launch and flight dynamics, incorporation of predictions into trajectory simulations, trajectory flight dynamics affecting the impact accuracy of missiles and projectiles, and analysis of flight test data.

Small/Mini/Micro Aerial Vehicles: Currently there is great interest in very small flight vehicles for a variety of purposes. Such small vehicles pose many new challenges for the design engineer. Low flight speeds, hovering flight, light-weight-low-inertia vehicles, and unconventional designs all present challenges for development. Papers are requested, therefore, relating to the unique flight mechanics and handling qualities of small/mini/micro aerial vehicles. Topics include low-Reynolds number aerodynamic prediction methods, flight mechanics for low-inertia vehicles, effects of flexible vehicle structures, very low speed flight mechanics, and transition between forward and hovering flight. Additionally, topics relating to the flight mechanics of unconventional small/mini/ micro flight vehicles (e.g., ornithopters, flapping wing vehicles, rotorcraft, etc.) are welcome.

Planetary Entry and Aeroassist Technology: Papers are requested relating to the entry dynamics into the Earth's atmosphere as well as the atmosphere of other celestial bodies. Topics include hypersonic flight performance, optimization of reentry vehicle configurations, trajectory optimization, and trans-atmospheric vehicles. Papers are also requested in the area of aerogravity assist orbit transfer dynamics. Topics include planetary aero-braking and aerocapture, low-density atmospheric flight mechanics, and atmospheric maneuvering to effect orbital transfer. Papers in other areas related to very high speed reentry atmospheric flight mechanics are also welcome.

Please direct questions to:

Atilla Dogan
University of Texas at Arlington
817.272.3744 • 817.272.5010 FAX
Email: dogan@uta.edu

Design Engineering

Papers are solicited on current design engineering and design process activities. Design-oriented papers should focus on innovative, novel, or otherwise distinctive designs or concepts resulting in or leading toward products that effectively satisfy requirements or demonstrate design efficiency improvements. Emphasis on current aerospace programs such as commercial access to space, very light business jets, NASA Environmentally Responsible Aviation, ESTOL, satellites, missile systems, Unmanned Air Systems, and service life extension projects are encouraged. The definition, application, and implementation of emerging design tools that have resulted in significant design-cycle time reduction from tool integration, and the use of experiments, simulation, or rapid synthesis and analysis tools that have resulted in the ability to analyze a large number of design configurations resulting in or leading toward reduced program cost and risk should be emphasized.

Process-oriented papers should focus on current design engineering process activities, such as process definition, analysis, architecture, and metrics, as applied to aerospace hardware products from the exploratory design phase through the detailed design phase. Papers on the advances in model-based design processes and related activities are especially encouraged. Other design engineering process-related activities that may be addressed are the interaction between processes and tools, impact of tool integration on a process, and risk reduction from the use of higher-fidelity tools earlier in the design process. Other enablers to reducing design cycle time and cost while increasing the ability to meet all cost, schedule, and technical requirements may also be addressed.

Education-oriented papers are solicited that emphasize design in curriculum development, class content and student activities. Examples showing how to teach design are especially requested.

Please direct questions to:

E. Russ Althof
Raytheon Missile Systems
520.663.7753
Email: eralthof@raytheon.com

Education

Aerospace engineering is both the most specialized and the most diversified of fields, thus challenging the aerospace community to educate engineering students effectively to meet a dynamic environment. As the complexity of our field continues to increase, the multidisciplinary aspects of the aerospace curriculum must be strengthened while maintaining or improving the more traditional fundamentals of engineering science. For this year's meeting, papers are especially encouraged that address these issues, including but not limited to:

- New, more effective pedagogies for improving understanding of the fundamentals of engineering science and subdisciplines such as aerodynamics and propulsion
- Curricular development addressing the multidisciplinary nature of aerospace system analysis and design
- Novel teaching approaches that incorporate nontraditional methods
- Best practices for ABET assessment
- Broader innovative collaboration of industry and academia in engineering education

Topics for papers and/or open forums:

- Innovations on the horizon—new directions in research and development by industry and educational institutions
- Translating the effects of globalization and green engineering practices from industry to the classroom
- Better preparing graduates for a rapidly evolving work environment

Please direct questions to:

Dolores S. Krausche
Florida Center for Engineering Education
352.378.1304
Email: dsk@atlantic.net

Calls for Papers

Energetic Components and Systems

The science of energetic materials is critical to the aerospace community. Energetic components, both explosive and pyrotechnic, provide critical performance attributes to aeronautical and astronautical missions. The successful engineering and application of the controlled use of energetic materials in these components is a result of fundamental understanding of scientific phenomena that govern the performance of these materials. Papers relating to the science of energetic materials and devices are sought for sessions at ASM 2013. Paper topics are solicited in the following, non-inclusive list of areas:

- Energetic materials synthesis/characterization
- Energetic materials compatibility/aging/surveillance
- Analytical method development for analysis of energetic materials
- Testing and diagnostics of energetic materials events
- Numerical simulation of energetic materials/components
- Nano-scale phenomena of energetic material performance
- Environmental initiatives relating to energetic materials and components
- Practical applications and novel uses of energetic materials

Please direct questions to:

Keith A. Gonthier
Louisiana State University
225.578.5915 • 225.578.5924 FAX
Email: gonthier@me.lsu.edu

Fluid Dynamics

Papers are solicited in the areas of experimental, theoretical, and computational fluid dynamics relevant to aerospace applications, including basic research and development, applied research, and advanced technology development. Papers that present new insights into flow physics, introduce innovative applications, address emerging technical areas, or combine experimental, computational, and/or theoretical approaches are strongly encouraged. Authors who have recognized expertise in a particular area and are interested in writing a comprehensive review are encouraged to contact the track chair. Potential subject areas include, but are not limited to:

- CFD Methods
  – Structured CFD algorithm development, methodology, and validation
  – Higher-order unstructured CFD algorithm development, methodology, and validation
- CFD Modeling and Applications
  – Case studies, modeling, optimization, and uncertainty quantification
  – Combined experimental-computational studies, including uncertainty quantification
- Flow Control
  – Active approaches
  – Passive approaches
  – Closed-loop flow control and flow control actuators
- Fundamental Fluid Flows
  – Hypersonic and chemically-reacting flows
  – Turbomachinery, combustion and internal flows
  – Cross-disciplinary fluid dynamics involving aero-optics, fluid/structure interactions, micro- and nano-fluidics, multi-material flows, and multiphase flows
  – High-speed turbulent flows
- Boundary-Layer Transition
  – Low- and high-speed flows
  – Roughness effects
  – Control methods

In addition, sessions are planned in other areas of fluid dynamics, including the following areas of interest:

- Turbulence: including free-shear, wall-bounded, and high-speed flows
- Shock-dominated flows: including shock boundary-layer interactions
- Low Reynolds-number flows: including biologically-inspired flight
- Wing Aerodynamics: including deformable wings and flapping wings

Authors should indicate under which of the above topics they prefer their paper to be included.

Please direct questions to:

Gary Dale
Wright-Patterson Air Force Base
937.255.1113
Email: gary.dale@wpafb.af.mil

Matthew Borg
Wright-Patterson Air Force Base
937.255.3401
Email: matthew.borg@wpafb.af.mil

Gas Turbine Engines

Papers are solicited in the disciplines of thermodynamics, aerodynamics, aeroelasticity, mechanical design and fabrication, combustion, heat transfer, icing, and controls as related to the science, research, technology development, and testing of gas turbine engines and related components for air vehicles in the subsonic and transonic flight regimes. Topics areas include, but are not limited to:

- Experimental and computational efforts related to inlets, fans, compressors, combustors, turbines, augmentors, transmissions, bearings, seals, and nozzles
- Techniques for the advancement of engine component technologies, including design and manufacturing methods, materials, testing, diagnostics, and instrumentation
- Improved analytical/computational methodologies for fluid, thermal, and structural analysis of engine components
- Analytical and computational models for engine-level analysis/simulation
- Advances in turbine engine systems and components
- Advanced engine cycles and game-changing component technologies

- Engine preliminary and detailed design methodologies
- Variable cycle engines
- Combustion technologies in emissions, operability and reliability
- Turbomachinery technologies in noise, efficiency, cooling, and durability
- Engine icing
- Electric power generation
- Comparisons of engine flight test with ground test data and simulation results
- Auxiliary systems and structures, and their interaction with the primary engine system
- Open rotor
- "Green"/environmentally friendly aviation
- Engine inlet compatibility
- Geared turbofan engines
- Distributed propulsion
- Alternate fuel manufacturing and testing

Please direct questions to:

Won-Wook Kim
GE Energy
864.254.2408
Email: wonwook.kim@ge.com

Ground Testing

Ground Testing papers are solicited on unclassified topics related to all aspects of aerodynamics, propulsion, and space systems ground testing and related facilities. Topics of interest include, but are not limited to:

- Test simulations for all aerodynamic flow regimes, propulsion (including propellant conditioning), and space environments
- Design, development, and performance of new, modified, or unique ground test facilities, subsystems, and components thereof
- Advances in test techniques, experimental uncertainty, and integration of computation with experiment, for reduced risk in predicted flight characteristics
- Emerging requirements for aerospace ground testing that exceed current capabilities
- Issues focused on computational fluid dynamic comparisons with wind tunnel and flight test data, including code development, validation, and verification
- Integration and use of computing equipment for real-time test control, data acquisition, processing, validation, and presentation
- Development, application, and validation of flow diagnostics in ground testing facilities, with special emphasis on pressure sensitive paints, temperature sensitive paints, video model deformation, infrared imaging, and optical diagnostics
- All aspects of increasing "knowledge per test," including new test techniques, instrumentation, automation, design of experiments, and experimental uncertainty
- Unique or innovative uses of existing facilities
- Improvements in the quality of wind tunnel testing and reduction of the cost and cycle times for these tests, with emphasis on test article design, fabrication, and usage, testing productivity, and test program management
- Ground and flight test integration
- Expert systems, artificial intelligence, and neural networks related to ground test issues
- Knowledge capture for ground test related facilities, systems, and techniques
- Development of educational and continuing education/career path opportunities in experimental testing for new students, technicians, and engineers

In addition, timely surveys and reviews of these topics are sought. The Ground Test Technical Committee will also conduct a program to recognize "Outstanding Papers" presented in the Ground Test sessions.

Please direct questions to:

Thomas Wayman
Gulfstream Aerospace
Phone: 912.965.6867
Email: thomas.wayman@gulfstream.com

High Speed Air Breathing Propulsion

Papers are solicited that address the design, analysis, testing, and evaluation of technologies and systems that enable supersonic and hypersonic air vehicle propulsion. Topic areas include, but are not limited to:

- Advances in propulsion systems including ramjets, scramjets, pulse detonation engines, and combined cycles (including rocket and turbine based)
- Experimental and/or numerical results pertaining to high-speed inlets, isolators, combustors, nozzles, fuel injectors/systems, thermal management systems, and integrated flowpaths
- Instrumentation, diagnostics techniques, and test methods
- Engine component materials and manufacturing
- Analytical/computational methods involving fluid, thermal, structural, or multidisciplinary analysis
- Comparison of numerical simulation with flight or ground engine test data

Papers on other topics related to high speed air breathing propulsion technologies and systems are also invited.

Please direct questions to:

Ronald R. Springer
Johns Hopkins University
Applied Physics Laboratory
240.228.9784 • 240.228.5229 FAX
Email: ronald.springer@jhuapl.edu

History

In 2013, we mark the 100th anniversary of Orville Wright's 1913 Collier Trophy, awarded for the automatic stabilizer, and the 50th anniversary of the 34-hour mission of astronaut L. Gordon Cooper, marking the end of Project Mercury, as well as the 25th anniversary of the U.S. Air Force's public unveiling of the Stealth Fighter, the F-117A Nighthawk. This year's history sessions will remind us of the early accomplishments of AIAA, its members, and the industry. Papers are sought covering significant advancements of flight, both in air and in space. All papers on the history of aeronautics and space flight will be considered.

Please direct questions to:

Cam Martin
NASA Dryden Flight Research Center
661.276.3448
Email: Cam.Martin@NASA.gov

Homeland Security

Homeland security depends critically on a number of research areas, encompassing the full range of AIAA technical committees and beyond. We strongly encourage submission of abstracts for the relevant sessions, including examples such as:

- Fluid dynamics and multi-phase flow relating to atmospheric dynamics, climate, oceans, and water supplies
- Unmanned sensor platforms
- Space assets and capabilities/limitations
- Sensors and intelligent systems

- Manned assets/operations
- C2I, communications, and interoperability
- Human factors and dynamics
- Biometrics
- Economic and legal considerations/impact
- Air traffic and operations
- Energy, lasers, directed energy, and non-lethal counter-asset/counter-personnel technologies
- Modeling/simulation in any pertinent areas

The above list is simply to suggest possibilities. All papers relating to homeland security will be considered.

Please direct questions to:

James W. Somers
OSI
775.849.2157 • 775.849.3701 FAX
Email: jsomers@orgstrategies.com

Intelligent Systems

Papers are sought that illustrate the relevance of Intelligent System (IS) technologies to aerospace sciences. Topics of interest include, but are not limited to:

- Autonomous systems
- Data fusion and reasoning
- Evolutionary (genetic) algorithms
- Expert systems
- Fuzzy logic
- Human-machine interaction
- Intelligent and adaptive control
- Intelligent data/image processing
- Knowledge-based systems and knowledge engineering
- Machine learning techniques
- Model-based reasoning
- Neural networks
- Planning and scheduling algorithms
- Qualitative simulation

Please direct questions to:

Kevin Kochersberger
Virginia Polytechnic Institute and State University
540.231.5589
Email: kbk@vt.edu

Kelly Cohen
University of Cincinnati
513.556.3523
Email: kelly.cohen@uc.edu

Meshing, Visualization, and Computational Environments

The Meshing, Visualization, and Computational Environments TC solicits papers describing tools and techniques that facilitate simulation of real-world problems in all areas of computational field simulation including computational fluid dynamics (CFD), computational aeroacoustics (CAA), computational solid mechanics (CSM), and computational electromagnetics (CEM). Although not limited to these topics, papers that describe advanced techniques and extreme applications in the following areas are encouraged particularly:

- A priori and a posteriori grid quality metrics related to solution accuracy involving real-world configurations such as the Drag Prediction Workshop, Shock Wave Boundary Layer Interaction Workshop, High Lift Prediction Workshop, and large-eddy simulation
- Integrated computational environments, including user interfaces, Internet technology, virtual reality, and advances in the interaction, automation, and computational speed/efficiency of and between preprocessing, computational simulation execution and monitoring, and post-processing as well as between computational simulations across multiple disciplines that increases fidelity and capability
- Advances in the management and comprehension of trends across multiple solutions, summary of results, discovery of relationships, feature detection, knowledge capture, engineering animation, and management of large volumes of data involved with optimization
- Geometry modeling for meshing and simulation, including CAD-CAE interoperability
- Meshing techniques, including surface and volume grids, grid adaptation, overset grid techniques, and moving/deforming meshes
- Applied meshing for real-world engineering applications

A special session will be developed for computational environment papers for this meeting. Authors are encouraged to submit their manuscripts, either before or after the meeting, to the *Journal of Aerospace Computing, Information, and Communication* for possible publication.

Please direct questions to:

Stephen Alter
NASA Langley Research Center
757.864.7771 • 757.864.8670 FAX
Email: stephen.j.alter@nasa.gov

Multidisciplinary Design Optimization

Multidisciplinary Design Optimization (MDO) is a computational technology for the discovery and exploitation of interactions among disparate disciplines to improve performance, lower cost, and shorten the product/system design cycle through the application of optimization algorithms. The influence of MDO reaches diverse phases of a product or system life, including manufacturability, operability, and serviceability.

We seek papers discussing applications of MDO methods toward a wide variety aerospace engineering design problems. Papers incorporating more than one discipline or technology should explain the nature and benefit of interdisciplinary synergies at the system level. Papers limited to single discipline optimization should emphasize aspects of the optimization process such as sensitivity analysis, approximation, or visualization. MDO applications of interest address aeronautical and mechanical systems that may incorporate any number of enabling technologies.

Core topics of interest include:

- Multidisciplinary analysis and optimization applications
  - Aircraft system design
  - Spacecraft system design
  - Aircraft power and thermal systems design
  - Aeroelastically tailored structural design
- Computational design frameworks
  - Environments
  - Visualization techniques
  - Interfaces to CAD
- Modeling and simulation methods
  - Design decomposition strategies
  - Modeling and simulation approaches
  - Simulation-based design of power and thermal systems
- Uncertainty quantification and nondeterministic design optimization
  - Multi-point design
  - Robust design
- Shape and topology optimization
  - Fundamental methods
  - Applied aerodynamic shape generation

Please direct questions to:

Timothy Takahashi, Ph.D.
Santa Clara University
520.977.4459
Email: ttakahashi@scu.edu

Plasmadynamics and Lasers

Papers describing basic and/or applied research and development results in the areas of plasmadynamics and lasers and related topics are solicited. Efforts combining contemporary theoretical/computational analyses with experimental verification/validation and that represent notable advancements in the aerospace sciences especially are encouraged. Special consideration will be given to works reporting milestone R&D and/or engineering achievements related to aerospace system application of plasma and laser technologies. Survey papers on the current state of the art and historical perspectives are also desired. Specific topics of interest include, but are not limited to:

- Plasma and laser physics: Including fundamental processes, laboratory plasma generation and characterization, experimental research or methods, plasma chemistry and kinetics, non-equilibrium reacting flows, properties, and advances in theory and/or computational simulation methods
- Space plasma physics and applications: Including spacecraft-plasma interactions, space laser applications, and space experiments
- Laser devices and systems: Including the physics, engineering, and application of high-energy lasers, chemical lasers, electric lasers, laser material interaction, laser optics, and fluid-optic interactions
- Highly energetic plasma systems: Including the physics, engineering, and application of high-power gas discharge and plasma generation devices, arc-heater technology, explosively generated plasma applications, compact pulse power, and high temperature systems and environments
- Magnetohydrodynamics (MHD): Including MHD power generation and propulsion technologies, terrestrial and aerospace systems applications, combustion plasma methods, innovative non-equilibrium plasma techniques, nuclear MHD systems, electromagnetic-fluid interaction and characterization, fundamental processes, and theoretical and/or computational simulation methods
- Plasma and laser propulsion: Including innovative and efficient plasma formation and acceleration approaches, high power thruster concepts, electrode erosion issues, electrodeless discharge mechanisms, modeling of fundamental processes, experimental performance characterization, and beamed energy propulsion
- Plasma materials processing and environmental applications: Including exhaust gas treatment, remediation, and hazardous materials disposal
- Advanced diagnostics: Including the development and utilization of laser-based diagnostics, flow field characterization methods, and plasma diagnostics
- Weakly ionized plasma physics and aerospace applications: Including plasma actuators for aerodynamic flow control
- Fluid-optics interactions: Including the propagation of laser

beams through the atmosphere and the effects of aerodynamics on the transmission of laser beams
- Fusion energy science: Including emerging confinement concepts for terrestrial or in-space power or propulsion, experimental programs, enabling technologies, instrumentation and diagnostic development, computational or theoretical modeling, and mission analysis

Papers concerning dual-use technologies that address non-aerospace issues of major public concern, such as energy, environment, and medicine are strongly encouraged. Suggestions for invited papers and joint sessions are also welcome.

Students are strongly encouraged to present papers on their research at this meeting. There will be a student paper competition for those papers where the student is the primary author. Papers submitted and accepted for the PDL meeting whose principal author is a student and which are delivered by that student will be considered for a "Best Student Paper Award." Please identify the principal author as a student (graduate or undergraduate student) at the time the abstract is submitted.

Comprehensive abstracts of several pages that state the purpose and scope of the work, methods used, and relevant contributions including figures and preliminary results are recommended for accurate evaluation.

Please direct questions to:

Michael Stanek
Wright-Patterson Air Force Base
937.286.8264 • 937.656.4169 FAX
Email: michael.stanek@wpafb.af.mil

Propellants and Combustion

Papers are sought from all areas of propellants and combustion relevant to aerospace sciences, technologies, and applications. New developments as well as review papers are of interest. Potential topics include the following:

- Rocket and air-breathing combustion: design and analysis issues for practical combustors such as rockets, gas turbines, turbojets, ramjets, and other hybrid engines; related topics of interest include combustion instabilities, thermo-acoustic interactions, active and passive combustion control, plume characteristics, fuel flexibility, and other fundamental combustion processes related to conventional propulsion systems
- Detonations, explosions, and supersonic combustion: fundamental research in detonation and supersonic combustion as well as combustion dynamics involving scramjets, pulse detonation engines, oblique detonation engines, ram accelerators, and other unconventional propulsion systems
- Spray and droplet combustion: liquid-jet break-up processes, atomization, vaporization, mixing, and their impact on spray flame characteristics as well as droplet combustion, supercritical combustion, and other related topics
- Combustion chemistry: development and application of reduced kinetic mechanisms, surrogate fuels, NOx and SOx chemistry, soot formation and oxidation, flow-chemistry interaction, and other related physical and chemical processes affecting reaction kinetics
- Micro-combustion and micro-propulsion: micro-scale combustion for power generation, micro-IC engines, micro-propulsion engines, and micro-thrusters

- Combustion diagnostics: development and application of advanced diagnostic or sensing techniques for understanding and controlling the combustion phenomena
- Heterogeneous combustion and propellants: fundamental aspects of combustion of solid fuels, propellants, and fuel additives, as well as propellant synthesis and related topics
- Turbulent combustion: fundamental aspects of turbulent reacting flows and combustion dynamics involving premixed, partially-premixed, and non-premixed turbulent flames linked to rockets, air-breathing combustors, etc.
- Laminar flames: fundamental aspects of laminar flame behavior along with their ignition, extinction, stabilization, instabilities, and interactions with laminar flow processes
- Advanced combustion concepts, fuel technology, and environmental impact: fundamental aspects of flameless combustion, alternative fuels, bio-fuels, hydrogen technologies, and other combustion-related environmental technologies as well as papers on associated environmental impact
- Other topics in combustion and propellant research, such as fire research, high-energy fuels, endothermic fuels, novel propellants, and in situ propellant production for planetary missions

Please direct questions to:

Keith R. McManus
GE Global Research Center
518.387.6597 • 518.387.7104 FAX
Email: mcmanus@ge.com

Society and Aerospace Technology

The Society and Aerospace Technology Technical Committee examines societal benefits of aerospace technologies as well as the relationship between aerospace and society, culture, and the arts. Abstracts are solicited that address these and related issues. Areas of interest include, but are not limited to:

- Aerospace and terrorism
- Aerospace and public safety
- Astrosociology
- Benefits and examples of aerospace technology spin-offs
- Utilization of aerospace assets to address social problems
- Space medicine and medical astrosociology
- Group dynamics and societal institutions in isolated communities (space settlements, Antarctica, etc.)
- Discussion of aerospace topics and programs from the perspective of disciplines such as psychology, social psychology, sociology, and anthropology

Please direct questions to:

Daniel Lockney
NASA Headquarters
202.358.2037
Email: daniel.p.lockney@nasa.gov

Software Systems

Abstracts are solicited on a wide range of topics in aerospace-related applications of software engineering and software systems. Areas of interest include, but are not limited to:

- COTS and open-source software for aerospace technologies
- Knowledge management and collaborative software
- Autogeneration of software
- Software agents
- Software requirements
- Software complexity and maintenance
- Validation and verification testing
- Software development practices
- Software education and training
- Real-time software systems
- Parallel computing software issues
- Safety-, mission-, or security-critical software
- Formal methods
- Software assurance
- Software standards and certification
- Plug-and-play software

Authors are encouraged to submit their manuscripts, either before or after the meeting, to the *Journal of Aerospace Computing, Information, and Communication* for possible publication. Please direct questions to:

James R. Murphy
NASA Ames Research Center
734.676.1164
Email: james.r.murphy@nasa.gov

Space Exploration and Colonization

A complementary program of robotic and human exploration missions beyond low Earth orbit could lead to a robust civil space program and the eventual development of space settlements on the moon and Mars. The goals of exploring space include learning about our past, improving life on Earth, and shaping our future through discovery, scientific scrutiny, and sound judgment, planning, and management. The Apollo era was shaped by the space race and was widely popular and successful. The present environment presents unique challenges for the space program to be relevant and to captivate the next generation. Experience in space has shown that operations outside Earth's atmosphere and on the surfaces of extraterrestrial moons, planets, and asteroids frequently encounter serious and unique challenges. These include the effects of radiation and microgravity on materials and humans, electrical charging and arcing, pervasiveness of abrasive lunar dust, effects of hard vacuum, atomic oxygen, and rarefied gases, and significant thermal loads. New exploration strategies and technologies must be developed to address these challenges and support mission logistics for human and robotic exploration, power generation, and resource utilization. The yearning of people to travel into space, even in short sub-orbital flights, is an important first step toward future space colonization by humans. Space tourism represents an important commercial aspect of this endeavor as we mature the technologies, achieve measurable successes, and develop the strong advocacy needed to enable us to move permanently to new residences elsewhere in the solar system, hopefully within this century. Papers are invited that address the following specific topics within the broad portfolio of Space Exploration and Colonization. Submissions should contain sufficient detail for the program committee to evaluate the technical content of the final presentation and paper. Topics include:

- Value proposition for space exploration and colonization
- Space, lunar, and planetary environmental challenges
- Enabling research: theoretical and applied
- Solar system exploration strategies and mission logistics
- Space transportation and lander vehicle/architecture design
- Design concepts for surface mobility and power
- Design concepts for space colonies
- Design concepts for space tourism/adventure
- Lunar, planetary, and asteroid commercialization
- Legal issues, including sovereignty and land rights

Please direct questions to:

Mark Benton
The Boeing Company
310.364.5186 • 310.416.0345 FAX
Email: mark.benton@boeing.com

Calls for Papers

Space Operations and Support

The AIAA Space Operations and Support Technical Committee (SOSTC) is soliciting papers in all areas of space operations and ground support. Topics include, but are not limited to, original space operations research and reports in the areas of new technology, technology trends, operations procedures, standards and practices. Areas of interest include:

- Human factors
- Space policy and law factors
- Human and robotic space exploration operations
- Space operations tools and technologies
- Space operations policies
- Ground support in space operations
- Public safety for launch and reentry planning and operations
- Commercial space operations
- Error reduction (command file error reduction, process improvement, etc.)

Please direct questions to:

J. Paul Douglas
NOAA Satellite Operations Facility
301.817.4031
Email: JPaul.Douglas@noaa.gov

Systems Engineering

Papers in all areas of systems engineering (SE) are encouraged. All types of papers will be considered, including case studies, developmental work, and technical analysis. Topics include but are not limited to systems engineering applications, integrated disciplines and technology, future trends and predictions in systems engineering, systems engineering education and research, and systems engineering life cycle processes and systems effectiveness.

Please direct questions to:

John C. Hsu
California State University, Long Beach
714.349.6810
Email: jhsu2@csulb.edu

Terrestrial Energy Applications of Aerospace Technology

The Terrestrial Energy Systems Technical Committee is sponsoring sessions on the use of aerospace technology in ground-power systems. Papers are solicited on development and application of technology common to the aerospace and terrestrial energy communities. Experimental, computational, and theoretical papers dealing with fundamental and applied energy conversion technologies will be considered for presentation. Topics include, but are not limited to:

- Combustion modeling and measurements
- Active and passive combustion control
- Fires and explosions
- Gasification and related technologies
- Clean and alternative fuels
- Nuclear energy
- Sustainable energy sources
- Energy use and climate change
- Energy efficiency and waste reduction
- Energy-power system efficiency and economics
- Advanced materials for energy systems

Please direct questions to:

Ahsan Choudhuri
University of Texas at El Paso
915.747.6905 • 915.747.5019 FAX
Email: ahsan@utep.edu

Thermophysics

The Thermophysics Technical Committee solicits abstracts of proposed papers on topics in thermophysics and heat transfer. Papers are solicited on topics related to all aspects of thermal energy transfer and aerospace applications therein. Contributions based on analytical, numerical and/or experimental studies are welcomed. Scientific and technical contributions are emphasized, rather than status reports on work in progress. Areas of specific interest include, but are not limited to:

- Aircraft/spacecraft thermal management
- Ablation
- Aerothermodynamics
- Cryogenics and cryogenic systems
- Direct simulation Monte Carlo methods
- Electronic and microelectronic avionics cooling
- Electronic thermal management
- Heat pipes, loop heat pipes, and innovative heat pipe designs
- Heat exchangers
- Heat transfer: computational, conduction, convection (free and forced), phase change, and radiation
- Heat transfer and cooling in turbomachinery
- High-speed flows
- Historical perspectives in thermophysics research
- Hypersonic and low density facilities
- Microgravity effects on high power two-phase thermal management systems
- Microgravity testing for aerospace applications
- Micro-scale heat transfer and micro-fluidics
- Missiles thermal management
- Non-equilibrium flows
- Non-equilibrium radiation
- Non-intrusive diagnostics
- Particle-laden flow modeling and measurement
- Rocket plumes
- Propulsion
- Power systems
- Radiation analyses (surface properties)
- Radiators and heat rejection systems
- Spacecraft contamination
- Space environmental effects
- Spacecraft thermal management and modular spacecraft
- Surface catalysis
- Thermal contact conductance
- Thermal control
- Thermal protection systems
- Thermophysical properties

Emerging Topics:

- Advanced materials thermal management applications
- Advanced thermoelectrics
- Integrated and multidisciplinary modeling and simulation
- Minimization of entropy production
- Nanoscale heat transfer and nanofluidics
- MEMS and nanotechnologies
- Multiphase flows and heat transfer continuum methods for transition-to-rarefied flows
- Plasma actuated heat transfer
- Wireless thermal measurements

Authors are requested to address a single subject area from the above list. Each year, the Thermophysics Technical Committee has offered a best paper award for both the professional and student categories (with the student receiving a monetary award). Student submissions are strongly encouraged. Also, timely survey and review articles on the above topics are solicited. Authors are encouraged to submit their manuscripts, either before or after the meeting, to the *Journal of Thermophysics and Heat Transfer* for possible publication.

Please direct questions to:

Ingrid Cotoros
Lockheed Martin Space Systems
650.424.2079
Email: ingrid.a.cotoros@lmco.com

6th Symposium on Space Resource Utilization

The 6th Symposium on Space Resource Utilization is soliciting papers on research and development of processes, technologies, and hardware that demonstrate the utilization of space resources in support of human or robotic exploration and science missions to the moon, Mars, the moons of Mars, and near-Earth objects. Papers including analytical and hardware development results in the following areas are of particular interest:

- Mission critical consumables: Production of consumables such includes oxygen, hydrogen, water, and propellants from available resources
- Planetary atmosphere processing: Acquisition and conditioning of planetary atmospheres in preparation for processing
- Surface material manipulation: Physical processing of regolith, rocks, and dust such as drilling, excavation, beneficiation, dust mitigation, and surface transportation
- Construction materials: Production of metals, glasses, ceramics, and plastics from natural resources and from recycled hardware and consumables

Additional areas of interest include:

- Environmental synergy: Concepts for making use of natural thermal gradients, radiation, particle fluxes, vacuum and pressure differentials, atmospheric gases, and other aspects of the space environment that can reduce the mass launched from Earth to further exploration and science objectives
- System integration: Integration of ISRU systems with other surface systems including joint use technologies such as electrolysis or cryogenic storage systems
- Propulsion systems: Utilization of in situ derived propellants to supply propellant depots in support of missions to various destinations (including mass and cost-benefit comparisons)

Where possible, papers should include performance of hardware or hardware concepts in the space environment at the component, sub-system, or system levels.

Please direct questions to:

Julie E. Kleinhenz
NASA Glenn Research Center
216.433.5383
Email: Julie.e.kleinhenz@nasa.gov

15th Weakly Ionized Gases Workshop

The 15th Weakly Ionized Gases (WIG) Workshop will be held concurrently with the 51st AIAA Aerospace Sciences Meeting. The workshop will consist of technical papers and invited presentations that will be integrated into a series of sessions to be held throughout the week.

Papers are solicited on a broad range of topics related to the study of flight interactions with weakly ionized gases. Subject material for papers can range from basic R&D to applied and advanced technology. Papers regarding contemporary experiments, analytical and computational methods, new theory, results, test data, and conclusions are desired. Interdisciplinary papers and those that combine theory and analysis with experimental validation, with results and conclusions that can be directly applied, are of special interest. Survey papers and those that are of an historical perspective are also sought.

Topics of interest include:

- Air/fuel plasma properties and interactions
- Internal and external plasma aerodynamics
- Non-equilibrium thermal and chemically reacting flows, including combustion
- Methods of on-board plasma generation
- Plasma-based drag reduction and flow control
- Shock attenuation in plasma flows
- Electromagnetic (EM) and magnetohydrodynamic (MHD) interactions and applications, including flow control and energy extraction
- Systems applications

Please direct questions to:

Campbell D. Carter
U.S. Air Force Research Laboratory, AFRL/RZAS
937.255.7203
Email: campbell.carter@wpafb.af.mil

Charles F Suchomel
Wright-Patterson Air Force Base
973.904.8653
Email: Charles.Suchomel@wpafb.af.mil

27th Symposium on Gravity-Related Phenomena in Space Exploration

The 27th Symposium on Gravity-Related Phenomena in Space Exploration is being organized for January 2013 to actively investigate scientific and technological possibilities in gravity-dependent research and to support strategic research and technology enabling space exploration. As such, papers are solicited from academic, commercial, and governmental institutions in the following areas:

- Acceleration environment: measurements of microgravity, sensitivity of physical phenomena to acceleration environment including disturbances
- Biotechnology: bio-fluids, protein crystals
- Combustion science and chemically reacting flows: fundamental and applied research in flames, fire detection and suppression, heterogeneous combustion, micro-combustion systems, and reacting systems for in situ space resource utilization such as propellant production and life support systems
- Fluid physics and transport phenomena: fundamental and applied research related to biological systems, in-space propulsion, in situ space resource utilization, and space-based power and life support systems
- Materials science: fundamental and applied research in electronic materials, metals and alloys, ceramics, glasses, polymers, radiation shielding, advanced materials for propulsion systems, space manufacturing
- Special session: technological applications from research in reduced gravity including examples from the scientific, commercial, and educational realms

Papers in related but not cited topics are strongly encouraged. Papers describing spaceflight hardware will be considered where specific innovations in functionality, performance, or hardware development processes are the focus.

Abstract submissions should be sufficiently detailed to survive competitive peer-review for selection into the symposium. Summaries of the research or study activity, results, and applications should be highlighted, keeping background information to a minimum. Important references, graphs, or pictures may be included.

A Best Paper and Best Student Presentation will be selected by the Microgravity and Space Processes Technical Committee from among the participants in the Symposium.

Please direct questions to:

Stephen D. Tse
Rutgers, the State University of New Jersey
732.445.0449
Email: sdytse@rci.rutgers.edu

31st ASME Wind Energy Symposium

Papers are solicited for a broad range of topics related to wind energy conversion, both land-based and offshore. Topics of interest include, but are not limited to:

- Acoustics
- Airfoil, blade, and wake aerodynamics
- Atmospheric physics and inflow
- Wind farm and turbine-wake interactions
- Offshore wind systems and environment
- Hybrid and off-grid systems
- Testing: non-destructive testing, inspection and QA, field test results, laboratory testing techniques
- Controls: energy capture enhancement, load attenuation, sensors and actuators, generator and power electronics
- Structural dynamics
- Reliability
- Fatigue and failure
- Innovative components and subsystems
- Materials and manufacturing processes
- Turbine design and development: design loads and certification, site specific design and optimization
- Drivetrains
- Health monitoring
- Electrical systems and machines
- Utility and grid integration
- Radar interference

This conference will follow the abstract/manuscript submission and approval process used by AIAA as outlined in this call for papers.

Please direct questions to:

Pat Moriarty
National Renewable Energy Laboratory
303.384.7081 • 303.384.6901 FAX
Email: patrick.moriarty@nrel.gov

Upcoming AIAA Professional Development Courses

22–23 January 2012

The following Continuing Education class is being held at the AIAA Strategic and Tactical Missile Systems Conference and AIAA Missile Sciences Conference in Monterey, California. Registration includes course and course notes; sessions (with approved security clearance form); Tuesday, Wednesday, and Thursday luncheons; and Tuesday and Wednesday receptions.

STRAT TAC COURSE AND CONFERENCE REGISTRATION FEES

To register, go to **www.aiaa.org/events/strattac** or **www.aiaa.org/events/missilesciences**

	Early Bird by 19 Dec 2011	*Standard (20 Dec–21 Jan)*	*Onsite*
AIAA Member	$1188	$1338	$1488
Nonmember	$1265	$1415	$1565

***Note**: A Security Clearance Certification Form is also required for this event (by **19 December 2011**). The Security Clearance Certification Form is separate from conference registration. Submitting a Security Clearance Certification Form does not register you for the conference. You must also register with AIAA.*

Missile Design and System Engineering **(Instructor: Gene Fleeman, International Lecturer, Lilburn, GA)**
This short course provides the fundamentals of missile design, development, and system engineering. A system-level, integrated method is provided for missile configuration design and analysis. It addresses the broad range of alternatives in satisfying missile performance, cost, and risk requirements. Methods are generally simple closed-form analytical expressions that are physics-based, to provide insight into the primary driving parameters. Configuration-sizing examples are presented for rocket, turbojet, and ramjet-powered missiles. Systems engineering considerations include launch platform integration constraints. Typical values of missile parameters and the characteristics of current operational missiles are discussed as well as the enabling subsystems and technologies for missiles. Sixty-six videos illustrate missile development activities and performance. Attendees will vote on the relative emphasis of types of targets, types of launch platforms, technical topics, and roundtable discussion.

21–22 April 2012

The following Continuing Education classes are being held at the 53rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference; the 20th AIAA/ASME/AHS Adaptive Structures Conference; the 14th AIAA Non-Deterministic Approaches Conference; the 13th AIAA Gossamer Systems Forum; and the 8th AIAA Multidisciplinary Design Optimization Specialist Conference in Honolulu, Hawaii. Registration includes course and course notes; full conference participation: admittance to technical and plenary sessions; receptions, luncheons, and online proceedings.

SDM COURSE AND CONFERENCE REGISTRATION FEES

To register, go to **www.aiaa.org/events/sdm.**

	Early Bird by 26 Mar 2012	*Standard (27 Mar–20 Apr)*	*Onsite (21–22 Apr)*
AIAA Member	$1260	$1360	$1460
Nonmember	$1338	$1438	$1538

Fundamentals of Composite Structure Design **(Instructor: Rikard Heslehurst, Senior Lecturer, School of Aerospace, Civil and Mechanical Engineering of the University College, UNSW at the Australian Defense Force Academy)**
This seminar has been developed specifically for engineers who require some fundamental understanding of the structural design requirements for composites. The application of composite materials is discussed initially in terms of the constituent component material properties and manufacturing processes based on the design requirements analysis. The tailoring of structural properties through lamination and fiber orientation placement are discussed in relationship to strength of materials issues and load/deformation response. The design development of the laminate is based on design outcomes and how fiber/resin systems and ply orientation is determined to achieve these design outcomes. This seminar briefly will cover the design requirements of stress analysis for the design detail such as joints, structural stiffening against instability, and other structural discontinuities. Other aspects of the seminar to be covered include environmental and longevity aspects, certification and in-service support issues.

Introduction to Bio-Inspired Engineering **(Instructor: Chris Jenkins, Head of Mechanical & Industrial Engineering, MSU, Bozeman, MT)**
The primary purpose of this course is to inform engineers and other technical professional in the use of bio-inspired engineering (BiE) to expand the design space of possible solutions to technical problems. We do that by first understanding how nature solves problems. Then, and at least as important, is learning how to translate biological knowledge into engineering practice. Even though the domain of biology is vast and new discoveries occur daily, much is known about biological solutions. Turning this knowledge into technical solutions is the challenge we face—it is also the focus of considerable attention in modern BiE, and hence this course as well.

Aeroelasticity: State-of-the-Art Practices (Instructors: Dr. Thomas W. Strganac, Texas A&M University, College Station, TX; Dr. Carlos E. S. Cesnik, University of Michigan; Dr. Walter A. Silva, NASA Langley Research Center; Dr. Jennifer Hegg, NASA Langley Research Center; Dr. Rick Lind, University of Florida; Dr. Paul G. A. Cizmas, Texas A&M University; Dr. Gautam SenGupta, The Boeing Company; John Lassiter, NASA Marshall Space Flight Center)
In recent years, there has been a renewed interest in aeroelasticity arising from high performance aerospace systems, multiple control surface configurations, and pathologies associated with nonlinear behavior. This course provides a brief overview of aeroelasticity and examines many new "fronts" currently being pursued in aeroelasticity that include reduced-order models, integrated fluid-structural dynamic models, ground vibration testing, wind tunnel tests, robust flutter identification approaches for wind tunnel and flight test programs, aeroservoelasticity, and aeroelasticity of very flexible aircraft. The course will emphasize current practices in both analytical and experimental approaches within industry and government labs, as well as advances as pursued by these organizations with the support of university research.

Introduction to Non-Deterministic Approaches (Instructor: Dr. Ben H. Thacker, Director, Materials Engineering Department, San Antonio, TX; Dr. Michael P. Enright, Principal Engineer, Materials Engineering Department, San Antonio, TX; Dr. Sankaran Mahadevan, Professor, Civil, Environmental and Mechanical Engineering, Vanderbilt University, Nashville, TN; Dr. Ramana V. Grandhi, Professor, Department of Mechanical and Materials Engineering, Wright State University, Dayton, OH)
This course is offered as an introduction to methods and techniques used for modeling uncertainty. Fundamentals of probability and statistics are covered briefly to lay the groundwork, followed by overviews of each of the major branches of uncertainty assessment used to support component and system level life cycle activities, including design, analysis, optimization, fabrication, testing, maintenance, qualification, and certification. Branches of Non-Deterministic Approaches (NDA) to be covered include Fast Probability Methods (e.g., FORM, SORM, Advanced Mean Value, etc.), simulation methods such as Monte Carlo and Importance Sampling, surrogate methods such as Response Surface, as well as more advanced topics such as system reliability, time-dependent reliability, probabilistic finite element analysis, and reliability-based design. An overview of emerging non-probabilistic methods for performing uncertainty analysis will also be presented.

Publications

New and Forthcoming Titles

Designing Unmanned Aircraft Systems: A Comprehensive Approach
Jay Gundlach

AIAA Education Series
2011, 800 pages, Hardback
ISBN: 978-1-60086-843-6
Member Price: $84.95
List Price: $109.95

Tactical and Strategic Missile Guidance, Sixth Edition
Paul Zarchan

Progress in Astronautics and Aeronautics
2012, 900 pages, Hardback
ISBN: 978-1-60086-894-0
Member Price: $104.95
List Price: $134.95

Boundary Layer Analysis, Second Edition
Joseph A. Schetz and Rodney D. Bowersox

AIAA Education Series
2011, 760 pages, Hardback
ISBN: 978-1-60086-823-8
AIAA Member Price: $84.95
List Price: $114.95

Introduction to Flight Testing and Applied Aerodynamics
Barnes W. McCormick

AIAA Education Series
2011, 150 pages, Hardback
ISBN: 978-1-60086-827-6
AIAA Member Price: $49.95
List Price: $64.95

Space Operations: Exploration, Scientific Utilization, and Technology Development
Craig A. Cruzen, Johanna M. Gunn, & Patrice J. Amadieu

Progress in Astronautics and Aeronautics Series, 236
2011, 672 pages, Hardback
ISBN: 978-1-60086-817-7
AIAA Member Price: $89.95
List Price: $119.95

Spacecraft Charging
Shu T. Lai

Progress in Astronautics and Aeronautics Series, 237
2011, 208 pages, Hardback
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AIAA Member Price: $64.95
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Jose Camberos and David Moorhouse

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Engineering Computations and Modeling in MATLAB/Simulink
Oleg Yakimenko

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Introduction to Theoretical Aerodynamics and Hydrodynamics
William Sears

AIAA Education Series
2011, 150 pages, Hardback
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AIAA Member Price: $54.95
List Price: $69.95

Eleven Seconds into the Unknown: A History of the Hyper-X Program
Curtis Peebles

Library of Flight
2011, 330 pages, Paperback
ISBN: 978-1-60086-776-7
AIAA Member Price: $29.95
List Price: $39.95

Basic Helicopter Aerodynamics, Third Edition
John M. Seddon and Simon Newman

AIAA Education Series
Published by John Wiley & Sons, 2011, 3rd Edition, 264 pages, Hardback
ISBN: 9-781-60086-861-0
AIAA Member Price: $49.95
List Price: $74.95

Gas Turbine Propulsion Systems
Bernie MacIsaac and Roy Langton

AIAA Education Series
Published by John Wiley & Sons, 2011, 368 pages, Hardback
ISBN: 9-781-60086-846-7
AIAA Member Price: $84.95
List Price: $119.95

Standard Information for all AIAA Conferences

This is general conference information, except as noted in the individual conference preliminary program information to address exceptions.

Photo ID Needed at Registration

All registrants must provide a valid photo ID (driver's license or passport) when they check in. For student registration, valid student ID is also required.

Conference Proceedings

This year's conference proceedings will be available in an online format only. The cost is included in the registration fee where indicated. If you register in advance for the online papers, you will be provided with instructions on how to access the conference technical papers. For those registering on-site, you will be provided with instructions at registration.

Young Professional Guide for Gaining Management Support

Young professionals have the unique opportunity to meet and learn from some of the most important people in the business by attending conferences and participating in AIAA activities. A detailed online guide, published by the AIAA Young Professional Committee, is available to help you gain support and financial backing from your company. The guide explains the benefits of participation, offers recommendations and provides an example letter for seeking management support and funding, and shows you how to get the most out of your participation. The online guide can be found on the AIAA Web site, **www.aiaa.org/YPGuide**.

Journal Publication

Authors of appropriate papers are encouraged to submit them for possible publication in one of the Institute's archival journals: *AIAA Journal*; *Journal of Aircraft*; *Journal of Guidance, Control, and Dynamics*; *Journal of Propulsion and Power*; *Journal of Spacecraft and Rockets*; *Journal of Thermophysics and Heat Transfer*; or *Journal of Aerospace Computing, Information, and Communication*. You may now submit your paper online at **http://mc.manuscriptcentral.com/aiaa**.

Speakers' Briefing

Authors who are presenting papers, session chairs, and co-chairs will meet for a short briefing at 0700 hrs on the mornings of the conference. Continental breakfast will be provided. Please plan to attend only on the day of your session(s). Location will be in final program.

Speakers' Practice

A speaker practice room will be available for speakers wishing to practice their presentations. A sign-up sheet will be posted on the door for half-hour increments.

Timing of Presentations

Each paper will be allotted 30 minutes (including introduction and question-and-answer period) except where noted.

Committee Meetings

Meeting room locations for AIAA committees will be posted on the message board and will be available upon request in the registration area.

Audiovisual

Each session room will be preset with the following: one LCD projector, one screen, and one microphone (if needed). A 1/2" VHS VCR and monitor, an overhead projector, and/or a 35-mm slide projector will only be provided if requested by presenters on their abstract submittal forms. AIAA does not provide computers or technicians to connect LCD projectors to the laptops. Should presenters wish to use the LCD projectors, it is their responsibility to bring or arrange for a computer on their own. Please note that AIAA does not provide security in the session rooms and recommends that items of value, including computers, not be left unattended. Any additional audiovisual requirements, or equipment not requested by the date provided in the preliminary conference information, will be at cost to the presenter.

Employment Opportunities

AIAA is assisting members who are searching for employment by providing a bulletin board at the technical meetings. This bulletin board is solely for "open position" and "available for employment" postings. Employers are encouraged to have personnel who are attending an AIAA technical conference bring "open position" job postings. Individual unemployed members may post "available for employment" notices. AIAA reserves the right to remove inappropriate notices, and cannot assume responsibility for notices forwarded to AIAA Headquarters. AIAA members can post and browse resumes and job listings, and access other online employment resources, by visiting the AIAA Career Center at http://careercenter.aiaa.org.

Messages and Information

Messages will be recorded and posted on a bulletin board in the registration area. It is not possible to page conferees. A telephone number will be provided in the final program.

Membership

Professionals registering at the nonmember rate will receive a one-year AIAA membership. Students who are not members may apply their registration fee toward their first year's student member dues.

Nondiscriminatory Practices

The AIAA accepts registrations irrespective of race, creed, sex, color, physical handicap, and national or ethnic origin.

Smoking Policy

Smoking is not permitted in the technical sessions.

Restrictions

Videotaping or audio recording of sessions or technical exhibits as well as the unauthorized sale of AIAA-copyrighted material is prohibited.

International Traffic in Arms Regulations (ITAR)

AIAA speakers and attendees are reminded that some topics discussed in the conference could be controlled by the International Traffic in Arms Regulations (ITAR). U.S. Nationals (U.S. Citizens and Permanent Residents) are responsible for ensuring that technical data they present in open sessions to non-U.S. Nationals in attendance or in conference proceedings are not export restricted by the ITAR. U.S. Nationals are likewise responsible for ensuring that they do not discuss ITAR export-restricted information with non-U.S. Nationals in attendance.