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November 2012

AEROSPACE AMERICA

Troublesome trends in U.S. air transportation

Cosmic comeback for military space?

Conversations with Douglas Barrie

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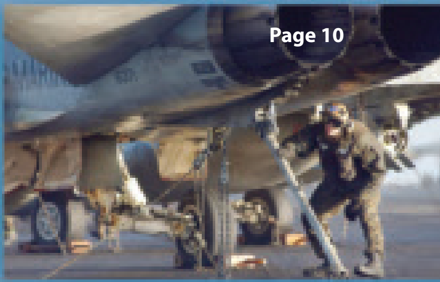
AEROSPACE AMERICA

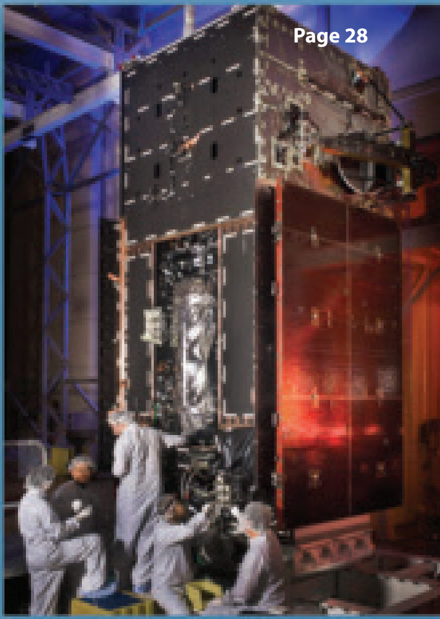
November 2012

DEPARTMENTS

FEATURES

BULLETIN





COVER

Current trends in U.S. air transportation indicate that fewer markets are being served, at lower frequency, than in earlier decades. Turn to page 20 to find out what this may mean for the airlines—and the passengers.

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Editorial

Getting there is just part of the story

Since the end of the space shuttle program approached in August 2011, the focus of national attention has been on U.S. access to space, in particular to the international space station. In the weeks leading up to that final shuttle flight, and the months since, concern has been centered on the lack of U.S. access to the station, both for crew and cargo.

But as events have unfolded, the picture has become brighter. Apart from the crewed flights by the Russian Soyuz, cargo deliveries to the ISS by ESA's ATVs and Japan's H-II transfer vehicle were followed by a successful demonstration flight and berthing by the SpaceX Dragon and a subsequent cargo mission—including a long-awaited ice cream delivery. These flights are expected to lead to crewed flights in the not-too-distant future, .

The first Boeing CS-100 capsule is scheduled to fly in the next few months, and Orbital Sciences has its Cygnus waiting in the wings. India is working on a capsule of its own.

Perhaps overlooked in all of this discussion about access to the space station is some of the exciting work going on there right now, and the opportunity being offered for scientists and laboratories from all over to conduct their own research.

One of the most interesting studies currently being conducted on the station may hold the possibility of assisting hundreds of victims of accidents, illness, and war injuries. NASA's Robonaut 2, developed at NASA Johnson, has been working on the space station since February 2011. And in a spinoff from R2, NASA has joined with the Florida Institute for Human and Machine Cognition as well as Oceaneering Space Systems of Houston to develop X1. This robotic exoskeleton may be worn over a person's body to inhibit or enhance mobility, or perhaps enable people to walk for the first time. X1 was originally developed as an exercise device both for space station stays and deep space missions. But the promise is for so much more.

Says Michael Gazarik, director of NASA's Space Technology Program, "What's extraordinary about space technology and our work with projects like Robonaut are the unexpected possibilities space tech spinoffs may have right here on Earth. It's exciting to see a NASA-developed technology that might one day help people with serious ambulatory needs begin to walk again, or even walk for the first time."

And the opportunities are not just for NASA scientists to share. A portion of the ISS was designated a national laboratory in 2005, and scientists from around the country have been invited through NASA Research Announcements to conduct experiments on the station. The latest of these RAs "challenges scientists to propose experiments that could provide answers to questions about how life adapts and responds to microgravity." This research will not only benefit future travelers on long-duration space missions but may also help us improve health care here on Earth.

In all the debate about the U.S. losing its own access to the ISS, fueled in part by genuine concern and in part by political rhetoric, the reason to get there may be overlooked. Exciting opportunities are there; we just need to seize them!

Elaine Camhi
Editor-in-Chief

Transatlantic defense and aerospace mergers move closer

THE TASK FORCE THAT WAS SET UP BY the European Commission in November 2011 to examine how Europe can maintain a competitive defense industrial base in the face of increasingly stringent budget cuts is due to release its preliminary findings at the end of this year.

The task force has four key aims: to determine how to turn Europe into an open defense market; to identify areas where a strategic technology base must be maintained; to find ways of exploiting synergies between the security and defense industries; and to ensure coherence on security of supply issues.

At the heart of the work are two key issues that need to be resolved: How can Europe's defense sector strengthen its research and technological efforts and secure the skill-base capabilities of its employees while companies consolidate and national programs disappear? And how can national governments preserve strategic capabilities—such as advanced weapon systems—for their own use while allowing their main industries and suppliers to consolidate and compete in the global market?

Consolidation is key

Finding the right way for major defense companies to consolidate across borders is at the heart of both requirements. Therefore the announcement in September that BAE Systems and EADS were planning to merge came at a critical time for Europe's aerospace and defense sectors.

Although the merger was called off just weeks later, its announcement probably signalled the start of further consolidation among European prime and second-tier suppliers, many of these with a focus on finding synergies with European partners. But the failure of the two sides to agree on terms now means the process of consolidation—which most in the industry believe is now inevitable—will become more complex, and European companies are likely to seek new partners across the Atlantic.

The U.S. has a crucial role to play in what happens next, following the failure of the merger. Over the last 10 years BAE has repositioned itself in the market—shedding its European civil aircraft manufacturing businesses in favor of building a large defense interest in the U.S., supplying the DOD with armored combat vehicles, artillery systems, and munitions. The company employs 37,300 staff in the U.S. (2,500 more than in the U.K.) and in 2011 generated sales of $14.4 billion from its U.S. division.

This link made the merger interesting on two counts. How would a tie-up with French and German partners impact BAE Systems' defense business in the U.S., and how would it impact competition with major U.S. suppliers in the global market? The new question is, how possible will it be for European defense manufacturers to consider transatlantic consolidation?

F-35

A not-so-silent partner

"For the merger to happen, the Dept. of Defense and other U.S. regulators—as well as politicians—would need to be satisfied on several counts, including that the security of U.S.-funded technologies would not be compromised, that there would be no unhealthy market concentration, and that government shareholdings in EADS would not distort the U.S. market," according to a report in mid-September by the London-based military think tank the International Institute for Strategic Studies (IISS).

"Given that sensitive technologies in the hands of foreign companies are covered by security agreements that, for example, bar non-Americans from getting sight of them, there seems no reason why such arrangements should not be extended."

'Firewalls' have existed for many years, separating the U.S. activities of U.K. companies such as BAE Systems and Rolls-Royce so that not even the main boards of these groups have access to product details of their U.S. divisions. In any transatlantic mergers these would need to be transparently effective.

This is a complex business—BAE Systems is integrated within the U.S. defense industrial market through its activities in the U.K. as well as North America. Around 2,000+ BAE Systems employees work on Lockheed

Martin's F-35 program in the U.K., building the aft fuselage and vertical and horizontal tails for all three variants of the aircraft. According to the company, 15% of all F-35 production work is carried out in the U.K., and more than 130 U.K. companies contribute to the supply chain. The program will support around 25,000 U.K. jobs over the next 25 years.

In contrast, EADS was the 83rd largest DOD contractor last year, according to the Center for Strategic and International Studies.

A would-be giant

These two companies have turned down the prospect of creating a global defense giant that will probably be the last shot corporate Europe will have at matching U.S. defense companies in terms of scale and scope. The combined company would have an income greater than that of Boeing.

"The creation of a dual-listed company structure, under which both companies would operate as one group by means of equalisation and other agreements but with separate listings on their existing exchanges, would significantly increase the companies' market power, with a total sales volume in the region of £58 billion ($93 billion) based on last year's data, and access to a broad skills, technology and production base," according to a September assessment by another London-based think-tank, the Royal United Services Institute.

"If I were a U.S. company would I fear this?" asks Howard Wheeldon, a managing director at the U.K. trade association AeroSpace, Defense & Security Industries. "No, certainly not in terms of my domestic market. Would I fear it in terms of my international perspective? No more than I do now—the combined company would not produce any greater level of threat to the U.S. than the separate companies do now. But it presents an investment challenge for the future in which the combined companies may be able to take a higher degree of risk than they do now in terms of long term investment," he explains.


Neuron

But the world is changing. While proprietary technology is a key element in hardware like fifth-generation fighters, armored vehicles, and advanced missiles, these are the sorts of platforms that, in general, will be required in fewer numbers in the future.

"Defense and civil security products rely heavily on generic, globally available technologies not least information and communications technologies (ICTs). Advances in microsystems, nanotechnology, unmanned systems, communications and sensors, digital technology, bio- and material sciences, energy and power technologies and neurotechnologies have all been identified as important for the defense sector and most if not all can be characterised as generic technologies," says the recent report *The EU defense market: balancing effectiveness with responsibility,* by the Flemish Peace Institute in Belgium.

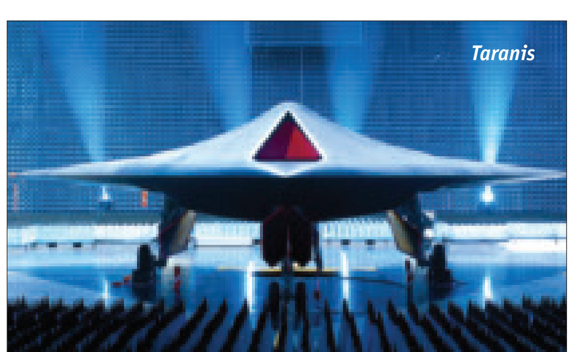
"In other words, the Cold War defense innovation model is breaking down. Because both military and nonmilitary security products draw on generic technologies, this does blur the boundaries around both knowledge production and the application of the technologies not just between military and non-military security products, but vis-à-vis wider civilian and commercial technology innovation."

The funding question

One of the key priorities of the EC's defense industry task force is to identify opportunities for European companies to access new technical capabilities within the EC's 'framework' research programs aimed at enhancing Europe's nonmilitary capabilities in areas such as cyber security and chemical, biological, radiological, and nuclear protection. But even with access to dual-use technology research, that still leaves an important set of bespoke military technology areas—such as kinetic material research, UCAVs, hypersonic engines and stealth systems, for example—requiring funding if Europe defense companies are to retain a competitive capability.

A BAE/EADS merger would have helped consolidate European industrial capabilities in the critical area of UCAV research, where there is considerable overlap.

Acording to the IISS report, "France and the U.K. recently launched an 18-month study to explore the development of an unmanned combat air system, led by BAE and Dassault. The proposed merger would place EADS within the project's orbit, and would also offer the potential to bring Germany on board. The Spanish arm of EADS is involved in a Dassault-led six-nation project for the Neuron unmanned combat air system technology demonstrator, which is due to end after a test-flight program. Partner nations are France, Spain, Greece, Italy, Sweden, and Switzerland. BAE is working on the U.K.-only Tara-


Taranis

nis unmanned combat aircraft demonstrator, a project also set to conclude after flight trials planned for 2013."

These programs need to be funnelled into a single project if a cost effective all-European UCAV project is to emerge as the likely replacement for today's Eurofighter Typhoon, Dassault Rafale, and Saab Gripen.

European governments and the EC have repeatedly said they want European defense businesses to consolidate in response to budget cuts. According to the Stockholm International Peace Research Institute, the three top spenders in Western Europe—France, Germany, and the U.K.—have begun to reduce spending as part of austerity measures imposed to reduce budget deficits.

"France's military budget has fallen 4% since 2008, and while reductions over the same period in Germany (1.4%) and the U.K. (0.6%) have been more modest, both states plan further cuts in the coming years. Far larger cuts have been made in Greece, Spain, Italy, and Ireland as a result of their sovereign debt crises, and most central European countries have also made severe cuts."

But a key sticking point is always the issue of 'golden shares' held by the governments of the U.K., France, and Germany in the merged company, which would prevent a predator obtaining a voting stake of more than 15% for security reasons. The EU allows golden shares for member states wishing to protect their supply of defense technology as long as this does not "adversely affect the conditions of competition in the internal market regarding products which are not intended for specifically military purposes." So while golden shares may be appropriate for EADS' and BAE Systems' military activities, they may not be appropriate for EADS' Airbus business.

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What will come after the failed BAE Systems/EADS merger? With one route to consolidation apparently blocked, European companies may now seek genuine transatlantic defense consolidation as a response to declining budgets on both sides of the ocean.

The next European companies to consider their consolidation options could be Thales, Safran, and Dassault of France; Saab of Sweden; and Italy's Finmeccanica. All suddenly have two attractive options: a potential merger with either BAE Systems or EADS—now that the regulatory hurdles are better understood—or a link with a U.S. prime without the need for a full-blown merger.

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A question of leadership

Celebrations marking India's 100th space mission in early September were a time for reflection—and a certain amount of angst from at least one top Indian space program leader. The milestone is certainly a worthy achievement for India, even though the total includes Indian satellites launched on other nations' rockets. But the apparent choice for a space exploration role model provides much food for thought, partly because the model selected was not the U.S. but China. The logic is understandable, but the result may be less than optimum.

In terms of humankind's overall scientific progress in space, India's accomplishment added luster to NASA's earlier success in seeing through a rapid-fire descent sequence that culminated with the landing of the exploration vehicle Curiosity on the surface of Mars on August 6. High hopes for the rover's postlanding progress have also been fulfilled; it has been sending back new images of the Martian surface and holds promise for much new scientific analysis and discovery.

India at a crossroads

In and of itself, however, India's space program is at something of a crossroads. Its 100th mission involved the launching of two satellites into LEO—the 1,569-lb Spot 6 Earth observation satellite for Europe's Astrium Services, and the 33-lb Proiteres amateur radio satellite built by Japan's Osaka Institute of Technology. Carrying them to an altitude of roughly 435 mi. was India's Polar Satellite Launch Vehicle. With a payload capacity of about 1.5-2 tons, this reliable midweight rocket has demonstrated a success rate of around 90% in 21 launches.

When it comes to heavier launch weights, however, the third stage of India's much larger Geosynchronous Satellite Launch Vehicle (GSLV) has run into problems. The GSLV has suffered four failures in seven launches since 2010, mostly the result of India's being forced to switch to building its own hardware for the rocket's cryogenic third stage. The move was mandated by the terms of its agreement with Russia, which only permitted the export of completed (that is, Russian-built) third stages to India, so any improvements to the basic Russian design were impossible unless India took over the whole job. Another launch attempt with an Indian-sourced GSLV is due later this year.

India's technical environment is changing in any case. India has long been a buyer of Russian technology, but in recent years it has been turning slowly toward the West. Restrictions on its access to U.S. technology began loosening with the easing of U.S. high-technology and dual-use technology export rules last year—rules that still hamper China.

But technology is only one of the pressures controlling the pace and direction of India's space program development. Social pressure (the availability of resources—money as well as scientists and engineers) and defense (meaning military ambitions) also play large roles, and under those broad headings must fall items such as high-tech education, local and international communications, and foreign relations.

China rising

This last point was one underscored by Manpreet Sethi, senior fellow at the Centre for Air Power Studies in New Delhi. Emphasizing the importance of China's success this year in performing manual dockings between spacecraft, she said in August, "…a Chinese space station and the demonstration of capabilities towards that objective have tremendous symbolic value for power projection. Achieving these tasks re-

Prime Minister Manmohan Singh (center) visits the PSLV launch facility on the eve of India's 100th space mission in September.

China achieved its first manual space docking in June.

flects favorably on the scientific, technological, and industrial/manufacturing capability of the country. Not only does this enhance the reputation of China to provide commercial services to global customers, it also enhances the soft power of the country."

China had performed automatic dockings last year, thus demonstrating reliability of its technology and showing it could replenish stores for a future space station—a feat already performed by both Russian and Japanese rockets for the ISS—and ultimately lunar landings and a manned lunar station. But manual dockings take the process a step further—China's spacecraft are human rated, unlike those of Japan, India, or, for the short-to-medium term at least, the U.S.—now that the space shuttle has been retired.

The manual dockings, and China's inclusion of a woman as a crewmember on its June mission, led Sethi to comment: "Each one of these feats is meant to fit into the long-term objective of having a Chinese manned space station in outer space by sometime towards the end of this decade. Such a goal was first articulated by the standing committee of the Politburo in 1992 when it approved the manned spaceflight program."

Sethi added, "As China enhances its space capabilities, it raises its profile amongst smaller nations taking tentative steps into this new domain. China plays upon the psychology of these nations by offering its space services as a means to break the monopoly of Western imperialism in a pioneering field of science and technology. That China gains commercially and strategically from such relations is self-evident."

Next steps

Of course, India has its own plans for its future in space. The next item on New Delhi's agenda is a mission to Mars, scheduled for November next year. But the Mars orbital probe is to be lofted on the proven PSLV, while a test flight of the larger (potentially two-man) GSLV with an Indian-built third stage (the Mark 2) is planned for later this year. A test flight of the still larger GSLV Mark 3 (with capacity for three crew) is proposed for early next year. China had its own Mars orbiter mission planned last year, but through no fault of China's it was unsuccessful—the Soyuz rocket on which it was carried failed to reach orbit, thus also losing the Russian Phobos-Grunt mission launched on the same flight.

A manned Indian spaceflight had been planned for 2016, to take two people in a 3-ton capsule into LEO for about a week. But the GSLV's technical problems and budget cuts have made this timetable look optimistic. The 2016 date was based on a crewed program's R&D phase starting in 2009, seven years from start to the mission itself, which would imply that a go-ahead now would mean the first manned mission launching in 2019 at the earliest.

Cooperation and 'soft power'

With the U.S. at present having no manned space launch capability, it is up to the Russians and their Soyuz fleet to feed people to the ISS until the gaggle of U.S. private operators trying to work up station resupply capabilities can break through into the manned flight business. That's a big jump. The other avenue, of course, is to book one of the Soyuz rockets that France's Arianespace has bought from Russia. There is no one else, except possibly China—which, having been isolated from U.S. rocket technology for a long time because of technology transfer and nuclear proliferation worries, has had to develop its own.

This, of course, it has done in a very deliberate fashion, with careful, long-term planning. But as things stand at present, China would be unable even to rescue the ISS crew in an emergency because its docking system would not fit the station's airlocks (and its capsules are not big enough to rescue a full ISS crew anyway). Perhaps a little cooperation in space would be a good idea, both for safety and to save money.

That is certainly the hope of the chairman of the India Space Research Organization, Krishnaswamy Kasturirangan, who said earlier this year that the Mars orbiter mission would stand India in good stead as credentials for joining multinational efforts in space.

As Sethi remarked in August, "Indeed, for the developing world, China has become a key provider of technology and other commercial launch services at competitive rates. But more importantly, China has taken upon itself the role of a mentor in space for many smaller countries in Asia. Since 2008, Beijing has led the Asia-Pacific Space Cooperation Organization. With headquarters in Beijing, it comprises Bangladesh, Indonesia, Iran, Mongolia,

Pakistan, Peru, and Thailand. Training of foreign scientists at Chinese institutes and donation of ground stations to member countries to receive information from Chinese satellites are some of the activities that the organization has undertaken."

And apart from foreign influence, China also gains benefits at home, she said, because the space events "do wonders for the party's self-confidence and enhance its legitimacy at home. Secondly, they also allow China to participate in international negotiations on use of space from a position of strength. Not surprisingly, therefore, China perceives great value in these projects and will persist in its efforts towards setting up a space station by about the turn of this decade."

A Chinese space station, Sethi explained, would be in service at around 2020—at just about the time that the ISS venture between the U.S., Russia, Europe, Canada, and Japan is due to be decommissioned and deorbited. She added, "In the next decade then, China might be the only country with a permanent human presence in low earth orbit. It is a thought that should spur India into action."

It might also spur the U.S. Adding weight to that idea is a statement from the head of ESA's human spaceflight division, former German astronaut Thomas Reiter, who in early September said his 19-country agency is preparing to hold talks with Chinese officials about cooperating on astronaut training, docking systems, and life support technology. Some of Europe's astronauts, he said, have already begun Chinese language training.

A glimmer of hope for India came from the U.S. in July from NASA Administrator Charles Bolden. Speaking in Dublin at Europe's largest scientific conference, the Euro Science Open Forum, Bolden offered the hope that India would be able to use NASA's astronaut training facilities at Kennedy Space Center.

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It is impossible to argue that China is not a good role model in terms of planning and execution, but the political ramifications might well be impossible to overcome. Ability sometimes runs out of phase with capacity, and though NASA is facing severe budget problems at present, eventually India will probably be drawn to forge an alliance with the U.S. in space exploration based on the latter country's sheer financial and scientific capacity. That is, unless Arianespace or Japan manages to have any of its own rockets human rated in the meantime.

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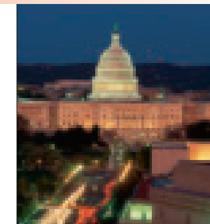


Heading home with little to show

CONGRESS WENT HOME ON SEPTEMBER 21, the earliest pre-election day adjournment date since 1960, giving lawmakers plenty of time to campaign but leaving business unfinished. But the comparison to 1960 does not tell the story. That year, Congress left town only after passing—on time—the annual budget for FY61, which began July 1, 1960.

Today's Senate majority leader, Sen. Harry Reid (D-Nev.), called this "the least productive Congress perhaps ever," and predictably laid the blame on the other side of the aisle. Sen. John McCain (R-Ariz.) spoke of having "watched the Senate deteriorate in a way that is almost spectacular." In an editorial, *USA Today* asked if this was the "Worst Congress ever?" The paper also published an opposing view arguing that an idle Congress "beats one that passes bad laws."

Apart from the de rigueur stopgap measure that prevents a government shutdown, Congress left the nation with no budget in effect for FY13, which began October 1, and no prospect for a budget any time soon. Nor has Congress acted on the looming 'fiscal cliff,' the poison pill of tax hikes and spending cuts that will take effect January 2 unless new legislation is passed.

Observers in Washington believe that when lawmakers return to Capitol Hill after November 6—some of them lame ducks, after being defeated at the polls—they will enact new legislation that will prevent the nation from flying off that cliff but will not address the core issues of the deficit and the debt.

Will lightning strike JSF program?

Without new legislation, the nation will be required by law to begin a new round of defense cuts totaling $400 billion over 20 years. If cuts are going to be made, the most obvious target is the F-35 Lightning II, which is behind schedule, over budget, and plagued with technical difficulties. But the story is a mixed one: The JSF test program is proceeding comfortably today, and airmen at Eglin AFB, Florida, are ramping up the first unit that will train pilots and maintainers. They expect to begin formal training this month.

The JSF world was shaken up in September when the program's deputy director (and director-designate), Air Force Maj. Gen. Christopher Bogdan, spoke bluntly about relations between the military and planemaker Lockheed Martin. In a speech at the annual convention of the Air Force Association, a group friendly to industry, Bogdan called the relationship between the program office and the contractor "the worst I have ever seen." Bogdan's remarks were interpreted by some in Washington as a slap not only at the company but also at program director Vice Adm. David Venlet, whose shoes Bogdan was slated to fill in October.

There is a huge contrast between the enthusiasms of those working on

Major Gen. Christopher Bogdan

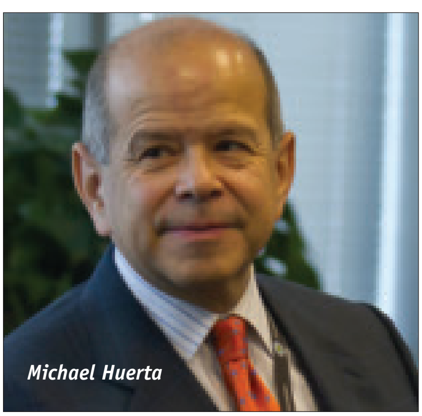
the F-35 and the criticisms proffered by the program's most severe skeptics. The aircraft "brings together everything that today's computer and digital age can do for an airplane in terms of how it flies and how it's maintained," Marine Corps Col. Arthur 'Turbo' Tomassetti, vice commander of Eglin's 33rd Fighter Wing, told this author. But the JSF "is an effort to be a 'jack of all trades,'" according to former Pentagon analyst Pierre Sprey, an advocate for inexpensive, single-mission war-

Among the issues besetting the F-35 are problems with the tailhook used for carrier landings.

planes, "and it doesn't do any of them very well."

Troubles persist with everything from the helmet-mounted cueing sight needed by all F-35 models to the tailhook used for carrier landings by the F-35C Navy version. Under flight restrictions in effect at the end of September, pilots were not flying the F-35 when the weather included rain and were prohibited from flying within 25 miles of lightning—in a plane named the Lightning II.

The Pentagon wants 2,443 F-35s for U.S. use—680 for the Navy and the Marine Corps, down from a once-planned 1,089, plus 1,763 for the Air Force. All three versions—the F-35A conventional takeoff, F-35B short takeoff/vertical landing, and F-35C carrier-based aircraft—are intended to be as alike as possible.



Michael Huerta

Unlike aircraft in past programs, the JSF is being developed using 'concurrency,' the Pentagon's policy of testing it and preparing it for combat simultaneously. Supporters say concurrency will help compensate for past delays and have the aircraft combat-ready sooner; detractors say the policy is intended to make the program 'too big to fail.' Analyst and freelance journalist David Axe recently quoted Frank Kendall, the Pentagon's top weapons buyer, as saying, 'Putting the F-35 into production years before the first test flight was acquisition malpractice." Kendall then added, "It should not have been done, okay? But we did it, okay?"

In addition to the full-fledged training of pilots and maintainers expected to begin at Eglin, the first combat-ready F-35B squadron is slated to become operational at Yuma, Arizona, early next year. Testing continues at Patuxent River, Maryland, and Edwards AFB, California.

Embarrassed by a 2010 Pentagon study that revealed delays and cost overruns resulting in a cost per copy that exceeded the original contract by 50%, officials like Bogdan now say the JSF program is under control and will give the nation a viable weapon in just a few months.

Next steps for NextGen

The FAA announced on September 20 that it was taking its next step in implementing the Next Generation Air Transportation System (NextGen) program by signing a contract to supplement voice communications currently used in commercial aviation with a digital communications system.

The FAA describes NextGen as "an umbrella term for the ongoing transformation of the National Airspace System. At its most basic level, it represents an evolution from a ground-based system of air traffic control to a satellite-based system of air traffic management." The agency says the system will avoid "gridlock in the sky" and will reduce aviation fuel consumption by 1.4 billion gallons, greenhouse gas emissions by 14 million tons, and operating costs by $23 billion. In February, after years of debate and delays, Congress approved its latest outlay, $63.4 billion, for the program.

The FAA once intended to have the first NextGen system components in operation in 2008; current scheduling calls for a phased implementation across the nation between 2012 and 2015.

Like the military's JSF, NextGen is a long-standing government program that has won praise from advocates and barbs from naysayers who argue it is taking too long and costs too much. It is an effort to use digital technology and satellite navigation, which

JetBlue became the first FAA-approved carrier to fly NextGen routes into JFK airport.

the FAA calls performance-based navigation, as a tool to bring U.S. airways up to the digital standard that has already been reached by much of the rest of the world.

The FAA's acting administrator, Michael Huerta, appeared in Orlando on September 20 in an event coordinated with JetBlue Airlines to announce the implementation of some aspects of NextGen in Florida. The FAA is breaking down its efforts into what it calls Metroplexes around the nation: His announcement means that a beta version of NextGen will replace earlier, analog navigation methods in the Metroplex that includes the Miami, Orlando, and Tampa areas. It will also make JetBlue the first FAA-approved carrier to fly NextGen routes into New York's JFK airport. JetBlue and Southwest Airlines are the first carriers to have NextGen-compatible equipment on board their aircraft, paid for partly with federal funds.

For some, that is not fast enough. Testifying on the Hill on October 5, 2011, Air Line Pilots Association President Lee Moak spoke of the safety advantages to be offered by NextGen. He called government spending on the program "not nearly enough" and pointed out that "aircraft manufacturers are currently delivering aircraft off the production line that possess capabilities that cannot be utilized, either because the current infrastructure is not prepared to use the technology or the necessary operational procedures have not been approved."

Moak said the nation needs but does not yet have "a fully funded plan that offers a systematic approach that builds on better science and improved decision support tools, advanced air traffic procedures, enhanced aircraft technology, sustainable alternative fuels, and policies to address environmental challenges."

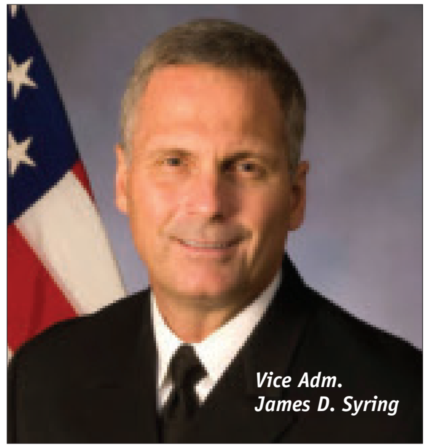
An FAA announcement says NextGen will mean "new methods of routing pilots, planes, and passengers, and landing procedures that [will] shave minutes from flight time."

New MDA chief

The Senate adjourned after confirming the new director of the Missile Defense Agency, Vice Adm. James D. 'Jim' Syring. MDA is under fire by critics who argue that U.S. missile defense plans are not working well. It does not help that the outgoing MDA director has been under scrutiny for his leadership style and for allegedly lowering morale at the agency.

Syring, who received a promotion to his new three-star rank for the job, is a 1985 naval academy graduate with surface warfare experience and a low-key following in Washington. He served as the technical director for the U.S. Navy's DDG 1000 shipbuilding program and followed that tour as the DDG 1000 Major Program manager.

Despite the spectacular technology (and sky-high costs) of missile defense, the U.S. is not seeking to build a shield against the ICBMs that belong



Vice Adm. James D. Syring

to the other two world powers, Russian and China. The MDA is the latest version of a succession of government agencies intended for the lesser goal of providing a limited defense against second-tier countries like North Korea and Iran. There have been successes, but the MDA-developed system of missile defense is "very expensive and has limited effectiveness," according to a new National Research Council report that had been requested by Congress.

"The system has [only] a very limited ability to defend the U.S. from missiles other than ones from North Korea," wrote missile expert L. David Montague, who cochaired the report panel. The report also weighs in on the best strategy for shooting down incoming missiles, suggesting the nation should target enemy missiles in midcourse—high above Earth's atmosphere. This would provide more time to identify threats and afford several opportunities to shoot down incoming missiles. The report criticizes earlier efforts to develop a system that would neutralize missiles in their boost phase, including an airborne laser program that the Air Force tested for several years and then abandoned.

Lt. Gen. Patrick O'Reilly

The $10 billion-a-year missile defense effort has a long record of flight test failures and successes, and the biggest research budget of any Pentagon program. Spencer Ackerman of the blog Danger Room called MDA "one of the most lavish-spending commands in the military." According to Bloomberg Government, an information and analysis website, in 27 years MDA and its predecessor agencies have spent $150 billion in current-year dollars, or about the same amount as the Apollo program that placed astronauts on the Moon.

Critics of missile defense policy—and of its costs—have mostly steered clear of comment about MDA leadership, but some in Washington are vocal. A May 2 report by the Pentagon's inspector general (IG) criticized the MDA director, Army Lt. Gen. Patrick O'Reilly, saying he "engaged in a leadership style that was inconsistent with standards expected of senior army leaders." O'Reilly has been a frequent target for Al Kamen, author of the "In the Loop" column in the *Washington Post*, who on September 18 referred to the general's "somewhat stormy four-year tenure."

O'Reilly told the IG that he disagreed with the conclusions of, and denied several of the allegations in, the report. Supporters of the general say he is being penalized for being closely associated with the previous administration.

When we went to press, it was unclear when O'Reilly would depart and Syring would move in. The Senate language on the Syring confirmation was explicit about his promotion but did not even mention the MDA by name, prompting some in Washington to believe (and Kamen to write, erroneously) that the upper house had completed only half the job. Sources on Capitol Hill and in the Pentagon confirm that language of the confirmation is all that is needed for Syring to pick up the MDA reins, and that the agency can make the transition at any time.

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Robert F. Dorr's Mission to Tokyo *was published September 1.*

Douglas Barrie

Interview by Philip Butterworth-Hayes

Given the current state of EU defense budgets and the capabilities of various member states, where do you think the major areas of technology gaps are—unmanned air systems, airlift, or transport helicopters, for example? Is there any sign these are being filled?

Inadequacies remain in terms of areas such as strategic airlift, tanker aircraft, and intelligence, surveillance, and reconnaissance [ISR] platforms—crewed and unmanned. This arguably is at least in part a historical legacy, since during the Cold War period the perceived existential threat was on Europe's doorstep. With a shift to out-of-area operations, such shortfalls come quickly to the fore.

With regard to ISR and other special-mission aircraft, the high cost associated with the acquisition and support of what are small fleets in terms of airframe numbers is also a barrier to entry for many nations. NATO's Alliance Ground Surveillance strategic ISR project—based on the Global Hawk UAV—is an effort to begin to improve its capability in this area through a pooled resource, but the project has been under way in one guise or another for two decades. The A400M, when it belatedly enters service, will also go some way to addressing the shortfall in European airlift.

What will the pressures on European defense budgets mean for aerospace manufacturers, both inside and outside the continent?

Given the challenges many European economies continue to face as a result of the 'euro crisis,' there is little reason to suspect the downward general pressure on defense expenditure will abate. Even France and the U.K., Europe's two most capable military powers, are struggling with defense commitments. France is in the midst of a defense review, and if present economic performance continues, the U.K. may face further difficult choices in its next strategic defense and security review, due in 2015. The intended 'Future Force 2020,' spelled out in the 2010 defense review, required that funding begin to be increased in the latter half of this decade. Without the increase, the desired force structure would not be achievable.

In the case of many other nations, some capability areas are being axed completely, or planned procurements cut significantly. The Netherlands has disbanded its heavy armor units, for example, while Germany has cut the number of attack and medium-lift helicopters it plans to buy. Role specialization is once again on the agenda for some nations, and is being considered as an element of NATO's Smart Defense Initiative, although there is a concern that some countries will use the guise of specialization to cut capability and reduce costs.

From an industrial perspective, the European defense market will provide only limited opportunity; sustaining (if possible) market share, rather than any thoughts of organic growth, will likely be the goal for industrialists involved in the sector. This makes the export market all the more important, while it will also likely encourage some to look at their overall business strategy and to consider acquisition or exiting the sector as options.

Irrespective of the outcome of the proposed BAE/EADS merger, additional consolidation in the European context appears inevitable. A merged BAE/EADS would obviously pose questions for Thales and Dassault. Dassault Aerospace has a 26% share in Thales, while the latter has in the past held discussions with France's Safran about collaboration in discrete business sectors. EADS also holds a 46% share in Dassault.

"Given the challenges many European economies continue to face as a result of the 'euro crisis,' there is little reason to suspect the downward general pressure on defense expenditure will abate."

Douglas Barrie is senior fellow for military aerospace at the International Institute for Strategic Studies in London. Before joining the institute he was, from 2002, London bureau chief for Aviation Week & Space Technology. *Previous professional positions include European editor of* Defense News, *defense aviation editor for* Flight International, *and deputy news editor for* Jane's Defence Weekly. *Barrie studied at Edinburgh University and holds an MA (Honors) in English language and literature.*

What have the EU states learned from Afghanistan and Libya?

A central lesson that could be drawn from Libya is that irrespective of the rhetoric that emanated from some European capitals, the Libyan mission continued to show the extent to which Europe and NATO remain dependent on the

"A central lesson that could be drawn from Libya is that irrespective of the rhetoric that emanated from some European capitals, the Libyan mission continued to show the extent to which Europe and NATO remain dependent on the U.S. for 'mission enablers'…."

U.S. for 'mission enablers,' while the opening sal-vos of the campaign also relied heavily on U.S. air and naval platforms.

The precursor to the NATO-led Unified Protector was the U.S.-led Odyssey Dawn. It also showed that when absolutely necessary the alliance could thrash out an agreement over the politics and mechanics of mounting a mission, and also be able to introduce nonalliance states (for example, the United Arab Emirates, Jordan, and Qatar as well as Sweden) into the coalition.

With regard to the air campaign itself, this served to reinforce the primacy of precision-guided munitions: Rules of engagement and public perception required that the risk of civilian casualties be kept as low as possible. Air power has a patchy record when used for purely coercive purposes; however, in the case of Libya, it proved arguably the decisive factor in providing the opposition forces with the time to develop the ability to successfully engage regime forces, while also shackling the regime's ability to use its armor and air assets.

It [air power] again underscored the importance—and the relative lack—of ISR, particularly when there was no land forces component contributing to the tactical 'ground picture.'

With regard to Afghanistan, air forces have to some extent had to relearn the skills and competencies required for close air support. The value of air-launched precision-guided weapons has also been clear (as has the burgeoning use of unmanned aerial vehicles during the decade of operations). It has also provided a salutary lesson as to the limits of precision-guided weapons: These can only be as accurate as the targeting information provided, as a number of blue-on-blue engagements have shown—an issue which is also apparent in the use of UAVs for 'targeted killing,' and concern over the uncertain number of civilian casualties resulting.

How much of a threat—competitive or otherwise—are fast-expanding aerospace military powers in India and China to Western suppliers?

In the military aerospace sphere, neither China nor India will prove competitors in either the U.S. or Europe's traditional markets. Where China in particular may continue to build market presence is in Africa and in some areas of Southeast Asia. In the case of India, the challenge for Western—and Russian—companies in the longer term is whether, as India's national capabilities develop, albeit slowly, there will still be room for foreign equipment acquisitions.

Which of the key technologies currently being researched will give European and U.S. military aircraft manufacturers an edge over other competitors in the marketplace?

The relative technology gap between the U.S. (and to an even greater extent, European manufacturers) and emerging defense aerospace nations is closing, China being the most obvious example. Areas that will be required to provide a capability advantage in high-threat environments will continue to include low-observable technologies, with work continuing into the application of active stealth. Development of the use of advanced low-observable unmanned combat air vehicles [UCAVs] will also address survivability in high-threat environments. Integrated sensor and processing suites and the ability to exploit their output across different platforms may also be a technology discriminator.

How will European industry consolidate over the next few years in the face of declining markets, and what role, if any, will the U.S. play in this consolidation?

It may be a cliché, but I do think European industry is at an inflexion point with the proposed merger of BAE and EADS. Should the deal go ahead, it will have a fundamental effect on the sector in Europe, and will have ramifications beyond, including in the U.S. In the late 1990s BAE's predecessor—British Aerospace—was on the brink of merging with Germany's DASA; the deal fell apart when the U.K. company was presented with the opportunity to buy GEC's defense business, Marconi. DASA instead formed EADS with French industry, although British Aerospace had signaled that it did still want to pursue a tie-up post the GEC deal. In the following decade BAE exited the commercial aerospace market, focusing on building up its U.S. business and developing its other core defense markets, such as Saudi Arabia.

EADS has also tried, less successfully, to build in the U.S., and at mergers with other European manufacturers. It held talks with Finmeccanica in 2001, but these didn't come to fruition. Given European defense spending trends there is a case for further consolidation in the industry, and a tie-up between EADS and BAE is a credible option.

EADS's defense business needs to grow either organically or through acquisition, and the former in the present environment seems unlikely. BAE's choice would appear to be between effectively becoming a U.S. company or looking to sustain a strong U.S. footprint but becoming a key defense element of a European aerospace giant. The deal, should it proceed, will raise fundamental questions of strategy for

Dassault, Finmeccanica, Saab, and Thales. It could also prompt U.S. primes to consider their own acquisition strategies, depending on how the Defense Dept. views the EADS/BAE proposal. [*Note: On October 10 BAE Systems and EADS announced that "the interests of the parties' government stakeholders cannot be adequately reconciled with each other" and that they were terminating discussions about a possible merger.*]

So what's the future for Saab, Finmeccanica, and Dassault in any major consolidation of the EU industry?

Italy's Finmeccanica is, alongside France's Thales, the main European provider of defense aerospace avionics and radar. It is not inconceivable that the Italian company might look to place at least some of its business units within a merged EADS/BAE in the future. Dassault and Saab face issues of scale in terms of combat aircraft manufacturing, while EADS is also a shareholder in the former company.

The notional in-service date of any operational system is in the mid-2030s. As far as a crewed replacement to the present fourth-generation fighter stable is concerned, the planned acquisition of the F-35 by several European countries, including the U.K., meets this requirement, and makes it more difficult to argue the case for an independent European program.

Whether in the fullness of time Europe has the appetite and ambition to fund the R&D required for an eventual successor crewed combat aircraft remains to be seen.

Do you think it likely that the European market for military aircraft will become more difficult to access in the future for U.S. companies?

Traditionally the U.S. has enjoyed access to the European marketplace, and this continues with the F-35. The C-130J has also attracted European customers. If, as seems possible, there is a further reduction in the number of European primes, then Europe may need to look to the U.S. as a means of providing competition. This of course assumes that should a common European defense market emerge, it would favor, to some extent at least, a competitive approach rather than that of directed procurement.

"Whether in the fullness of time Europe has the appetite and ambition to fund the R&D required for an eventual successor crewed combat aircraft remains to be seen."

What aircraft is likely to replace the current generation of European front-line fighters—Rafale, Typhoon, and Gripen?

One of the issues prompting European industry to look at strategy is the lack of direction and funding in terms of research and development for next-generation combat air platforms—crewed or uninhabited. The British Taranis and French-led Neuron UCAV demonstrator programs are just that. Both will, under present plans, conclude following flight tests of the demonstrator air vehicles.

London and Paris are, as a result of the Anglo-French Defense Treaty, now undertaking an 18-month study to scope the potential for a collaborative UCAV program that would see a prototype air vehicle flown around 2020.

What are the European prospects for the F-35?

As long as the F-35 remains now on track in terms of delivery schedule and projected cost, then it will become Europe's de facto fifth-generation fighter. Were there to be further significant delays due to technical issues, or were there additional price escalation, then it could prove difficult for some European nations to justify the program at a time when defense expenditure is under considerable pressure.

Export hurdles aid foreign UAV competitors

TECHNOLOGY RESTRICTIONS ON UAV exports to foreign countries are threatening U.S. manufacturers' worldwide leadership position in this market.

The coming year promises to be critical as major European countries—including Germany, France, and the Netherlands—decide what to do about their requirements for medium-altitude, long-endurance (MALE) aircraft. General Atomics Aeronautical Systems' MQ-9 Reaper faces tough competition from Israel Aerospace Industries' Heron TP and Elbit Systems' Hermes 900.

Northrop Grumman has the potential for a major export of the MQ-4C Broad Area Maritime Surveillance System, involving the sale of four to eight UAVs to Australia. South Korea has again quietly asked the U.S. government for pricing information for the RQ-4 Global Hawk after reports erroneously suggested the country has ended its interest in the aircraft. Japan also is interested in purchasing the land and maritime versions of Global Hawk, although a near-term purchase is unlikely.

These upcoming contests promise to help determine the extent to which products competitive to U.S. UAVs are able to build up their market positions.

Harming industry to no purpose

Leading U.S. UAV industry executives are frustrated with restrictions that make it difficult to meet foreign demand for their systems. "The export restrictions that we are facing today are hurting this industry and America without making us any safer," said Northrop Grumman CEO Wes Bush in an April speech in Washington, D.C. "They could cause the U.S. to relinquish its lead in these technologies to other nations based on their ability to meet global demand."

Bush expressed concern that the UAV industry could follow the path of

Reaper

the U.S. satellite industry, which lost ground to foreign competitors unfettered by the same restrictions. In fact, foreign rivals have even designed U.S. components out of their satellites so they could claim to be completely free of U.S. export control regulations.

If export restrictions are not loosened, it will be difficult for the U.S. to take advantage of the growing international market for UAVs in the future.

Teal Group projects that the international market for UAVs will be the most dynamic part of the market over the next decade, growing from $1 billion in 2012 to $3.4 billion in 2021. Asia-Pacific promises to be a particularly robust area over that period, growing almost sixfold over the decade to $1.4 billion.

These gains come at a time when the U.S. UAV market is cooling off because of an existing large base of UAVs purchased already, making capturing that export market all the more crucial for U.S. companies in the future. Teal Group projects that the U.S. UAV market will grow from this year's $2.5 billion to $3.2 billion in 2021.

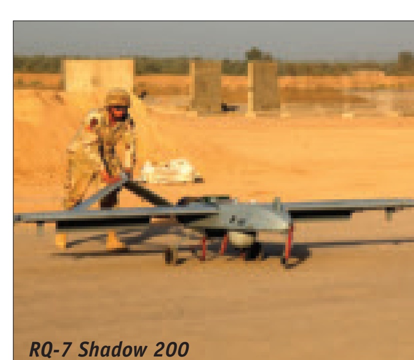
Despite boom, exports lag

The drive by UAV manufacturers to build up their international revenue follows that in other sectors of the U.S. defense industry, which see strong potential for foreign sales at a time when the U.S. defense budget will be under serious pressure. Major prime contractors such as Boeing and Lockheed Martin have been increasing their shares of international sales for several years and see potential for increasing those sales further. In FY12 the U.S. reported record foreign military sales of $64 billion, with FY13 expected to exceed even that record.

Yet it is manned aircraft that are driving these record figures. Blockbuster sales such as the $29.5-billion F-15 fighter sale to Saudi Arabia and the $10-billion F-35 JSF purchases by Japan have boosted sales. UAVs are not sharing in this windfall.

Ironically, the UAV sector, where the U.S. leads the world, has remarkably few exports over the past few years. The UAVs that are the backbone of the UAS military efforts—the Predator/Reaper, RQ-7 Shadow 200, and RQ-11 Raven—have sold only 5-7% of their systems for export over the past several years. In part that reflects the slow pace of foreign militaries in adopting UAVs, but it also reflects the immense difficulties U.S. companies face in exporting their systems.

Considering the natural advantages that U.S. systems have, this is an extremely low level of exports. U.S. companies have huge advantages in the overall market, with a domestic segment that in recent years has represented two-thirds of the worldwide market for UAV procurement and re-



RQ-7 Shadow 200

search. Massive procurement spending has given U.S. manufacturers tremendous potential advantages in economies of scale. U.S. military R&D for unmanned systems helps companies develop products that potentially could be sold to other countries. U.S. systems also offer interoperability with U.S. forces using the same systems.

In part, the lagging exports also reflect the slower rate at which UAV technology has been adopted by other militaries. It also reflects the tremendous U.S. military demand that major UAV manufacturers have often had to meet.

Yet there is more involved. Export controls are a major problem for the UAV industry. U.S. companies often find it difficult to provide needed marketing information, even to trusted allies such as Germany.

Control regime

The Missile Technology Control Regime looms as a particularly large obstacle to the U.S. ability to take advantage of its leadership in a number of UAV sectors. The MTCR was a voluntary agreement established to limit the proliferation of delivery systems for weapons of mass destruction, including missiles and UAVs. It created categories intended to restrict the export of such systems. Category I is for systems that would deliver a 500-kg payload at least 300 km. For this category, which includes systems such as Global Hawk and Reaper, there is to be a presumption of denial for exports. Category II covers all other systems.

MTCR has since grown to include 34 countries. Others, such as Israel and China, are not signatories but have indicated that they will abide by the terms of the treaty.

The Obama administration has been unwilling to undertake a renegotiation of the terms of the MTCR despite the evolution of UAV technology and the threats posed to U.S. UAV leadership. Unfortunately the administration is in a bind out of concern about creating a precedent that would allow other countries to provide advanced technologies to Iran. Rather than opening a potential loophole, the administration has chosen to remain firm in its commitment to the MTCR rules as currently written.

That effectively closes the door on some potential sales of advanced U.S. systems. For example, Singapore has been interested in purchasing Global Hawk for years, but cannot be considered because it is not a signatory of the MTCR. Saudi Arabia and the United Arab Emirates are interested in purchasing the Predator/Reaper, but are precluded from doing so by U.S. restrictions. Instead, General Atomics Aeronautical Systems is offering the Predator XP, a derivative that has been modified to ensure that it no longer can be considered a Category I MTCR system. The difficulty is that countries generally want a fully capable system rather than a scaled-down version.

In other cases, U.S. companies may not be able to team with foreign manufacturers to ensure that a system remains more easily exportable. Austria's Diamond Aircraft Industries, which builds an optionally piloted DA-42 aircraft, works with both Aurora Flight Systems, a U.S. company, and Germany's Rheinmetall to ensure that its systems are exportable. In some cases, such as the former Soviet Union, Rheinmetall's electronics will be used to ensure exportability of the system.

Diamond Aircraft also has found that the U.S. and Europe differ in their interpretations of MTCR rules, specifically over whether the system could theoretically be overloaded to make it a Category I system. These differences and the cumbersome U.S. export process have made dealing with a U.S. and a European electronics supplier a desirable solution for Diamond.

Growing competition

U.S. manufacturers face increasingly tough competition. Israeli companies, for example, are able to move much more quickly to take advantage of market opportunities. When European countries urgently needed to lease

Hermes 900

UAV systems to support their troops deploying to Afghanistan, it was Israeli UAVs from three different companies that they chose. Germany and France leased the Israel Aerospace Industries Heron, the U.K. leased the Elbit Systems Hermes 450, and the Netherlands chose the Aeronautics Aerostar.

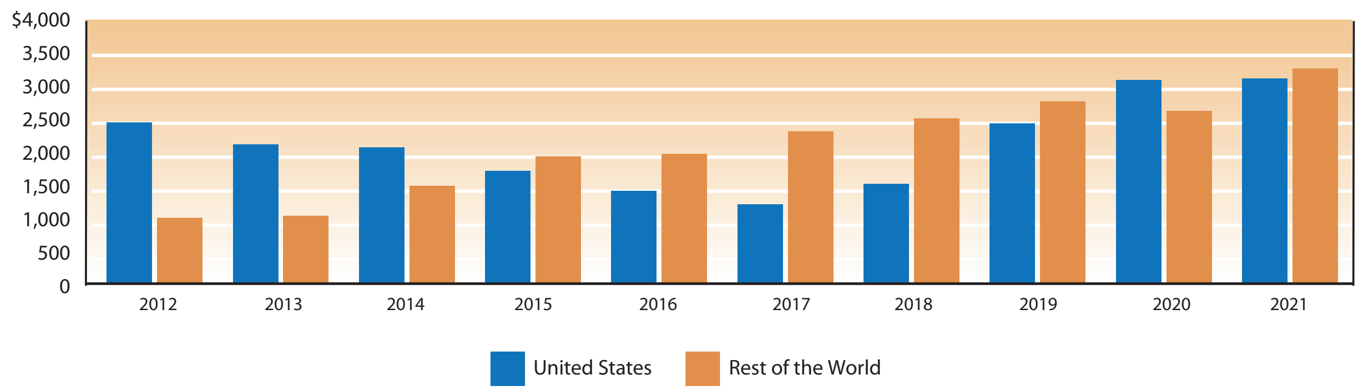
Since most of their sales are overseas, Israeli companies also have been able to develop systems targeting the international market. Elbit Systems' new Hermes 900 is billed as a low-end MALE UAV designed to be compliant with the MTCR. As a result, the company has been able to win export orders from Latin America, an area that U.S. manufacturers generally see as offering relatively little hope for relief from the treaty's strictures. Chile and Colombia have already contracted to purchase the Hermes 900, while Elbit Systems has created a joint venture with Brazil's Embraer to develop the new Harpias UAV, an all-new MALE UAV based loosely on the smaller Hermes 450.

As time goes on, new producers promise to enter the market. China has already been involved in competitions for a MALE system in the UAE and Turkey. Russia, which is far behind in UAV technology, is also focused on remedying that deficiency and moving into international markets.

Even Europe, which has chronically underfunded its UAV programs, is getting into the act. BAE Systems has offered its Mantis to the UAE, provided the country is willing to put up development money.

U.S. manufacturers complain that they are being held to a stricter standard than some of those competitors who are able to offer Category I UAVs

WORLD UAV PRODUCTION FORECAST
All figures are in $Millions

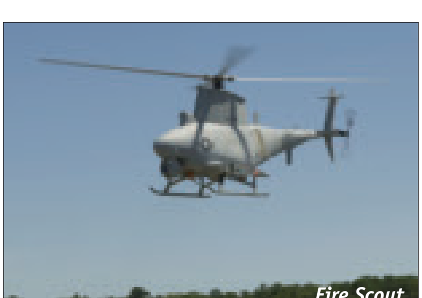


in areas considered out of bounds to U.S. companies. In recent years, it has taken U.S. government intervention to ensure that Israel would not allow the sale of the Heron to Russia and also to ensure that Harop loitering antiradar missiles would not be upgraded for China.

Red tape and other complications

The problem goes beyond the MTCR. At times bureaucratic red tape bedevils U.S. export marketing efforts. As a result, one major ally has faced long delays in getting key performance data needed to evaluate the Reaper for purchase.

In other cases, military requirements move away from easily exportable systems. The Navy has shifted its requirement toward the Fire Scout C, which would be considered a Category I system under MTCR, and therefore not easily exportable. Fire Scout B, which would be much easier to export, never finished the government evaluations necessary to prepare it for


Fire Scout

export since it has been engaged in urgent deployments. As a result, Northrop Grumman has throttled back on international marketing plans for the Fire Scout, a system that had tremendous interest around the world as a naval VTOL system.

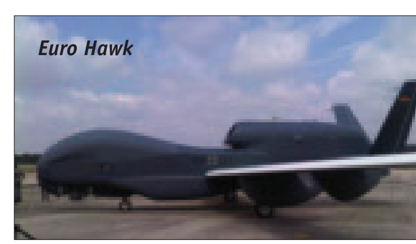
U.S. companies in some cases have faced legislative obstacles unlike those facing competitors. One lawmaker has held up the sale of an armed version of the Predator to Italy for the past two years.

Making inroads (for now)

Despite these problems, manufacturers are making progress in penetrating international markets. AeroVironment, whose mini UAVs face considerably fewer restrictions than those on larger UAVs, has a growing list of clients, including Australia, the Czech Republic, Denmark, Estonia, France, Italy, Lebanon, the Netherlands, Norway, Saudi Arabia, Singapore, Spain, Sweden, Thailand, Uganda, and the U.K.

Over the past several years, Textron's AAI has found growing success in international markets, winning Shadow 200 export orders from Sweden, Italy, and Australia.

Even Global Hawk, the world's most expensive UAV, has had increasing success in international markets. In May, NATO awarded Northrop Grumman a $1.7-billion contract to acquire five Global Hawk Block 40s to address glaring shortfalls in alliance capabilities that were underlined by last year's Libya air campaign. Euro-Hawk, a German version carrying a signals intelligence payload, is in testing, and Germany's military is expected to order an additional four systems in the next year.


Euro Hawk

Yet despite these recent successes, the relative U.S. UAV market position promises to decline over the long run without adequate reforms of U.S. export control procedures. International competitors are offering a growing number of increasingly capable systems. Technology that cannot be obtained in the U.S. will be purchased from other sources.

The danger for the U.S. industry goes beyond its ability to capture military sales. Over the longer term, as the commercial UAV market develops, current restrictions, at a minimum, will make it difficult for U.S. industry to respond quickly. In the commercial world, that could make the difference between success and failure in the marketplace.

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Troublesome trends in U.S. air transportation

The ups and downs of the nation's airline industry have ripple effects throughout the U.S. economy. Since deregulation in 1978, decisions on fares and regions of service are left up to the carriers. But a changed economic picture may call for a larger government role and some dramatic innovations.

by Lance Sherry and George Donohue

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The U.S. airline transportation system is a critical cog in the U.S. economic engine. By providing affordable, rapid intercity travel, the system is instrumental in bringing about the productivity gains experienced by the U.S. economy.

Economists and governments have generally taken these economic benefits for granted. Recent trends, however, cast doubt on the validity of this complacency and raise questions about whether the laissez-faire government approach is strategically

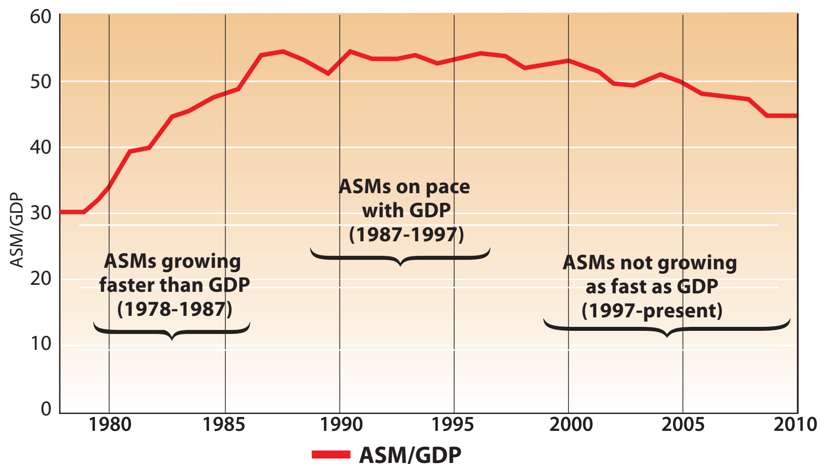
sound. An examination of trends in the U.S. domestic airline industry and the phenomena driving these trends may offer the government a roadmap for reversing them.

TRENDS

Since deregulation of U.S. airlines in 1978, there have been three distinct phases of growth in U.S. domestic service. In the first phase, from 1978 to 1987, the expansion of airline service was faster than the growth of the gross domestic product. In the second phase, from 1987 to 1997, expansion of service kept pace with growth in GDP. However, in the third phase, from 1997 to the present, airline service has expanded more slowly than the GDP.

The result is that during the past decade, in the presence of a net growth in GDP, airlines are serving fewer markets with lower frequency of service and smaller aircraft than estimates would have pre-

Since deregulation of the nation's airline industry in 1978, U.S. domestic airline service (measured in available seat miles, or ASMs), has grown faster than the GDP (1978-1987), at the same rate as GDP (1987-1997), and then more slowly than the GDP (1997-2011).



dicted had the trends from the previous decade continued.

The net effect is that U.S. domestic airlines are now configured to provide domestic service to *fewer, higher paying passengers*. Like the proverbial boiled frog, the public has been slow to perceive these gradual, subtle changes, which also have been masked by the effects of two recessions (in 2001 and 2007). The changes are real, however, and have significant economic and social implications.

IMPACTS

The increased prices and reduced geographic accessibility of air travel have had a direct effect on the economy through the multiplier effect of transportation. For businesses, the cost of travel is now significantly higher, affecting how much and how quickly companies can expand activities that generate innovation and productivity. In the tourism industry, another significant component of the U.S. economy, many leisure destinations rely on air transportation to compensate for small regional customer catchment areas. Thus the reduced affordability of air travel is having a significant effect on this sector as well.

Total revenues generated by air transportation have also directly affected income from federal excise taxes. These are collected by the airlines in the form of taxes applied to tickets and are used to fund the operation of the government-run air traffic control system. Shortfalls in such revenues also affect funding of the proposed National Airspace System modernization initiatives, including NextGen and the Airport Improvement Program.

Why did all this happen, and what, if anything, can the U.S. government do to reverse these trends? Researchers at George Mason University and MIT have been studying this phenomenon by mining historical data and developing simulations of the industry. Their findings are fascinating—and also counterintuitive.

FACTORS THAT SHAPE SERVICE

Prior to airline deregulation in 1978, the Civil Aeronautics Board strongly influenced the markets served, the frequency of service, and airfares. During that period, the airlines competed primarily by selecting the type of aircraft and amenities they provided passengers. In this way the government influenced how widespread and how affordable airline services were.

Since the industry's deregulation, all of the factors that determine the level of service (markets served, frequency, and airfare) are determined exclusively by the airlines, based upon the economics of the market. When the economics of the industry have failed to meet societal needs—leaving gaps in service to rural areas, for example—the federal government has subsidized airline service through the Essential Air Service (EAS) program.

AIRLINE ECONOMICS 101

In this deregulated market, publicly traded airline companies must make decisions to ensure the profitability of their networks. Profitable 'economic operating points' for service between two markets are determined by a complex interaction between nonlinear revenue and cost functions. The nonlinearities and asymmetries in these functions create several internal 'tipping points' that result in nonintuitive airline choices. For example, fewer passengers will be lost than will be gained, for the same increase/decrease in airfare.

A similar nonlinearity occurs when costs increase (fuel prices, for example). Instead of causing a shift to larger aircraft that (in theory) transport the additional passengers at lower cost, the interaction between revenue and cost functions shifts the maximum profit point to a new economic operating point where the revenues for excise taxes are lower.

This is exactly what has happened in the past decade. Inflation-adjusted, hedged jet fuel prices, which had hovered around $0.50 a gallon for the previous two decades, increased above $1 a gallon in 2004, peaking at $2.73 in the second quarter of 2008. This higher cost dictated that airlines respond by shifting to flying *fewer, higher paying passengers* on smaller aircraft. The average aircraft size for U.S. domestic flights decreased from 118 seats in 1997 to 96 seats in 2011. The inflation-adjusted average airfares increased from $283 in 1997 to $582 in 2011.

This is not a transient effect. Because of rising demand for fossil fuels from developing countries and increasing exploration and extraction costs, the DOE's Energy Information Agency (http://www.eia.gov/) forecasts that jet fuel prices will remain above $2 a gallon and increase over the next two decades to between $3 and $5 a gallon. This shift is a long-term structural change. Unless actions are taken to confront the phenomenon directly by addressing the control levers, this situation is here to stay.

COMPENSATING FOR HIGHER FUEL COSTS

To overcome the air transportation network contraction caused by higher fuel prices, the costs of operating a flight must be decreased. Traditional thinking has focused on improving fuel burn to compensate for the higher costs. However, analysis of empirical data on the costs experienced by U.S. airlines operating aircraft from 2005 to 2010 show there are marginal economies-of-density in aircraft seats for nonfuel costs and fuel costs.

Compensating for an increase in fuel costs from $1 a gallon to $4 a gallon, for example, would require an estimated improvement in nonfuel costs per seat-hour and fuel burn per seat-hour, to 41% of the existing performance for a 100-seat aircraft. Individually, this is a change in the nonfuel costs per seat-hour equivalent to three times the fuel burn per seat-hour, and a reduction in fuel burn per seat-hour to 25% of existing levels. This magnitude of change is greater than that of historical trends in technology. The only way forward is through a combination of improvements in nonfuel and fuel costs.

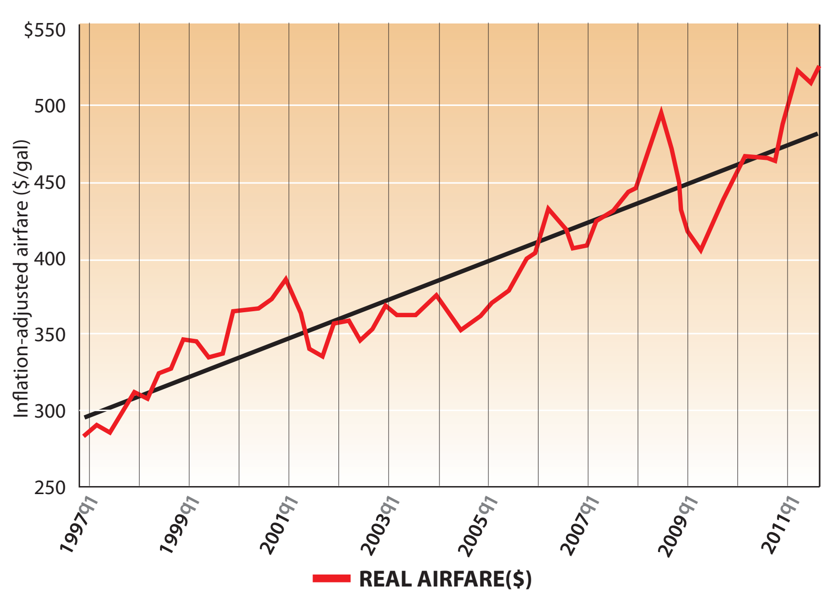
WHAT CAN THE GOVERNMENT DO?

With the existing technology and fleet mix, at $4 a gallon, maintaining affordability levels of $1 a gallon requires significant improvements in both nonfuel operating costs and fuel burn rates. A two-pronged approach is proposed: regulatory incentives and technological innovation.

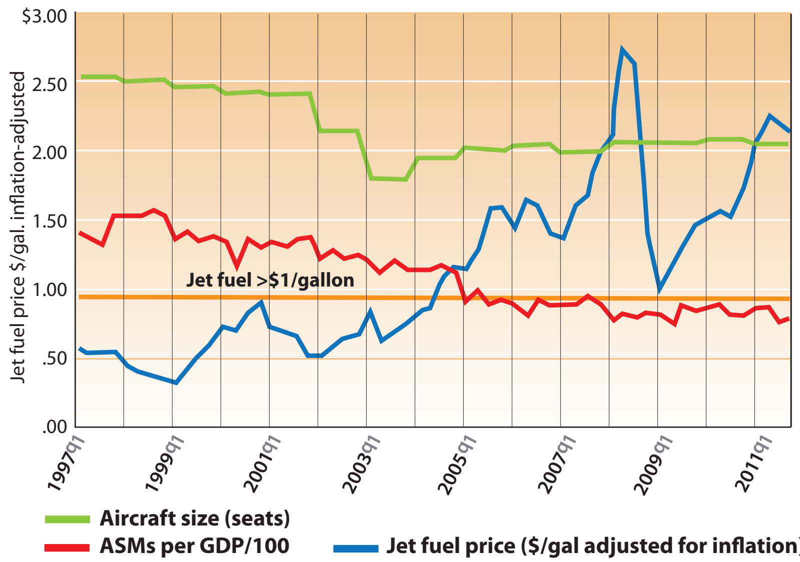
• *Regulatory incentives: Corporate average operating efficiency (CAOE) standards for new aircraft designs.* CAFE (corporate average fuel economy) standards are regulations enacted by Congress in 1975 to improve the fuel economy of cars and light trucks sold in the U.S. These regulations require manufacturers to design a fleet of vehicles that in aggregate meet a fuel efficiency standard. A similar approach could be adopted to incentivize aircraft manufacturers to meet operating cost standards. These standards would apply not just to fuel efficiency, but to total aircraft operating costs.

• *Technology innovation: Performance-driven comprehensive aeronautics research program.* To ensure that the proposed CAOE standards for commercial airliners can be achieved, the federal government

Inflation-adjusted average airfares have increased from $283 in 1997 to $582 in 2011.



The decline in ASMs per GDP is correlated with the rise of jet fuel prices above $1 a gallon, and the maximum profit migration to smaller sized aircraft flying fewer, higher paying passengers.



should embark on an aggressive performance-driven aeronautics research program. The program could be organized explicitly to achieve the 150% improvement in economies-of-density for the 50-150-seat class of aircraft that analysis indicates is critical to feeding U.S. hub airports from a thin-demand catchment area.

To achieve the performance goals, the research will need to cover a wide range of topics including, among others: turboprops, aerodynamics, higher payload-to-fuel/structures ratio, optimized aircraft design for U.S. dominant stage-lengths, reduced flight-deck crew size, and perhaps alternate fuels.

Based on economies-of-density data, there are three areas for research of 'low-hanging fruit': next-generation jet engines for regional jets; quiet, more efficient turboprops; and single-crew/ground-monitored flight decks.

The fuel efficiency of turboprops for efficient air transport is well established, as evidenced by widespread use in long-endurance military applications. A concerted effort to address the safety and noise concerns of the flying public may be required for this class of engine to gain acceptance. Unfortunately electric motors, powered by auxiliary power units or fuel cells, may not become feasible for this size aircraft in the near future without significant innovations leading to component weight reductions.

Achieving the performance goals will require improvements in more than propulsion. As flight crew costs are a major component of the nonfuel direct operating costs, this is also a likely target for future cost cutting. The past three decades have seen airline flight crews reduced from four to three to two. These changes were driven by a combination of economics and the availability of technology.

The proposed single-crew/ground-monitored flight deck would include a pilot on board the aircraft, assisted by an automated pilot associate as well as a ground-based monitoring pilot serving multiple flights simultaneously.

The ground-based monitoring pilot, with capabilities similar to those used for UAVs, might have responsibilities for crew resource management, checklist, data and communication, and system monitoring. This pilot would also be responsible for assuming control of the flight if the onboard pilot became incapacitated. The ground-based monitoring procedures, technology, and human factors would dovetail with ongoing research projects for UAVs. This research would leverage advances in 'pilot's associate' technologies and UAV ground station technologies that have been funded by NASA and DARPA.

Long lead times require an immediate start. Establishing the target performance requirements and the detailed research roadmap will be challenging, but it is critical to get started now. The lead times for technology development and fleet insertion are on the order of decades. For example, it took the intervention of a presidential task force in 1981 to facilitate the transition from a three- to a two-crewmember flight deck.

AMTRAK OF THE SKIES?

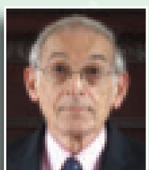
Failure to act decisively could lead to the same problem that U.S. passenger rail transport experienced half a century ago. As railroads found more profit in moving freight than in transporting people, they abandoned passenger service. To maintain desirable levels of commerce, the government was obliged to step in and subsidize passenger trains, namely Amtrak.

Given the future probability of government budget austerity, the Amtrak model for air service (such as expansion of the Essential Air Service program) is unlikely to be adopted. The result: reduced air commerce, with all the negative implications for the greater economy.

Honoring Achievement:

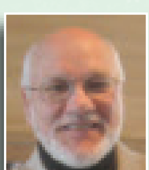
AIAA is proud to honor the very best in our industry: those individuals and teams who have taken aerospace technology to the next level … who have advanced the quality and depth of the aerospace profession … who have leveraged their aerospace knowledge for the benefit of society.

Awards presented between

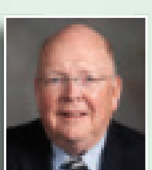


Aerospace Communications Award
Philip Rubin
President/CEO
RKF Engineering Solutions, LLC
Washington, D.C.

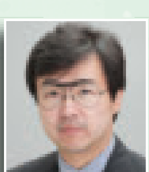
Aerospace Guidance, Navigation and Control Award
Jason L. Speyer
Professor
University of California – Los Angeles
Los Angeles, California



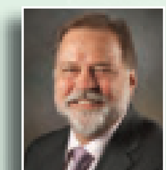
Aerospace Power Systems Award
Robert Wiley
Office of Space and Defense Power Systems (Retired)
U.S. Department of Energy
Germantown, Maryland



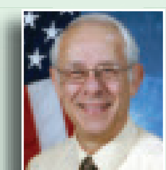
Air Breathing Propulsion Award
Walter F. O'Brien
J. Bernard Jones Professor
Virginia Polytechnic Institute and State University



Aircraft Design Award
Michimasa Fujino
President and CEO
Honda Aircraft Company
Greensboro, North Carolina

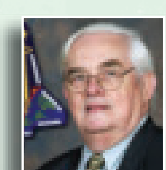


DeFlorez Award for Flight Simulation
Mark E. Dreier
Staff Engineer, Advanced Concepts and Preliminary Design
Bell Helicopter Textron, Inc.
Fort Worth, Texas

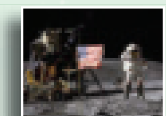


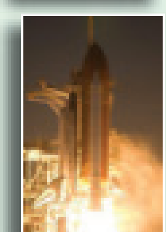
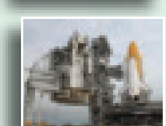
Energy Systems Award
Darrell W. Pepper
Professor, Mechanical Engineering
University of Nevada – Las Vegas
Las Vegas, Nevada

Engineer of the Year Award
John P. Clark
Principal Engineer, Turbine Division
Aerospace Systems Directorate
Air Force Research Laboratory
Wright–Patterson AFB, Ohio



Gardner-Lasser Aerospace Literature Award
John M. Logsdon
Professor Emeritus, Space Policy Institute
Elliott School of International Affairs
George Washington University
Washington, D.C.



George M. Low Space Transportation Award
NASA Space Shuttle Team
Award accepted by:
John W. Young, *Astronaut, NASA*
Robert L. Crippen, *Astronaut, NASA*
John P. Shannon, *Manager, Space Shuttle Program Office, NASA*
Stephen F. Cash, *Manager, Space Shuttle Propulsion Office, NASA Marshall Space Flight Center*
Peter P. Nickolenko, *Deputy Director, Launch Vehicle Processing, NASA Kennedy Space Center*
Donald S. Noah, *Manager, Space Shuttle Program SE&I Office, NASA Johnson Space Center*
Ronald D. Rigney, *Manager, Space Shuttle Main Engine Propulsion Test, NASA Stennis Space Center*

Jeffries Aerospace Medicine and Life Sciences Research Award
Cary Mitchell
Professor of Plant Physiology
Purdue University
West Lafayette, Indiana

Thank You Nominators!

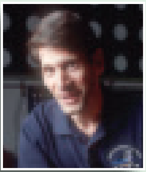
AIAA appreciates your time and effort in preparing the nomination packages!

Douglas Allen
M.S. Anand
Kevin Bowcutt
Janet Convery
Peter Covell
Robert Fortenbaugh
Ashwani Gupta
Jamie Johnson
John Junkins
Leland Nicolai
Paul Nielsen
Yaakov Oshman
James Russell
Jerry Sellers
William Sirignano
Ronald Smith
Eliot Winer
Simon Worden

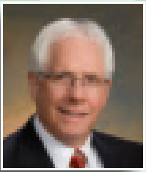
AIAA Hall of Fame

Honoring and awarding such achievement is an important AIAA tradition. Every quarter, award recipients are showcased through our Honors and Awards Program, so that all members have the opportunity to recognize their peers.

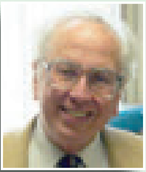
July 2012 and September 2012 include:



Haley Space Flight Award
Mars Exploration Rover Development and Operations Team
Jet Propulsion Laboratory
Pasadena, California
Award accepted by
John Callas, *MER Project Manager*

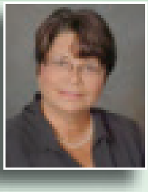


Hap Arnold Award for Excellence in Aeronautical Program Management
Ralph Heath
Executive Vice President of Aeronautics (Retired)
Lockheed Martin Corporation
Fort Worth, Texas



Hypersonic Systems and Technologies Award
John D. Anderson
Professor Emeritus, University of Maryland – College Park
Curator-Aerodynamics, Smithsonian National Air and Space Museum
Washington, D.C.

Mechanics and Control of Flight Award
John L. Crassidis
Professor, Department of Mechanical and Aerospace Engineering
University at Buffalo, State University of New York
Buffalo, New York

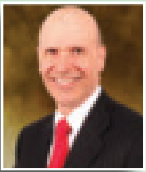


Multidisciplinary Design Optimization Award
Christina L. Bloebaum
Dennis and Rebecca Muilenburg
Professor of Aerospace Engineering
Iowa State University
Ames, Iowa

Propellants and Combustion Award
Stephen B. Pope
Sibley College Professor
Sibley School of Mechanical and Aerospace Engineering
Cornell University
Ithaca, New York

Space Science Award
Kepler Science Team
NASA Ames Research Center
Moffett Field, California
Award accepted by
William Borucki, *Principal Investigator*

Space Systems Award
Disaster Monitoring Constellation (DMC)
Surrey Satellite Technologies Ltd.
DMC International Imaging Ltd.
Guildford, Surrey, United Kingdom
Award accepted by
Sir Martin Sweeting, *Executive Chairman*



von Braun Award for Excellence in Space Program Management
James B. Armor
Vice President, Strategy and Business Development
ATK Space Systems Division
Beltsville, Maryland

Wyld Propulsion Award
Robert G. Jahn
Professor of Aerospace Science and Dean, Emeritus
School of Engineering and Applied Science
Princeton University
Princeton, New Jersey

AIAA Foundation Guidance, Navigation, and Control Graduate Award
Ved Chirayath
Stanford University
Stanford, California

AIAA
The World's Forum for Aerospace Leadership

12-0506

After years of struggle, many of the U.S. military's most troubled satellite acquisition programs are finally putting spacecraft into orbit, delivering much-anticipated new capabilities to the nation's warfighters. But even as the DOD continues to face challenges in developing new constellations, it has taken steps to avoid the kinds of problems that have plagued past programs.

Cosmic comeback for military space?

by Marc Selinger
Contributing writer

In a clean room, a HEO payload is prepared for delivery. HEO 1 and 2 were the first SBIRS satellites to be launched.

Building new satellites has long been a serious headache for the Dept. of Defense. Billions of dollars in cost overruns, years of schedule delays, and a seemingly endless spate of technical glitches have afflicted a host of major programs.

"The developmental systems promised giant single-step leaps in technology, but often overran program budgets and failed to meet requirements in a timely manner," says Air Force Col. David Arnold, a DOD space official.

As one congressional panel observed, "A myriad of reasons has contributed to the decline of space acquisition, not the least of which was the Dept. of Defense turning over space program management to contractors in an effort to reduce cost and improve efficiency."

Despite these problems, some of the most troubled systems have begun to show significant, tangible signs of progress. From 2009 to 2012, several programs providing communications, missile tracking, missile warning, and navigation have all launched their first satellites, prompting government and industry officials to suggest that military space may finally be turning a corner.

"The capabilities being delivered are the best in the world," says Arnold, Program Assessment Division chief for the DOD Executive Agent for Space Staff. "The current state of space acquisition is reaping the benefits of those years of development by having the ability to field mature systems now."

Even some of the DOD's harshest critics have been impressed by the improvement.

"The worst of the Defense Dept.'s space acquisition problems may be behind the department, as programs long plagued by serious cost and schedule overruns are finally being launched," says Cristina Chaplain, the GAO's director of acquisition and sourcing management. "Though acquisition challenges persist, they are not as widespread and significant as they were several years ago, and to its credit, DOD has taken an array of actions to reduce risks."

The House Appropriations Committee also sees improvement: "After two decades of troubled space acquisition, the national security space portfolio seems to be emerging from a period of programmatic excuses based on flawed acquisition strategies, poor cost estimating, and reliance on immature technologies," the panel wrote in its FY12 defense report. "Additionally, when new systems have actually become operational they have, for the most part, been successful on orbit despite problems that may have occurred in the development phase."

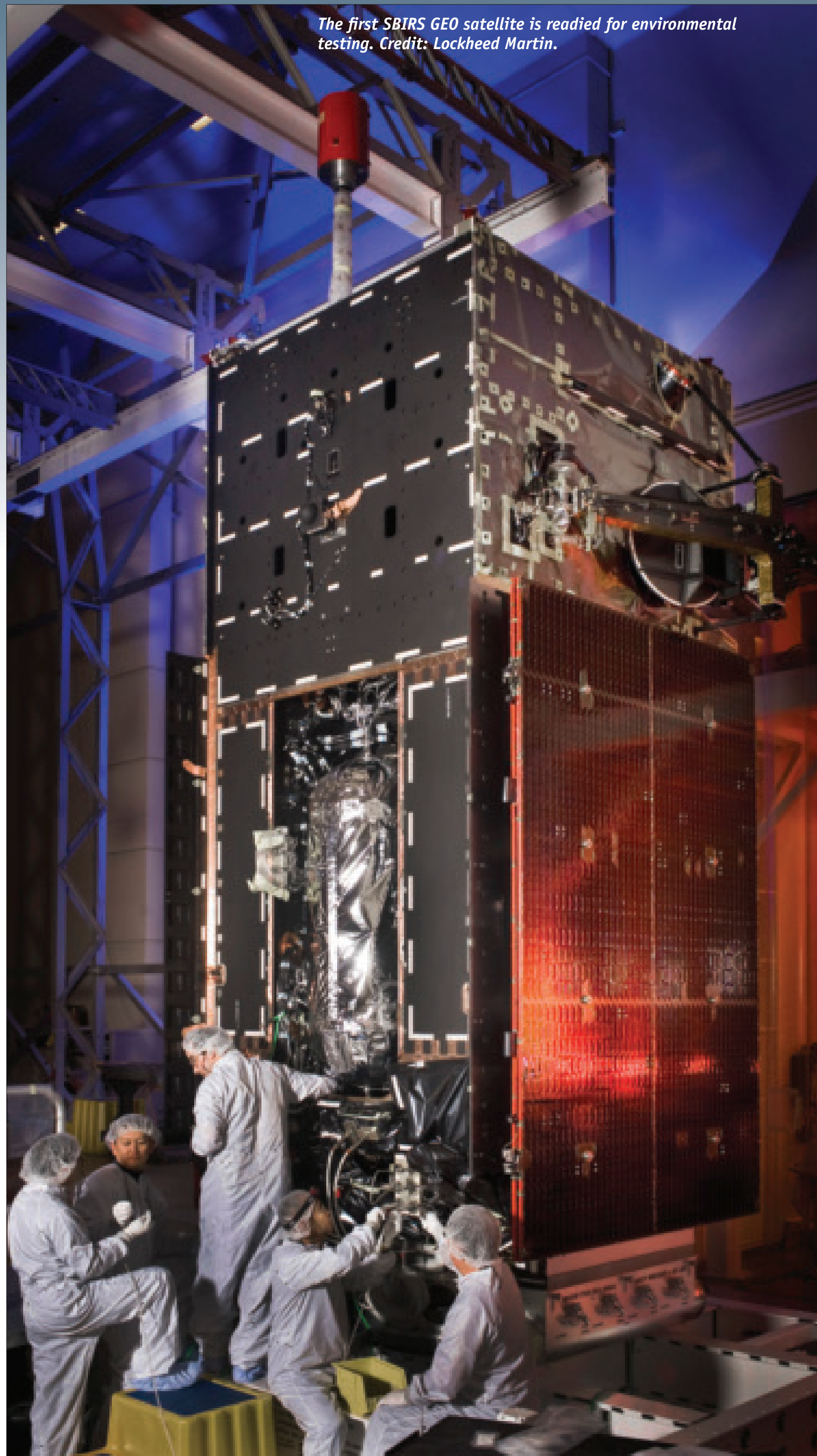
However, none of these accomplishments came easily, and difficulties still lie ahead.

Missile warning

For three decades, DOD has struggled to replace the aging Defense Support Program (DSP) satellites that detect launches of hostile ballistic missiles across the globe. Several potential DSP successors in the 1980s and early 1990s all foundered because of immature technology and high costs.

Military brass hoped the Space Based Infrared System (SBIRS) would finally be the charm. But the program, begun in 1996, seemed cursed instead. Problems mounted, and the price tag soared to $18.3 billion, up from an initial estimate of $4.6 billion.

"Since its inception, SBIRS has been burdened by immature technologies, unclear requirements, unstable funding, underestimated software


The first SBIRS GEO satellite is readied for environmental testing. Credit: Lockheed Martin.

complexity, poor oversight, and other problems that have resulted in billions of dollars in cost overruns and years in schedule delays," the GAO told Congress in 2007. "In addition, the program has been restructured several times to account for cost and schedule problems."

In 2006, the program finally lofted hardware into space—the first highly elliptical orbit payload (HEO-1) on a host satellite. HEO-2 followed two years later. And in May 2011, the first geosynchronous Earth orbit satellite (GEO-1) lifted off on an Atlas V rocket—nine years late but a major milestone nonetheless.

Air Force officials say SBIRS now meets or exceeds expectations. For example, GEO-1's pointing accuracy is almost 10 times better than expected, and it is seeing targets 25% dimmer than what is required. GEO-2 is on track to be launched in March 2013, and two more GEO satellites and two more HEO payloads are in production.

"I think we have positive momentum," says Col. James Planeaux, who oversees SBIRS as head of the Air Force's Infrared Space Systems Directorate. "We have a lot of confidence that SBIRS as a constellation capability will have a very enduring performance and will last for decades to come."

Not everyone is convinced the program is out of the woods. The GAO's Chaplain warns that GEO-3 and -4 could experience a one-year production delay and a $438-million cost overrun "due in part to technical challenges, parts obsolescence, and test failures." Prime contractor Lockheed Martin disputes that assessment, however.

"Production of GEO-3 and GEO-4 is proceeding well, and we are confident we will deliver these critical satellites on the baseline schedule and well under the cost figures reflected in the GAO report," says Jeff Smith, vice president of the overhead persistent infrared mission area for Lockheed Martin. DOD's plan to procure long-lead items for GEO-5 and GEO-6 is "a reflection of this increased confidence in the SBIRS team's ability to deliver the assets on budget and on schedule," he says.

What's next for SBIRS is unclear. DOD is studying what SBIRS-like capabilities it might pursue after GEO-6.

"If the country decides to procure more SBIRS, we'll be ready to do that," Planeaux says. "If the country decides to go in a different direction and pursue alternate technologies or an alternate acquisition approach, then we'll support that as well."

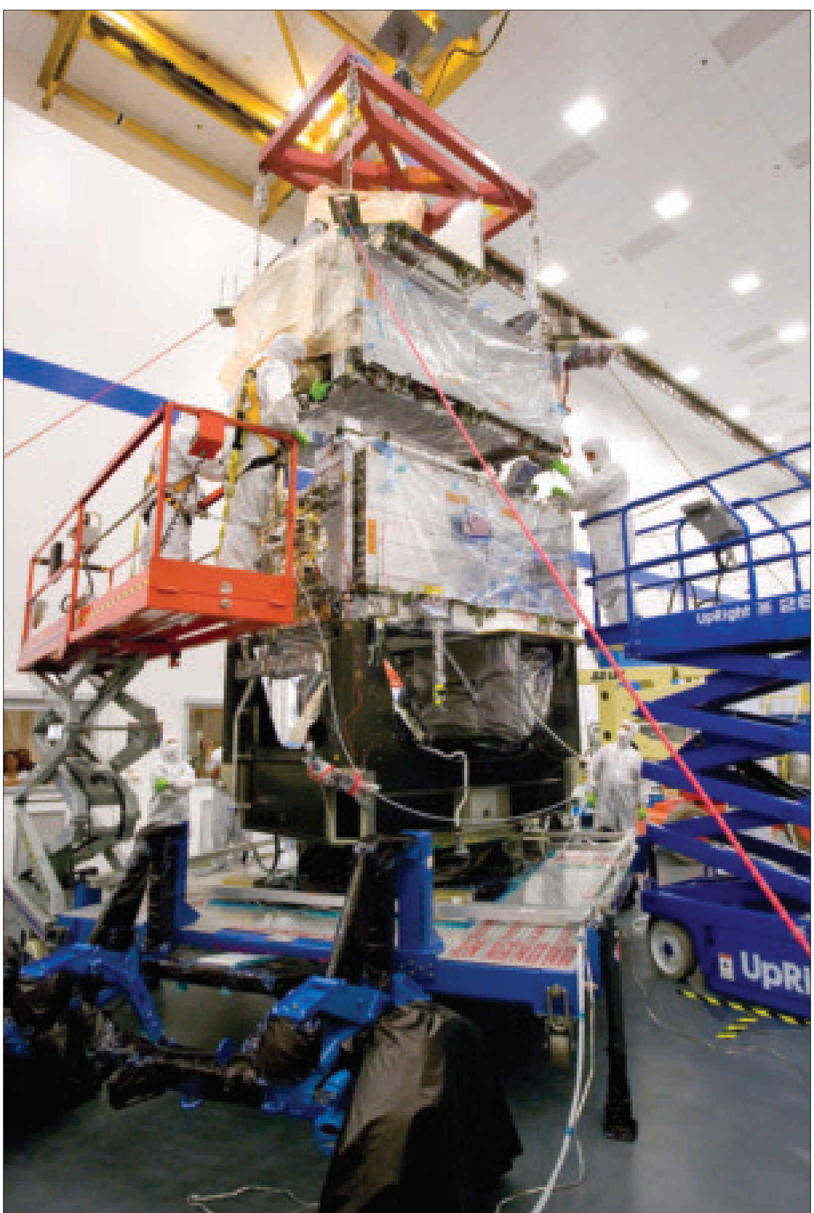
Missile tracking

Attempts to field missile-tracking satellites have also hit their share of snags. According to the GAO, DOD has spent billions of dollars since 1984 on a series of programs that were derailed by cost, schedule, and technical problems.

The latest effort, the Missile Defense Agency's Space Tracking and Surveillance System Demonstrators (STSS-D) program, launched its two satellites in September 2009—17 months late. MDA attributes the delay to defective electronic parts in the space/ground-link subsystem.

"By the time the problem was discovered, the manufacturer no longer produced the part," MDA says. "The delay was a re-

STSS-D satellites are meant to track ballistic missiles during the midcourse phase of flight. Credit: MDA.



sult of [the need for] identifying an alternate contractor to manufacture and test the replacement parts."

STSS-D, which has the "unique capability" to track ballistic missiles for long periods during their midcourse phase of flight, now provides valuable information, according to the agency. The two satellites, which marked their 1,000th day on orbit in June, have successfully tracked targets in 12 MDA tests, "demonstrating the viability of space-based remote networked sensors to deliver fire control quality tracks" to antimissile weapons systems, the agency says.

Despite being pleased with STSS-D's recent progress, MDA may not have an operational version anytime soon. The Precision Tracking Space System (PTSS) program, which is supposed to provide an STSS-like operational capability, is not scheduled to start launching satellites until FY17, and the first two spacecraft will be considered developmental. The GAO has warned that even that schedule is at risk because PTSS does not fully meet any of the nine 'best practices' for schedule development. But MDA insists STSS has laid a strong foundation for PTSS.

"STSS-D has shown a satellite can observe postboost threat objects, form a high-quality track for fire control solution purposes, and report this information to the [Ballistic Missile Defense System] battle manager within operationally realistic timelines," the agency says. "This success informs the PTSS program today."

PTSS is also expected to benefit from the NFIRE (Near Field InfraRed Experiment) satellite, which MDA launched in 2007 to improve its understanding of how rockets perform in flight.

"NFIRE is being used as a risk reduction strategy to predict what PTSS will see," the agency says. "That will influence design improvements to PTSS sensors."

Navigation

The Global Positioning System IIF (GPS IIF), the latest generation of GPS navigation satellites to be fielded, has had difficulties, too. Development challenges delayed the launch of the first satellite by four and a half years, to May 2010, and the Air Force program's cost more than tripled, from $729 million to $2.6 billion, the GAO reports.

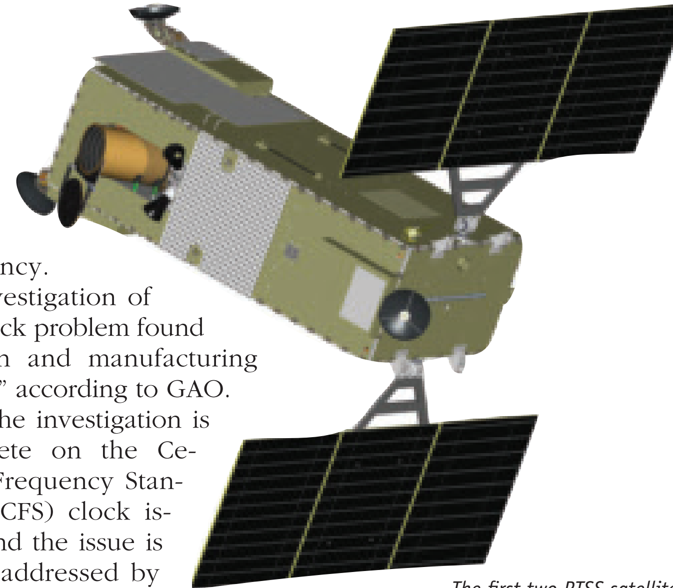
The second IIF satellite, launched in July 2011, experienced a failure of its cesium clock, one of three clocks that ensure the accuracy of the spacecraft through redundancy. An investigation of the clock problem found "design and manufacturing issues," according to GAO.

"The investigation is complete on the Cesium Frequency Standard (CFS) clock issue, and the issue is being addressed by a CFS unit modification," says an Air Force statement. "All future IIF space vehicles will undergo this modification prior to shipping to the launch location. The CFS investigation and repair process has not affected the GPS IIF production schedule, and the cost to modify [the clock] was paid for by the contractor, not the government."

Despite this glitch, Arnold says the Boeing-built IIF satellites are giving warfighters improved accuracy and security.

The newest GPS program, GPS III, is taking steps to avoid the kinds of snafus that have plagued GPS IIF. Among these steps is building the GPS III Non-Flight Satellite Testbed (GNST), a full-sized, flight-equivalent prototype of a GPS III satellite.

"Using the GNST, we have identified and solved many issues early on that would have cost more and presented more risk if they had been discovered later in program



The first two PTSS satellites, not expected before 2017, will be considered experimental.

The GPS IIF was plagued by snafus. Credit: Boeing.

production," says Michael Friedman, spokesman for GPS III prime contractor Lockheed Martin. "These investments early in the GPS III program will prevent the types of engineering issues discovered on other programs late in the manufacturing process or even on orbit. This approach will ensure mission success and save expensive rework and retest of built-up space vehicles in the production flow."

But cost remains a topic of debate. GAO says the price tag for the first two GPS III satellites has risen at least 18% above initial estimates. Friedman counters, "While we have encountered challenges associated with higher standards for parts testing and first-time technical issues, the program is on firm footing, and our cost estimate at completion remains within the original Air Force program office budget."

The first MUOS lifts off from Cape Canaveral AFS, Fla. Credit: United Launch Alliance.

Communications

When the Navy launched its first Mobile User Objective System (MUOS) satellite in February, it may have helped fill a potential capability gap created by the unexpected failure of two legacy satellites. Prime contractor Lockheed Martin boasts that a single MUOS spacecraft will provide four times the capacity of the entire legacy Ultra High Frequency Follow-On system constellation.

But the program, which is designed to improve ground communications for U.S. forces on the move, is not out of the woods. The first satellite was expected to begin on-orbit operations in May of this year, over two years later than planned, according to GAO. Moreover, the MUOS spacecraft might initially be "significantly underutilized," because most of its capabilities will be enabled by Joint Tactical Radio System terminals, whose operational testing has been delayed until 2014.

Another communications program, the USAF Advanced Extremely High Frequency system, launched its first satellite in 2010, but the spacecraft was about 13 months late in reaching its orbit because of a glitch in one of its three propulsion systems. The Air Force and prime contractor Lockheed Martin insist the satellite's 14-year operational life expectancy will be preserved.

Weather

One long-troubled effort that has yet to find its footing is a replacement for polar-orbiting environmental satellites. The National Polar-orbiting Operational Environmental Satellite System program spent $5 billion over 16 years but never launched a satellite and was killed in 2010. A successor program, the Defense Weather Satellite System, failed to win over Congress and was axed in FY12, creating what the GAO calls "a potential capability gap for weather and environmental monitoring."

A new program, the Weather Satellite Follow-on, is in its early stages. Current activities include "preacquisition studies to reduce risk," according to an Air Force statement. DOD has incorporated the lessons learned from prior programs and is considering a variety of options," the statement says. "The requirements focus on continuing current on-orbit capabilities rather than enhancing performance with immature new sensors."

Future prospects

Military space efforts continue to face tough scrutiny. The GAO found parts quality problems in all 21 of the DOD and NASA space programs it recently reviewed, and discovered that "significant barriers" still exist, including "fragmented leadership," high launch costs, proposed funding cuts in space-related science and technology, and delays in standing up ground systems that process information from the new satellites.

"All of the barriers…require action from the Air Force and the Office of the Secretary of Defense as well as the participation and cooperation of all the military services, the intelligence community, and other agencies such as NASA and NOAA," Chaplain says. "Moreover, though successful launches are being experienced, problems within ongoing development efforts, such as GPS III, indicate that space acquisitions are still at risk of significant cost and schedule problems, and attention to reforms must be sustained."

DOD has taken a host of steps to avoid future problems in space programs. It is making greater use of fixed-price contracts and "evolutionary upgrades," and is telling contractors to "place as much emphasis on engineering for cost control and affordability as [they have] historically placed on engineering for performance," Arnold says. DOD also streamlined its space leadership structure and is working with NASA to improve parts quality.

"The department," he says, "has taken important steps to improve our acquisition practices to deliver better capabilities to the warfighter while achieving better value for the taxpayer."

Airliner designs have remained largely unchanged for decades, despite many proposed innovations. Virtually all of these 'good ideas' have run into basic but insurmountable barriers. Now another radical concept—tailless aircraft—promises huge benefits. It still entails some complicated solutions, but if it succeeds, it could render traditional airliner designs obsolete overnight.

There seems to be a never-ending supply of innovative configuration concepts purporting to improve the efficiency or performance of commercial airliners. Strange arrangements of wings, tails, and fuselages arise, gain adherents, grace the covers of aviation magazines, and figure prominently in the optimistic design projects of impressionable university students. Yet after all these years and all these promised paradigm shifts, the Boeings and the Airbuses of our commercial fleets still look like traditional airliners.

Outsiders often accuse designers of being too conservative, too unwilling to try something new. This ignores our industry's proud history. When a new and better idea is proven to work—from retractable landing gear to jet engines to composite structure—we do use it, and gladly. But we do not do something new just to do something new.

In some cases there are subtle but com-

A tale of no tail

The benefits of eliminating the airplane's tail are obvious. The trick is to make it fly.

by Daniel P. Raymer
Conceptual Research

plicated reasons why a new idea is not adopted, usually because some less than obvious penalties overwhelm the obvious benefits. It takes an in-depth study to find those penalties, and proponents of the idea often downplay the negative results or even attack the bearer of the bad news.

Simple realities

For many concepts, the ultimate problem is simply excess weight. Often this is not discovered until well past the conceptual design stage, at which point the choice becomes 'accept the extra weight, or cancel the whole thing.'

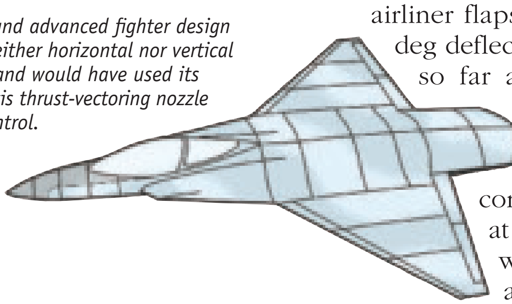
But there is another fundamental reason why so many 'good' ideas in the end prove to be not so good: They often increase aircraft wetted area. The parasitic drag of an airplane depends directly on this exposed skin area; in fact, it is calculated by multiplying that total wetted area by an appropriate coefficient. Simply put, 10% more wetted area is 10% more parasitic drag. Plus, more wetted area usually means more weight. In the end, an increase in wetted area usually obliterates whatever benefit the innovation might have promised.

Some innovative configurations increase wetted area by using noncircular fuselage cross sections, or by adding various extra lifting surfaces, fairings, bracings, or even fuselages.

These problems are serious, but there is a bigger problem for many innovative concepts, one too often ignored until late in design development. Complicated schemes are then devised to address an entirely predictable issue.

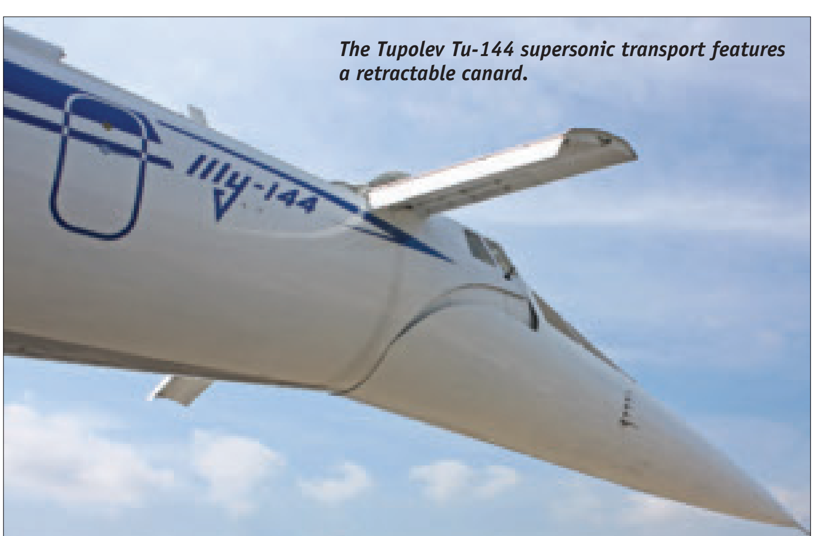
The problem is the flaps. Innovative design concepts often cannot incorporate large flaps on all lifting surfaces. Typical airliners have large, multisegment flaps along most of the wing trailing edge. These flaps are near the aircraft's center of gravity, so their pitching moments are easily handled with a modest elevator deflection.

But for many innovative designs, a significant portion of the lifting surface area lies far behind the center of gravity. Normal airliner flaps with their near 90-deg deflections cannot be used so far aft. They cannot be trimmed.



The Rand advanced fighter design had neither horizontal nor vertical tails, and would have used its two-axis thrust-vectoring nozzle for control.

For example, in a tandem wing configuration, the flaps at the back of the rear wing are much farther aft than those at the back of the front wing. No amount of flap deflection on the front wing will balance the nose-down moments from the flaps on the back wing, so tandem wing designs have small or nonexistent flaps in back. This problem also affects the canard configuration, the joined wing, braced wing, box wing, and others.



The Tupolev Tu-144 supersonic transport features a retractable canard.

Why are flaps so important? They allow for smaller wings. Any design concept that cannot use large airliner flaps on all of its lifting surfaces will need larger wings, which will increase wetted area, drag, and weight. That alone usually kills these otherwise attractive ideas.

A different approach

What approach can we take for future airliners? What can we do to reduce, not increase, the total wetted area?

A wing is required for lift. A fuselage is required to hold passengers and cargo, and a streamlined cylindrical shape is probably best when drag and pressurization loads are considered. Engines are required, and when structural weight and access issues are considered, podded engines seem best.

So what can we reduce or eliminate?

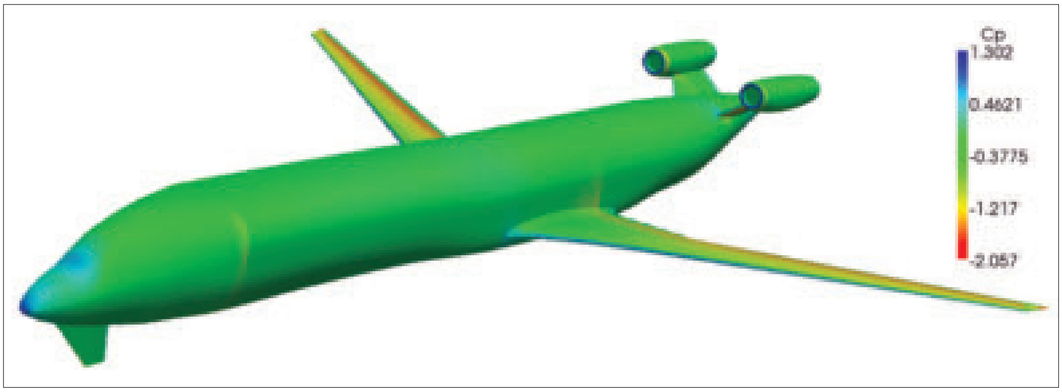
Tails. An aircraft has tails for three reasons—stability, control, and trim. If these can be provided in some other manner, we can throw away the tails and gain substantial savings in both drag and weight.

In a 1994 project for Rand, this author did a tailless aircraft trade study for a JSF-like advanced fighter design (see Rand MR-595-AF). Having neither horizontal nor vertical tails, this design would have used its two-axis thrust-vectoring nozzle for control, probably augmented with split elevons and other pop-out aerodynamic devices.

Eliminating the tails for this fighter concept reduced total structural weight by 7%, empty weight by 3%, and wetted area by 5%. Together these produced a net 8% reduction in sized takeoff gross weight, or a 24% increase in range at the same gross weight. These are big numbers, but such an approach was considered too risky for 1994. With appropriate technology development and maturation, it should be entirely feasible for 2020 and beyond. After all, similar technology was flight tested in the X-36 back in 1997.

Huge potential payoff

Could this apply to airliners as well? In a recent study for NASA Glenn, Conceptual Research developed a tailless airliner concept in the 180-passenger class (such as the Boeing 737-800). This design should be



CFD studies have shown that a 'chin rudder' can counteract sideslip angles with a control gain of two relative to the freestream.

considered speculative and does not represent an official endorsement by NASA, but if it works—and it should—it offers a huge payoff. Calculations show a 60% reduction in fuel consumption over a typical 737 route. And yes, it does permit large airliner flaps over most of the wing.

The concept is not as crazy as it looks. It is based on flight-proven technologies, available hardware, and well-understood engineering practices. The design approach starts with a conventional airliner fuselage. It was basically copied from the 737 and is identical in diameter, length, passenger compartment, and cargo hold geometry. Passengers fit, as do normal galleys, toilets, exits, and even 737 cargo containers. There are windows, and the design readily interfaces with standard airport gates.

But no tail.

The benefits are obvious—large reductions in wetted area, drag, and weight. The problem is also obvious—how do you make it fly?

Computers to the rescue

The solution is a bit complicated, and is different during different speed regimes. To begin with, this tailless concept assumes an active, computerized flight control system, like those used in all fighter aircraft since the F-16. Yes, if it fails, the airplane crashes. But we have the technology to make such a failure an extremely improbable event, no more likely than a wing suddenly breaking off. After all, how many operational F-16s or B-2s have crashed for this cause alone?

At low speeds this tailless airliner deploys large, multisegment flaps like those of current airliners. Such flaps will create a nose-down pitching moment, but they are near the center of gravity so they can be trimmed. This is done by extending a retractable canard, much like the one on the Russian Tu-144 supersonic transport. The canard and its movable elevator are sized both to balance the flap moments and provide pitch control at low speeds, and are sequenced to retract when the flaps retract, shortly after takeoff.

For yaw control a small 'chin rudder' is used. This is a ventral surface just under the cockpit. Being all-moving and far from the aircraft's center of gravity, it can be much smaller than an aft tail. CFD studies have shown that it can counteract sideslip angles with a control gain of two relative to the freestream. In other words, one degree of sideslip to the left can be countered with two degrees of chin rudder deflection to the right of the flight direction. This gain is considered aggressive but 'doable' for today's state-of-the-art control systems. With another decade of development, it should be easy. Also, this analysis did not include the additional yaw control that can be obtained by using differential drag at the wingtips.

In the event of an engine failure, the chin rudder would be used to yaw the fuselage slightly toward the running engine, actually using the forebody as a yaw trim surface rather than relying upon continuous rudder deflection. This would occur automatically, leaving the pilots free to fly the airplane, and is possible precisely because the aircraft is unstable in yaw.

Airliner of the future?

This design is obviously speculative, almost science fiction. Making it happen will require a lot of development, and a lot of things could go wrong along the way. The first priority is for more detailed conceptual design, including detailed configuration layout, detailed CFD, structural design and analysis, and subsystems and mechanism definition. Full dynamic simulation of the flight control system should be performed, including flexibility effects. Wind tunnel testing is needed, too. Further development of the active aeroelastic wing concept, with application to commercial transports, should be initiated, along with a serious study of certification issues. Finally, a flight demonstrator should be designed and built. It should be large enough that the results are believable, yet small enough to be affordable. But even after all of that, we may learn, one more time, that there are good reasons why the Boeings and the Airbuses of our commercial fleets still look like Boeings and Airbuses!

The active aeroelastic wing was flight demonstrated in the X-53, a modified F-18.

For high-speed flight, the horizontal canard retracts into squared-off fairings at the top corners of the fuselage, outside the cylindrical pressure vessel. This happens automatically as the flaps are retracted. But how is pitch control obtained when the horizontal canard is gone?

Active measures

There is another advanced technology featured in this design but not visible on a drawing. Already proven in flight, it promises a 10% wing weight savings, gust alleviation, drag modulation, and improved three-axis flight control. It is the active aeroelastic wing (AAW).

AAW was developed at Rockwell International starting in 1982 to solve problems with excessive wing flexibility in Rockwell's Advanced Tactical Fighter design. AAW was initially conceived as a computerized implementation of an emergency procedure used by B-47 pilots. The B-47 had long, flexible swept wings with such bad aileron roll reversal that flight was normally restricted to below 455 kt. Above that speed, B-47 pilots practiced flying the airplane 'backwards,' moving the stick to the right to roll the bomber to the left.

In the AAW, this is done by the flight control computer without the pilot even being aware of it. First, the wing box is deliberately designed with reduced torsional stiffness. This saves weight since the torsional stiffness requirements are often the most critical loads on the outer third of the wing. High-speed actuators are then used on leading- and trailing-edge control surfaces, which are capable of deflecting up as well as down.

To roll to the right at low speeds, the trailing-edge surfaces on the left wing deflect downward like normal ailerons, creating more lift on that side. At higher speeds, however, the ailerons will twist the wing so much that the net force is downward and the airplane rolls to the left. The flight control computer therefore reverses the aileron deflections appropriately. For greater roll control, deflection of the leading-edge flap twists the wing even more.

AAW even allows the creation of additional wingtip drag, both for yaw control and to act as speed brakes. This is done by deflecting the leading- and trailing-edge surfaces so that they 'fight' each other, each trying to twist the wing in the opposite direction. AAW also provides active flutter suppression using its sophisticated sensors, computers, and actuators.

AAW was flight demonstrated a decade ago in the X-53, a modified F-18. More than 50 flights were made, half of them supersonic, and AAW proved to be trouble-free and highly effective. AAW is applicable to any advanced transport aircraft, but for this tailless design it is especially useful. During high-speed flight the AAW provides roll and yaw control and, since the wing is highly swept, can also provide pitch control and trim through the twisting of both wingtips symmetrically.

So if the tailless airliner configuration works, what is the payoff versus a normal airliner configuration? Obviously, total wetted area is substantially reduced by elimination of the tails, more than 15% for the 737. The gust and maneuver load alleviation made possible with AAW plus the elimination of torsional stiffness as a structural design criterion permit a higher wing aspect ratio without the usual weight penalty. And a 20% increase in aspect ratio gives about 30% less drag due to lift. These improvements, plus reasonable airframe cleanup and the increased laminar flow likely by that timeframe, give a total 50% improvement in cruise lift over drag for the tailless airliner concept. This is huge.

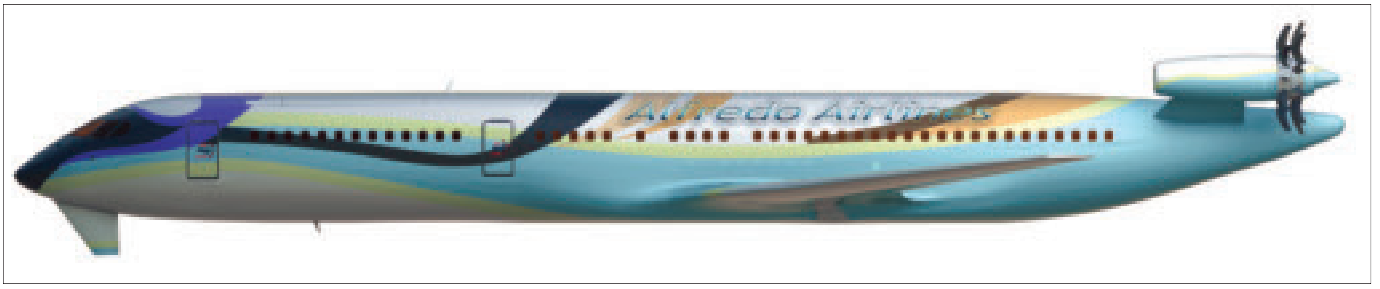
Empty weight is also reduced with removal of the tails, which total about 3% for the 737. Of course the retractable canard, the chin rudder, and the AAW mechanisms will themselves add weight, but even taking those weight penalties into account, substantial weight savings are indicated. More detailed calculations are in order.

A balancing act

This tailless airliner concept was developed and analyzed using the classical methods in the RDS-Professional software program, calibrated to Boeing 737-800 flight handbook data. Of course, such classical analysis includes numerous assumptions and 'fudge factors' for advanced technologies, so these results must be considered preliminary—but they seem credible.

An advanced open-rotor turbofan was defined for this study by NASA Glenn staff. This is essentially a turbofan engine with a very high bypass ratio, and with the usual shroud removed from around the rotor blades. Using an advanced core with an overall pressure ratio of 70, a 30% improvement in specific fuel consumption is expected compared with current engines.

The open rotor turbofan might have excessive noise, mostly from the exposed blades. One solution is to block the noise by placing the engines over a large horizontal tail or an extra-wide aft fuselage. That would probably increase aircraft wetted area and structural weight. For this design it was assumed that ongoing technology development programs at NASA and engine manufacturers will solve this without such geometric shielding. Progress to date is encouraging. Alternatively, the engines could have noise-suppressing rings added around the rotors, converting them into ultra-high-bypass turbofans.



If the tailless concept works, 'old-technology' airliners will become obsolete.

The tailless airliner design was sized to a standard commercial airliner mission, with a 2,800-n.mi. range plus a 200-n.mi. divert distance, with the same total payload as a 737. Since the drag, fuel consumption, and empty weight are all much better than the 737, a smaller and lighter airplane can carry the same number of passengers and payload over the same distance. Of course, the fuselage must be about the same size to hold the people and cargo, but everything else can shrink—wings, engines, and fuel tanks. Normally tails would shrink too, but there aren't any!

The sized takeoff gross weight of the advanced tailless airliner comes to 127,169 lb, burning 18,991 lb of fuel. That is 60% less fuel consumption than that of a 737-800 over the same range mission—a huge savings, well worth the technology development required to make it happen.

In addition, an airplane with less than half the fuel consumption will have less than half the environmentally undesirable emissions, sure to be even more important in the years to come

✈✈✈

If this tailless airliner works, if its flight control system can be trusted, and if the estimates above are reasonably correct, then all of the 'old-technology' commercial airliners will become obsolete. Airlines flying them will be noncompetitive, having fuel costs more than twice as high. Companies, and countries, producing the old technology designs will frantically try to catch up—if they can. I think it will work.

For the technical details see the contract final report, Advanced Technology Subsonic Transport Study: N+3 Technologies and Design Concepts, *NASA/TM-2011-217130, by Dan Raymer, Jack Wilson, Doug Perkins, Art Rizzi, Mengmeng Zhang, and Alfredo Ramirez, available at www.aircraftdesign.com*

25 Years Ago, November 1987

Nov. 13 The NASA/DARPA X-Wing completes its first flight. The plane climbs 25 ft above the runway, flying for only 16 sec. The goal of this experimental hybrid aircraft, which features a four-blade rotor system and two jet engines, is to combine conventional airplane speed with the vertical capabilities of a helicopter. Sikorsky serves as prime contractor. The flight is made without the rotors; lift is provided by the aircraft's stubby wings. *NASA Astronautics and Aeronautics, 1986-1990*, p. 138.

Nov. 28 The Air Force places a DSP-5R early warning defense satellite into orbit 23,000 mi. above the Earth using a Titan 34D booster. *NASA Astronautics and Aeronautics, 1986-1990*, p. 139.

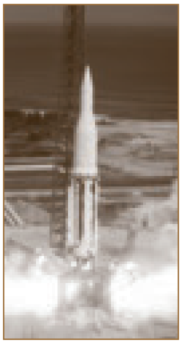
50 Years Ago, November 1962

Nov. 1 The USSR launches its Mars 1 space probe, also called Sputnik 23, initiating its unmanned exploration of Mars program. Mars 1 is designed to fly to within about 7,000 mi. of the planet and send back images of its surface as well as data on cosmic radiation, micrometeoroid impacts, possible organic compounds, and other data. But on March 21, 1963, when the spacecraft is 66 million mi. from Earth, communications fail, probably because of a fault in the antenna orientation system. *Flight International*, Dec. 13, 1962, p. 960; *Aviation Week*, Dec. 24, 1962, pp. 18-19.

Nov. 2 France's Dassault Balzac VTOL prototype achieves its first free flight. Powered by eight Rolls-Royce RB.106 engines for lift and a Bristol Siddeley Orpheus for forward propulsion, the aircraft hovers and maneuvers at a height of 70 ft. Previous test flights have been tethered. *Flight International*, Nov. 8, 1962, p. 728.

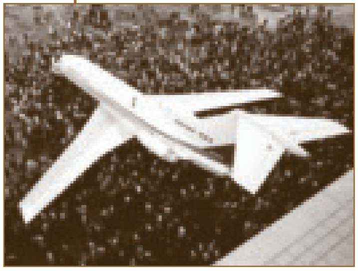
Nov. 2 The final B-52H Skybolt air-launched ballistic missile carrier aircraft is delivered to the Strategic Air Command. However, the Skybolt program is abruptly canceled the following month. *Flight International*, Nov. 15, 1962, p. 768.

Nov. 9 The North American Aviation X-15 hypersonic rocket research plane No. 2 is seriously damaged when NASA research pilot John B. McKay makes an emergency landing on the dry bed of Mud Lake, Nev., after completing his seventh mission in the aircraft. The problem is due to a malfunction in the XLR-99 rocket engine. Although most of the propellants are jettisoned before the landing, there is still structural damage. Fortunately, McKay's injuries are only minor, and the damage is reparable. D. Jenkins, *X-15: Extending the Frontiers of Flight*, pp. 411-413, 627.



Nov. 16 The third Saturn C-1, later called the Saturn I, is successfully launched at Cape Canaveral, Fla., in a flight designated SA-3. The vehicle is unmanned, with inert upper stages, and ballasted with 95 tons of water to simulate propellant weight. The water is released at a peak altitude of 104 mi. in Project Highwater to obtain data on atmospheric physics. Eventually, Saturn I leads to the Saturn V, which takes men to the Moon in Project Apollo. *Flight International*, Nov. 22, 1962, pp. 827-828; M. Morse and J. Bays, *The Apollo Spacecraft: A Chronology, Vol. II*, p. 4.

Nov. 17 President John F. Kennedy formally opens Dulles International Airport outside Washington, D.C., with former President Dwight D. Eisenhower in attendance. Named after former Secretary of State John Foster Dulles, the facility officially becomes operational on Nov. 19 with 58 flights. Dulles subsequently becomes one of the nation's busiest airports, serving over 23 million passengers annually. *Aviation Week*, Nov. 19, 1962, p. 43; *The Aeroplane*, Nov. 29, 1962, pp. 28-29.



Nov. 27 The Boeing 727 midsize three-engine medium-range jet transport is featured in roll-out ceremonies at Boeing's plant in Renton, Wash., near Seattle. *The Aeroplane*, Nov. 29, 1962, p. 4, and Dec. 6, 1962, p. 33.

Nov. 28 NASA awards a $6-million contract to General Dynamics/Convair for development of the Little Joe II all-solid-fuel unmanned launch vehicle. Its purpose is to

Past

An Aerospace Chronology

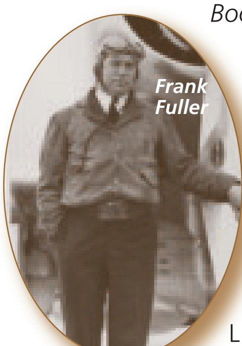
by **Frank H. Winter**
and **Robert van der Linden**

test the launch escape system of the later Saturn manned launch vehicle for Project Apollo and to verify the performance of the command module parachutes for the Apollo spacecraft. Little Joe is used from 1963 to 1966. M. Morse and J. Bays, *The Apollo Spacecraft: A Chronology, Vol. II*, p. 8.

Nov. 29 Britain's Minister of Aviation, Julian Amery, signs an agreement with the French ambassador in London for the joint Anglo-French development of a British Aircraft/Sud Aviation Mach-2.2 supersonic airliner. This marks the official beginning of what becomes the famous Concorde. The turbojet-powered Concorde is first flown in 1969, enters service in 1976, and continues commercial flights for 27 years. *Flight International*, Dec. 6, 1962, pp. 894-825.

75 Years Ago, November 1937

Nov. 3 At Monfalcone, Italy, Mario Stoppani and Nicola di Mauro set a new world altitude record for seaplanes, flying to 29,367 ft in a Cant Zappata 506-B powered by three 700-hp Alfa Romeo 127 RC-50 engines. *Aircraft Year Book, 1938*, p. 412.


Frank Fuller

Nov. 4 Frank W. Fuller flies in his Pratt & Whitney Twin Wasp engine from Vancouver, B.C., to Agua Caliente, Mexico, in a record time of 4 hr 54 min. Using only 670 hp of the 1,200 hp available, he averages 250 mph despite unfavorable winds. *Aero Digest*, December 1937, p. 111.

Nov. 7 Percival Elliott Fansler, who in 1914 inaugurated the world's first scheduled airline, the St. Petersburg Tampa Airboat Line, dies. *Aero Digest*, December 1937, p. 108.

Nov. 11 Hermann Wurster smashes Howard Hughes' world land-plane speed record of 352.38 mph at Augsburg, Germany. Wurster takes his Daimler-Benz DB 600-powered Messerschmitt Bf 109 single-seat fighter, equipped with a controllable-pitch propeller, to 379.6 mph. *Aircraft Year Book, 1938*, p. 412.

Nov. 14-20 Flag Officer A.D. Clouston and Betty Kirby-Green establish an England-to-South Africa round-trip flight record in a de Havilland DH.88 Comet they call the Burberry. They beat the existing flight time by almost four days, flying from Croydon, England, to Cape Town and back in five days 17 hr 28 min. *Aero Digest*, December 1937, p. 111.

Nov. 19 Andrei N. Tupolev, acclaimed Soviet airplane designer of the ANT series of bombers and transports, is allegedly shot by the secret police in Moscow's Lubyanka Prison, for sabotage. The rumor turns out to be false, although he falls out of favor and is incarcerated between 1938 and 1943. Throughout his career, Tupolev directed

the design of over 100 aircraft, including the Tu-2 and Tu-4 bombers of WW II. He later designs the Tu-104, the first jet airliner in regular passenger service. *The Aeroplane*, Nov. 24, 1937, p. 610; Andrei Nikolayevich Tupolev file, NASM.

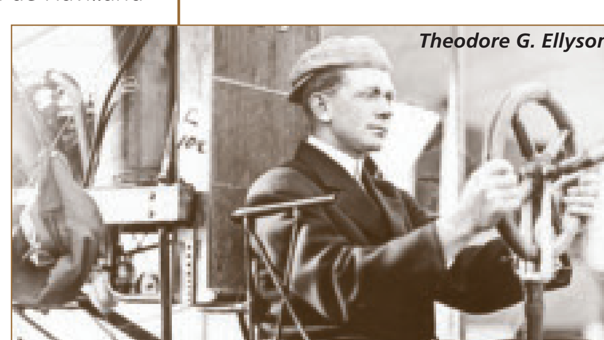
100 Years Ago, November 1912

Nov. 12 Navy Lt. Theodore G. Ellyson makes the first catapult takeoff of a plane, a Curtiss A-3, at the Washington Navy Yard. The catapult is afterwards modified and used on April 16, 1915, by Lt. Patrick N.L. Belinger, who sometimes is incorrectly credited with Ellyson's achievement. R. Grossnick, *United States Naval Aviation 1910-1995*, p. 10.

Nov. 30 The Navy's first flying boat, the C-1, begins tests at Hammondsport, N.Y. R. Grossnick, *United States Naval Aviation 1910-1995*, p. 10.

And During November 1912

—The Bulgarians use reconnaissance planes in the Balkan War, and some of the aircraft are fired upon by the Turks at Adrianople. *Flight*, Dec. 7, 1912, p 1137.


Theodore G. Ellyson

PENNSTATE

Aerospace Engineering

1855

The **Department of Aerospace Engineering at the Pennsylvania State University** invites nominations and applications for a full-time, tenure-track assistant professor position starting in Fall 2013. Unusually-qualified candidates could be considered at higher ranks. Expertise in one or more of the following areas is of particular interest: aerospace materials and structures, structural dynamics and aeroelasticity, fluid/structural interaction, adaptive structures, composite materials and structures, additive manufacturing, and aerospace systems. Applicants must have an earned doctorate in aerospace engineering or a related field; at least one degree in aerospace engineering or related aerospace experience is preferred. Responses received before January 7, 2013 are assured full consideration, but the search will remain open until the position is filled. Applicants should send an email with an attached ***single*** PDF file that contains a cover letter, a CV, a statement of research and teaching interests, and the names and contact information for at least three references to the Faculty Search Committee at **aerosearch@engr.psu.edu.**

The Department of Aerospace Engineering enjoys an excellent international reputation in aeronautics and astronautics. The Department currently has 16 full-time faculty members, with more than 225 juniors and seniors and more than 130 graduate students. Annual research expenditures exceed $6 million.

Penn State at University Park is a land-grant institution located within the beautiful Appalachian mountains of central Pennsylvania. State College and nearby communities within Centre County are home to roughly 100,000 people, including over 40,000 students, and offer a rich variety of cultural, recreational, educational, and athletic activities. State College is a wonderful community in which to raise a family and has an excellent public school system. Employment will require successful completion of background check(s) in accordance with University policies. We encourage applications from individuals of diverse backgrounds. Penn State is committed to affirmative action, equal opportunity and the diversity of its workforce.

Aerospace Engineering
University of Kansas

The University of Kansas Aerospace Engineering Department invites on-line applications for a tenure-track ***Assistant Professor with a research emphasis in flight control, flight testing or flight vehicle avionics.*** Exceptionally qualified candidates could be considered at the Associate Professor level. Our faculty is currently engaged in a wide range of sponsored research, including the design, manufacture and flight of autonomous and semi-autonomous aircraft ranging in size up to 1100 lb gross takeoff weight, flying both domestically and in the cryosphere.

Our faculty additions are among the first of the School of Engineering's Building on Excellence Initiative, which will expand the School faculty by 30 faculty members over the next 5 years. Special consideration will be given to applicants committed to excellence, who can contribute to the University's innovative, collaborative, and multidisciplinary initiatives to educate leaders, build healthy communities, and make discoveries that will change the world. See http://www.provost.ku.edu/planning/.

Applicants must have an earned doctorate in Aerospace Engineering, Electrical Engineering or a closely related field prior to the expected start date of August 18, 2013. Applicants should have evidence of the ability of a successful research program ***relevant to the development of unmanned air or space vehicles. Experience with vehicle electronic hardware and/or software, or flight testing is highly desirable. Industry experience is also desired.***

All faculty members are expected to teach both undergraduate and graduate courses in an effective manner, and to be active in research and service, to both the University and the engineering profession. Research productivity at KU is evaluated with respect to publications in respected academic journals as well as success in financially supporting and mentoring PhD and MS students.

Applicants must apply on-line at https://jobs.ku.edu, for position #00209310. Review of complete applications will begin on 15 January 2013. Successful candidates must be eligible to work in the U.S. prior to the start date of the appointment, 18 August 2013. Salary is commensurate with experience. Equal Opportunity Employer M/F/D/V.

Tenured Faculty Position No. (52181)
Department of Mechanical Engineering
Southern Methodist University

SOUTHERN METHODIST UNIVERSITY, Bobby B. Lyle School of Engineering invites nominations and applications for the position of Professor and Chair of Mechanical Engineering Department (Position No. 52181). The successful candidate will be an educator and a recognized scholar with distinguished accomplishments in both engineering education and scientific research demonstrated by a strong record of external funding and publication. The candidate is expected to be the intellectual leader of the Mechanical Engineering Department with strong interest in educational programs at the BS, MS and PhD levels and develop a world renowned interdisciplinary research program synergistic with the ongoing research in the Department and the Lyle School of Engineering. He/she will possess strong administrative skills and will be an outstanding communicator representing the Mechanical Engineering Department and the Lyle School on- and off-campus. The anticipated starting date is August 2013. Candidates must have a Ph.D. degree in mechanical engineering or a closely related field and must be qualified for a tenured appointment at the full Professor level.

With over 10,000 students, SMU is a leading private University located in the Dallas-Fort Worth Metroplex, a dynamic region with leading high-technology companies in the aerospace, defense, energy, information technology, life sciences, semiconductors, telecommunications, transportation, and biomedical industries. Some of the top companies include Texas Instruments, Raytheon, Bell Helicopter, Lockheed-Martin, Turner Construction, Trinity Industries, Baylor Research Institute and University of Texas Southwestern Medical Center.

The Mechanical Engineering Department resides within the Lyle School of Engineering and is located in the Embrey Engineering Building, a LEED Gold designed facility. The Department offers B.S., M.S., and Ph.D. degrees in mechanical engineering and is home to the Research Center for Advanced Manufacturing, the NSF Industry/University Cooperative Research Center for Lasers and Plasmas for Advanced Manufacturing. It is also the home of several other research laboratories in the areas of mechanics of materials; dynamics, systems and controls; porous materials applications; nanoscale electro-thermal sciences; opto-electronics packaging; laser micromachining; micro-optical sensor technology and experimental fluid mechanics (http://www.lyle.smu.edu/me/).

Applications received by January 15, 2013 will be given full consideration but the search committee will continue to accept applications until the position is filled. The applicants should send, a cover letter, curriculum vitae, list of five references and a statement of interest and capabilities related to academic leadership, education and research to MEChair@lyle.smu.edu. SMU will not discriminate on the basis of race, color, religion, national origin, sex, age, disability, or veteran status. SMU is committed to nondiscrimination on the basis of sexual orientation. Hiring is contingent upon the satisfactory completion of a background check.

BAYLOR UNIVERSITY

Two Positions: Assistant Professor
Department of Mechanical Engineering

The Department of Mechanical Engineering in the School of Engineering and Computer Science seeks dynamic scholars to fill two tenure-track faculty positions in specific program areas including solid mechanics/materials, and biomaterials/biomechanics. The positions will begin in August 2013 at the Assistant Professor level. Those interested in a higher position are strongly encouraged to apply, and applications from candidates with appropriate levels of experience will be considered for higher rank.

Requirements include an earned doctorate in Mechanical Engineering or a closely related field, outstanding English communication skills, a commitment to teaching excellence, demonstrated research achievement, and a commitment to professional activities. In light of Baylor's strong Christian mission, the successful applicant must have an active Christian faith. For complete information, please visit: http://www.ecs.baylor.edu/mechanicalengineering/.

Baylor is a Baptist university affiliated with the Baptist General Convention of Texas. As an Affirmative Action/Equal Employment Opportunity employer, Baylor encourages minorities, women, veterans, and persons with disabilities to apply.

UNIVERSITY OF ARIZONA

The Dept. of Aerospace and Mechanical Engineering invites applications and-nominations for tenure track faculty positions at the rank of Assistant Professor. Positions at higher ranks will also be considered for applicants with exceptional stature and professional record. Applicants in all areas of aerospace and mechanical engineering will be considered. However, preference will be given to candidates with expertise and interest in: a) space systems including propulsion/combustion, space vehicle design and integration, and orbital mechanics, b) robotics, especially as applied to autonomous systems (surgical and rehabilitation robotics, and human-assist robots) and c) multi-scale, multi-physics computation applied to one or more departmental research focus areas which include: fluid dynamics/combustion, solid mechanics, biomechanics, alternative energy and micro/nanotechnologies. Opportunities for synergy with existing research activities in the department and the University will be viewed favorably.

The Department offers excellent opportunities to interact with other programs on campus such as the Department of Planetary Sciences, the School of Sustainable Engineered Systems, the Arizona Health Sciences Center, the Bio5 Institute for Collaborative Bioresearch, the College of Optical Sciences and the Program in Applied Mathematics, all of which enjoy international recognition as centers for world-class academic programs and research.

Successful candidates will be expected to teach specific courses at the undergraduate and graduate levels and to establish active research programs. Previous teaching experience is expected for senior candidates, and desirable in all cases.

Required qualifications are a Ph.D. degree in Aerospace or Mechanical Engineering or a closely related discipline and demonstrated research potential or accomplishments. Review of applications currently ongoing and will continue until position is filled. Interested applicants should consult the university website URL: https://www.uacareertrack.com/enter job #51103 then follow instructions to make a formal application. The University of Arizona is an EEO/AA employer-M/W/D/V. Women and minorities are encouraged to apply.

Tenure-Track/Tenured Faculty Positions in the Mechanical and Aerospace Engineering Department
The University of Texas at Arlington
Search Code ENG092012MAE
To apply, visit www.uta.edu/engineerapply

The College of Engineering at The University of Texas at Arlington is building areas of excellence that foster cross-disciplinary, cutting edge research. The Department of Mechanical and Aerospace Engineering (MAE) is recruiting one or more outstanding faculty in these areas, and interested candidates are invited to apply. Areas of excellence in the MAE department include Life Cycle Management of Advanced Material Systems and Multiscale Structures; Efficient, Green Propulsion Systems; Control of Unmanned Aerial Vehicles; Renewable Energy and Thermal Management of Multiscale Engineered Systems; and Hybrid and Electric Automotive Engineering.

The focus in air transportation is on disruptive research and technologies leading to significantly improved fuel efficiency and significantly lower emissions propulsion systems. In automotive transportation, the focus is on automotive composite lightweight structures and their low cost, advanced manufacturing, advanced energy conversion and management systems, and energy storage.

An earned doctorate degree in mechanical engineering, aerospace engineering, engineering mechanics or a closely related field is required. Candidates must have demonstrated a commitment to quality teaching and scholarly research at the undergraduate and doctoral level. Applicants in senior ranks are expected to have an excellent record of research, scholarship, funding, visibility and demonstrated leadership to collaborate in teams, and be committed to teaching and mentoring. The department has ongoing projects with area industry, medical schools and hospitals, as well as active inter-disciplinary collaborations with other departments on campus. Competitive salaries and research startup funds are available for these positions.

UT Arlington has excellent laboratory and computational facilities to support research in these areas, with state-of-the-art fabrication facilities at the Nanotechnology Research & Education Center (http://www.uta.edu/engineering/nano) and the University of Texas at Arlington Research Institute (UTARI, http://arri.uta.edu). Opportunities exist for collaborative research with various other UT Arlington research centers, programs, and local industry partners.

UT Arlington is a doctoral, research-extensive university with a current enrollment of over 33,000 students and is part of the University of Texas System. The University is located in Arlington, Texas, in the Dallas/Fort Worth Metroplex, one of the centers of aerospace, electronics and telecommunications activity in the nation. The College of Engineering (uta.edu/engineering) is one of the most comprehensive engineering programs in North Texas and the nation. It offers nine baccalaureate, 13 master's, and nine doctoral degree programs, and its graduate school was ranked by U.S. News and World Report as one of the best in the nation. With more than 4,200 students and 23,000 alumni, the College of Engineering is the fourth-largest in Texas.

The MAE Department (uta.edu/mae) offers B.S., M.S. and Ph.D. degrees in both aerospace and mechanical engineering and currently has 37 faculty members with 307 graduate students and 1,078 undergraduate students. Excellence in research and teaching are valued, with a number of its faculty receiving NSF, NASA, and other types of funding.

Review of applications will begin on November 1, 2012, and continue until January 15, 2013. For further information, visit www.uta.edu/engineerapply.

UT Arlington is an Affirmative Action/Equal Opportunity Employer. Women, minorities, veterans, and individuals with disabilities are encouraged to apply. The use of tobacco products is prohibited on UT Arlington properties. A criminal background check will be conducted on finalists.

Faculty Positions in Aerospace Engineering

The Ira A. Fulton Schools of Engineering at Arizona State University seek applicants for tenure-track/tenured faculty positions in aerospace engineering. Areas of interest focusing on the important thrust area of security include,

- **Aeronautics:** systems integration in flight mechanics, guidance, navigation and control, fluid dynamics, propulsion, and autonomous systems. Submit applications to aeronautics.faculty@asu.edu
- **Astronautics:** sensor integration, power and thermal management, spatial situational awareness, and robotic vehicles and structures. Submit applications to astronautics.faculty@asu.edu

Aerospace engineering research in the Fulton Schools of Engineering addresses a variety of topics in autonomous systems and processes, robotics, bio-inspired control of distributed systems, design, adaptive structures and structural health monitoring, structural dynamics and vibrations, computational fluid dynamics, multi-scale and multi-physics modeling, laser diagnostics, turbulence, and modeling and simulation of multiphase flows. Collaborative possibilities exist not only within the Fulton Schools of Engineering but also across the university, including the Security and Defense Systems Initiative (http://sdsi.asu.edu) and the School for Earth and Space Exploration (http://sese.asu.edu). The current openings are intended to broaden this expertise and expand collaborations, especially in systems.

The successful candidates will hold an earned Ph.D., or equivalent, in Aerospace Engineering, Mechanical Engineering, or a related field. Required qualifications also include demonstrated evidence of research capability and commitment to teaching excellence as appropriate to the candidate's rank.

Faculty members are expected to develop an internationally recognized and externally funded research program, develop and teach graduate and undergraduate courses, advise and mentor graduate and undergraduate students, and undertake service activities.

Appointments will be at the assistant, associate or full professor rank commensurate with the candidate's experience and accomplishments, beginning August 2013. Although the faculty appointment may be anywhere in the Fulton Schools of Engineering, the Aerospace Engineering and Mechanical Engineering programs are currently the most involved in aeronautics and astronautics.

Review of applications will begin **November 1, 2012;** if not filled, reviews will occur on the 1st and 15th of the month thereafter until the search is closed. To apply, please submit as a single PDF file a current CV, statements describing research and teaching interests and contact information for three references to the appropriate email address above.

For more information or questions about this position, please contact the search committee chair Prof. Ron Adrian at rjadrian@asu.edu. Current information regarding these positions is also available at http://engineering.asu.edu/faculty-positions.

Arizona State University is an equal opportunity/affirmative action employer. Women and minorities are encouraged to apply. See ASU's complete non-discrimination statement

Professor (Open-Rank) Faculty Position in Autonomous Aerospace Systems

Department of Aerospace Engineering

University of Illinois at Urbana-Champaign

The Department of Aerospace Engineering at the University of Illinois at Urbana-Champaign is seeking candidates at all academic ranks for a full-time faculty position beginning August 16, 2013. Applications from women and underrepresented minorities are especially welcome and are strongly encouraged. The Department seeks exceptional candidates for a tenure-track or tenured faculty position in the area of Autonomous Aerospace Systems with particular interest in emerging areas including, but not limited to, unmanned aerial systems, aerospace robotics and cyber-physical systems, human-robot interaction, novel sensing and navigation systems, cooperative control, and avionics/embedded systems. Outstanding candidates with expertise in other aspects of research related to aerospace engineering, for example multi-functional materials, computational non-linear aeroelasticity and unsteady aerodynamics, are encouraged to apply. Please visit http://jobs.illinois.edu to view the complete position announcement and application instructions. The closing date for this position is December 1, 2012.

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

University of Illinois is an AA-EOE.

TENURE TRACK FACULTY POSITION

California Institute of Technology

The Division of Engineering and Applied Sciences at the California Institute of Technology invites applications for one tenure-track position at the assistant professor level.

We are seeking candidates who have an outstanding research record and a strong commitment to teaching, with a focus in Fluid Mechanics. Research areas of interest include but are not restricted to fundamental studies in compressible, reacting, and turbulent flows with applications to high-speed aerodynamics and transient flows. Initial appointment at the assistant professor level is for four years and contingent on completion of the PhD degree. Exceptionally qualified candidates may also be considered at the associate or full professor level.

Candidates should apply online at **http://eas.caltech.edu/positions/aero_fluids**

A CV, list of publications, statements of research and teaching plans, copies of up to three publications and a list of four references are required.

Caltech is an Equal Opportunity/ Affirmative Action employer.

AIAA Bulletin

Members of the Southern New Jersey Section with Congressman Frank LoBiondo (NJ – 2) at their August is for Aerospace event. See a full description of the many August is for Aerospace events that AIAA members held on page **B7**.

NOVEMBER 2012

AIAA Directory

AIAA HEADQUARTERS
1801 Alexander Bell Drive, Suite 500
Reston, VA 20191-4344
www.aiaa.org

To join AIAA; to submit address changes, member inquiries, or renewals; to request journal fulfillment; or to register for an AIAA conference. **Customer Service: 800/639-AIAA†**

Other Important Numbers: ***Aerospace America*** / Greg Wilson, ext. **7596*** • ***AIAA Bulletin*** / Christine Williams, ext. **7500*** • **AIAA Foundation** / Suzanne Musgrave, ext. **7518*** • **Book Sales** / **800.682.AIAA** or **703.661.1595**, Dept. 415 • **Corporate Members** / Merrie Scott, ext. **7530*** • **International Affairs** / Megan Scheidt, ext. **3842***; Emily Springer, ext. **7533*** • **Editorial, Books and Journals** / Heather Brennan, ext. **7568*** • **Education** / Lisa Bacon, ext. **7527*** • **Honors and Awards** / Carol Stewart, ext. **7623*** • **Journal Subscriptions, Member** / **800.639.AIAA** • **Exhibits / Journal Subscriptions, Institutional / Online Archive Subscriptions** / Chris Grady, ext. **7509*** • **Professional Development** / Patricia Carr, ext. **7523*** • **Public Policy** / Steve Howell, ext. **7625*** • **Section Activities** / Chris Jessee, ext. **3848*** • **Standards, Domestic** / Amy Barrett, ext. **7546*** • **Standards, International** / Nick Tongson, ext. **7515*** • **Student Programs** / Stephen Brock, ext. **7536*** • **Technical Committees** / Betty Guillie, ext. **7573***

* 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				
5–8 Nov†	**27th Space Simulation Conference**	Annapolis, MD (Contact: Harold Fox, 847.981.0100, info@spacesimcon.org, www.spacesimcon.org)		
6–8 Nov†	**7th International Conference Supply on the Wings**	Frankfurt, Germany (Contact: Richard Degenhardt, +49 531 295 2232, Richard.degenhardt@dlr.de, www.airtec.aero)		
2013				
7–10 Jan	**51st AIAA Aerospace Sciences Meeting Including the New Horizons Forum and Aerospace Exposition** (Oct)	Dallas/Ft. Worth, TX	*Jan 12*	**5 Jun 12**
28–31 Jan†	**Annual Reliability and Maintainability Symposium (RAMS)**	Orlando, FL (Contact: Patrick M. Dallosta, 703.805.3119, Patrick.dallosta@dau.mil, www.rams.org)		
10–14 Feb†	**23rd AAS/AIAA Space Flight Mechanics Meeting**	Kauai, HI	*May 12*	**1 Oct 12**
2–9 Mar†	**2013 IEEE Aerospace Conference**	Big Sky, MT (Contact: David Woerner, 626.497.8451; dwoerner@ieee.org; www.aeroconf.org)		
19–20 Mar	**Congressional Visits Day**	Washington, DC (Contact Duane Hyland, duaneh@aiaa.org)		
25–27 Mar†	**3AF-48th International Symposium of Applied Aerodynamics Aerodynamics of Small Bodies and Details**	Saint-Louis, France (Contact: Anne Venables, secr.exec@aaafasso.fr, www.3af-aerodynamics2013.com)		
25–28 Mar	**22nd AIAA Aerodynamic Decelerator Systems Technology Conference and Seminar** **AIAA Balloon Systems Conference** **20th AIAA Lighter-Than-Air Systems Technology Conference**	Daytona Beach, FL	*May 12*	**5 Sep 12**
8–11 Apr	**54th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference** **21st AIAA/ASME/AHS Adaptive Structures Conference** **15th AIAA Non-Deterministic Approaches Conference** **14th AIAA Dynamic Specialist Conference** **14th AIAA Gossamer Systems Forum** **9th AIAA Multidisciplinary Design Optimization Conference**	Boston, MA	*Apr 12*	**5 Sep 12**
12–14 Apr†	**EuroGNC 2013, 2nd CEAS Specialist Conference on Guidance, Navigation and Control**	Delft, The Netherlands (Contact: Daniel Choukroun, d.choukroun@tudelft.nl, www.lr.tudelft.nl/EuroGNC2013)		
23–25 Apr†	**Integrated Communications Navigation and Surveillance 2013**	Herndon, VA (Contact: Denise Ponchak, 216.433.3465, denise.s.ponchak@nasa.gov, www.i-cns.org)		
27–29 May	**19th AIAA/CEAS Aeroacoustics Conference (34th AIAA Aeroacoustics Conference)**	Berlin, Germany	*Jul/Aug 12*	**31 Oct 12**
27–29 May†	**20th St. Petersburg International Conference on Integrated Navigation Systems**	St. Petersburg, Russia (Contact: Prof. V. Peshekhonov, +7 812 238 8210, icins@eprib.ru, www.elektropribor.spb.ru)		
29–31 May†	**Requirements for UTC and Civil Timekeeping on Earth: A Colloquium Addressing a Continuous Time Standard**	Charlottesville, VA (Contact: Rob Seaman, 520.318.8248, info@futureofutc.org, http://futureofutc.org)		
6 Jun	**Aerospace Today ... and Tomorrow: Disruptive Innovation, A Value Proposition**	Williamsburg, VA (Contact: Merrie Scott: merries@aiaa.org)		
12–14 Jun†	**6th International Conference on Recent Advances in Space Technologies (RAST 2013)**	Istanbul, Turkey (Contact: Suleyman Basturk, rast2013@rast.org.tr, www.rast.org.tr)		
17–19 Jun†	**2013 American Control Conference**	Washington, DC (Contact: Santosh Devasia,devasia@u.washington.edu,http://a2c2.org/conferences/acc2013)		
24–27 Jun	**43rd AIAA Fluid Dynamics Conference and Exhibit** **44th AIAA Plasmadynamics and Lasers Conference** **44th AIAA Thermophysics Conference** **31st AIAA Applied Aerodynamics Conference** **21st AIAA Computational Fluid Dynamics Conference** **5th AIAA Atmospheric and Space Environments Conference** **AIAA Ground Testing Conference**	San Diego, CA	*Jun 12*	**20 Nov 12**
14–17 Jul	**49th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit** **11th International Energy Conversion Engineering Conference (IECEC)**	San Jose, CA	*Jul/Aug 12*	**21 Nov 12**

DATE	MEETING (Issue of *AIAA Bulletin* in which program appears)	LOCATION	CALL FOR PAPERS (*Bulletin* in which Call for Papers appears)	ABSTRACT DEADLINE
14–18 Jul	**43rd International Conference on Environmental Systems (ICES)**	Vail, CO	*Jul/Aug 12*	**1 Nov 12**
11–15 Aug†	**AAS/AIAA Astrodynamics Specialist Conference**	Hilton Head Island, SC (Contact: Kathleen Howell, 765.494.5786, howell@purdue.edu, www.space-flight.org/docs/2013_astro/2013_astro.html)		
12–14 Aug	**AIAA Aviation 2013: Charting the Future of Flight Continuing the Legacy of the AIAA Aviation Technology, Integration, and Operations (ATIO) Conference and Featuring the 2013 International Powered Lift Conference (IPLC) and the 2013 Complex Aerospace Systems Exchange (CASE)**	Los Angeles, CA	*Oct 12*	**28 Feb 13**
19–22 Aug	**AIAA Guidance, Navigation, and Control Conference** **AIAA Atmospheric Flight Mechanics Conference** **AIAA Modeling and Simulation Technologies Conference** **AIAA Infotech@Aerospace Conference**	Boston, MA	*Jul/Aug 12*	**31 Jan 13**
10–12 Sep	**AIAA SPACE 2013 Conference & Exposition**	San Diego, CA	*Sep 12*	**31 Jan 13**
6–10 Oct†	**32nd Digital Avionics Systems Conference**	Syracuse, NY (Contact: Denise Ponchak, 216.433.3465, denise.s.ponchak@nasa.gov, www.dasconline.org)		

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 https://www.aiaa.org/Co-SponsorshipOpportunities/.

AIAA Courses and Training Program

DATE	COURSE	VENUE	LOCATION
2012			
7 Nov	**Flight Dynamics and Einstein's Covariance Principle**	Webinar	
14 Nov	**Risk Analysis and Management**	Webinar	
6 Dec	**Advanced Composite Materials and Structures**	Webinar	
2013			
5–6 Jan	**Specialist's Course on Flow Control**	ASM Conference	Grapevine, TX
5–6 Jan	**Six Degrees of Freedom Modeling of Missile and Aircraft Simulations**	ASM Conference	Grapevine, TX
5–6 Jan	**Systems Engineering Verification and Validation**	ASM Conference	Grapevine, TX

**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 or www.aiaa.org/SharpenYourSkills.

From the Corner Office

THANKS AND "GO AIAA"

By the time this appears in the "Corner Office" that office will have a new occupant. I hope that all our members and readers saw the announcements that Dr. Sandra Magnus—Sandy—was appointed as your new Executive Director and started on October 22.

In many ways, we couldn't be more different; in some we are very much alike. Sandy has a Ph.D. from Georgia Tech, worked on military aircraft technologies before joining NASA in 1996, and has flown in space three times including four and a half months on the International Space Station and on the final Shuttle mission, STS-135. On the other hand, we both majored in physics at the undergraduate level, neither of us had a long history with AIAA or association leadership, and we absolutely share a passion for aerospace. I think that last point is the one that really matters. Sandy and I had the chance to spend some time together in late September when she came to Reston for house hunting and to do an "all-hands" with the staff. The visit reinforced the impressions I had from meeting her at Space 2011 when the STS-135 crew was with us and from her biographies and other background information: Sandy is the right person to be your new Executive Director and join the leadership of the Institute as we move forward on many significant changes. I couldn't be more pleased and I'm sure you will be also.

Many have asked what I plan to do with all my new free time. My simplistic answer is: golf and sawdust! I hope to get my golf game—my enthusiasm for the game far exceeds my skill—to where I can play good courses, enjoy them, and also share that time with my wife, Barb. However, Barb also has a long list of refinishing and furniture projects that will fit in well with my woodworking hobby (also not particularly skilled—she calls it wood-playing although I can't imagine why). I'm looking forward to returning to the Air Force Scientific Advisory Board and to getting more involved with Project Liberty Ship, a volunteer support group for the historic SS John W. Brown, one of two WW-II Liberty Ships that can still go to sea. I have a role in sustaining the physical plant of our 60-year old church, with all that implies about being a handyman, and Barb and I intend to see many of those places in this great United States that we went past at 60 mph driving from one military assignment to another. To the extent it makes sense, I hope to help with the New Event Model transition, especially the new Defense Forum. So, we're not so sure there will be all that much free time.

I can't begin to thank all of you, and *you* are AIAA, for allowing me to be part of your leadership. When I took the job in February 2005, I said I would like to serve about seven years, no more than eight. That time has gone by much more quickly than I could have possibly imagined—because the profession we serve is exciting and the people involved are exceptional. As I think back to the many conferences and the countless volunteer hours spent organizing them, the dedication of the leadership at the Regions and Sections, the 20+ Standing Committees and all the work that's done by them and by committees under them, and especially the Board and the Presidents I've worked so closely with over the years, I am convinced that there is no other professional association like ours, with volunteers that give so much, so often, are so talented, and receive so little recognition.

Finally, thank you to my second family, your AIAA Staff. I wish you all could have the opportunity to work with them on a day-to-day basis and see how committed they are to the Institute, the profession, and our members.

Almost twenty years ago when I was at Cape Canaveral, on launch day many of the signs along the AIA highway would say: "Go Titan" or "Go Delta" or "Go MILSTAR" or "Go Atlantis"—cheering on the vehicle or payload. During the final countdown, similar words would be used, but to indicate that the system was ready. It was the final affirmation to go ahead with the launch: "Go Atlas", "Go Centaur", "Go Intelsat"—we'd done all we could, the entire system was ready to go.

"Go AIAA."

Bob Dickman
bobd@aiaa.org

On 10 September 2012, during the SPACE 2012 Conference and Exhibit, a group of corporate representatives enjoyed a luncheon with General Gene Tattini, Deputy Director of the Jet Propulsion Laboratory, and a personal tour of the Laboratory.

Dear Colleague:

Following a careful review of AIAA financials, current membership models, and other relevant data, the AIAA Board of Directors made the difficult decision to approve a three-year plan to modestly increase dues, starting **1 November 2012**.

The key factors that influenced the Board's decisions were:

- The annual assessment of our cost of service continues to show a gap between the price of membership and the cost of the services we provide.
- Although the implementation of more efficient operating systems and careful management of our expenses has helped reduce overall business expenses, the cost of doing business continues to increase.
- The U.S. Consumer Price Index (CPI) showed a 4.85% increase during the two-year period of 2010–2011.
- A comparative market survey of other professional engineering societies supported the conclusion that the value of our benefits and services is greater than our current pricing structure can support.

The modest dues increases over this three-year period will help reduce the gap between the cost of service and the price of dues, and will allow us to maintain the level of service you've come to expect while keeping us at the forefront of innovation.

The table below illustrates the planned increases that will take place starting 1 November 2012.

Category of Membership	Current Dues	2012–2013	2013–2014	2014–2015
Associate Member, Member, and Senior Member	$105	$110	$115	$120
Retired/Return to Full-Time Study/Spouse/ Unemployed (50% of member dues)	$52.50	$55.000	$57.50	$60.00
Associate Fellow	$105	$120	$125	$131
Retired/Return to Full-Time Study/ Spouse/Unemployed (50% of Associate Fellow dues)	$52.50	$60.00	$62.50	$65.50
Fellow	$120	$140	$146	$153
Retired/Return to Full-Time Study/Spouse/ Unemployed (50% of Fellow dues)	$60.00	$70.00	$73.00	$76.50
Full-Time Student	$20.00	$25.00	$25.00	$25.00
Student to Professional Transition*				
1st yr	$0	$27.50	$28.75	$30
2nd yr	$52.50	$55.00	$57.50	$60
3rd yr	$105	$82.50	$86.25	$90
4th yr = full member rate				

AIAA strongly values the continued commitment and involvement of all our members, and we believe that the plan outlined above will better support the short-term and longer-term viability of AIAA, for the benefit of all of our members.

If you have any comments or suggestions, please feel free to email me at merris@aiaa.org.

Sincerely,
Merri Sanchez
Vice President, Member Services

*Currently discounted to 0% of Member dues the 1st year after graduation and 50% the year following. As of 1 November 2012, rates will change to 25% of Member dues the 1st year after graduation, 50% and 75% the 2nd and 3rd year, and full member dues in the 4th year of graduation. (Example: A student graduating in 2012–2013 would have dues of $27.50 the 1st year, and dues of $57.50 the 2nd year, $90 the 3rd year, and $120 in the 4th year.

AUGUST IS FOR AEROSPACE! A ROUND-UP OF THIS YEAR'S PROGRAMS

Duane Hyland, AIAA Communications/Public Policy

This year's August is for Aerospace (A4a) program saw continued strong support from AIAA sections across the nation, with at least 27 sections taking part in this year's program. From office meetings to larger events involving the community, AIAA members were determined to reach out to as many elected officials as possible so that they understood the importance of aerospace to their individual states and to the United States as a whole.

As is traditional for each year's A4A program, several sections hosted or co-hosted events, beyond office visits, which stressed the importance of aerospace to lawmakers. Among those sections were:

- Members from AIAA's Orange County, San Fernando Valley, and San Francisco sections traveled to Sacramento, CA, where they joined AIAA's Ross Garelick Bell and Duane Hyland, for AIAA's "California Aerospace Days." Over the course of the two-day event, which included a panel discussion on the future of California's aerospace industry, members visited with several California lawmakers to urge them to take steps necessary to protect California's aerospace industry from other states that are aggressively courting businesses within California to leave.
- The Delaware Section held a town-hall meeting with Rep. Andy Harris, M.D. (Md-1), during which Rep. Harris was able to tour ATK's Elkton, MD, facility. After the tour, Rep. Harris met with ATK employees and Delaware section members, discussing "issues of defense spending, the federal deficit, the affordable healthcare act, and future of human spaceflight."
- The Long Island section teamed up with the Air Force Association to host Air Force Week on the *Intrepid*. Section member Frank Hayes met with the Honorable Michael B. Donley, Secretary of the Air Force, and several New York congressmen, to discuss the importance of aerospace to our nation.
- The Southern New Jersey section hosted Congressman Frank LoBiondo at a section gathering, where Congressman LoBiondo was able to meet with section members and discuss a wide range of aerospace issues (see photo on **B1**).
- The Twin Cities section teamed up with AirSpace Minnesota to help sponsor Minnesota Aerospace & Aviation Week, highlighting Minnesota's aerospace industry, and the importance of that industry to Minnesota, to numerous state and federal legislators and decision makers.
- The Southwest Texas Section hosted Congressman Lamar Smith, along with retired astronaut Charlie Duke, to speak about the importance of aerospace to students attending a section-sponsored rocket launch competition. Thomas Moore, of the Southwest Texas Section, also travelled to Washington, DC, to take part in an AIAA panel for the Senate on STEM Visas and immigration policy.
- The Phoenix Section hosted "Changing the Game," an event which featured a roundtable discussion about the importance of technology growth in Arizona, and how such growth will push aerospace development. Among the items discussed were the types of public policy strategies that can promote aerospace in a positive manner, how to stem off funding cuts for new technology, and how to work with federal lawmakers to promote robust federal budgets and acquisition policies for new technology. The event featured Dr. Mary Niemczy, Chair, Aviation Programs, Arizona State University; Dr. James Horkovich, AIAA Fellow, and Engineering Fellow at RMS Energy Systems; and Tracey Dodril, AIAA Phoenix Section public policy officer.
- The Utah Section had Congressman Jim Matheson in to speak to the section and to local aerospace leaders, from ATK, Northrop Grumman, and others, about the future of high tech jobs in Utah. Following the talk, the audience engaged in Q&A with the Congressman on a wide variety of concerns facing the aerospace industry.
- The Pacific Northwest Section took a unique approach to the August is for Aerospace program, and held virtual training session for its members, which covered the basics of grassroots advocacy—how to schedule a meeting, how to conduct a meeting, as well as a review of the issues that were being advocated. Then members were able to go out and effectively engage decision makers at both the state and federal levels in a series of meetings. Four members from the state of Washington and one member from the state of Oregon took part in the training and advocacy. Additionally, the Pacific Northwest Section has issued a modified version of AIAA's Presidential Questionnaire to the state Democratic and Republican parties in Washington, Oregon, Idaho, and Alaska, to see where each party stands on aerospace issues. They plan to publish the survey on their website in October.

In addition to the sections hosting larger events, representatives of these sections also took part in office visits with congressional representatives: Region I: New England, Greater Philadelphia, Hampton Roads, and Mid-Atlantic; Region II: Cape Canaveral, Carolina, and Tennessee; Region III: Dayton-Cincinnati, Illinois, and Northern Ohio; Region IV: Houston; Region V: Rocky Mountain; Region VI: Los Angeles, Orange County and San Diego. In all, 40 meetings with representatives and staff took place through these section meetings.

Delaware Section Members with Congressman Congressman Andy Harris (M.D. – 1)

AIAA BOARD OF DIRECTORS, YOUNG PROFESSIONAL LIAISON

Application Deadline: 1 February 2013
Position Duration: May 2013–May 2015

The Young Professional Liaison position on the AIAA Board of Directors helps give AIAA a more direct link to the Institute's young professional members, and provides insights and feedback to help AIAA create comprehensive programs to attract and retain young professionals and members in general.

The Young Professional Liaison is a non-voting Board of Directors position lasting two years. The liaison will be required to attend AIAA Board of Directors meetings in January, May, and July or August each year. In addition, the Young Professional Liaison will be asked to participate in various other meetings and activities that are collocated with the Board of Directors meeting (receptions, special events, etc.). The Young Professional Liaison will work with the AIAA Young Professional Committee (YPC) and perform various responsibilities including attending the committee's meetings and supporting the committee's various activities. AIAA will reimburse the liaison for necessary expenses incurred to attend the Board of Directors meetings.

ELIGIBILITY

Applicants for the position of Young Professional Liaison to the AIAA Board of Directors shall meet the following eligibility requirements:

1) Applicant must be an AIAA professional member in good standing for at least one year prior to selection.

2) Applicants must be a young professional member (35 years of age or under) for the entire duration of the appointment.

SELECTION CRITERIA

The Young Professional Liaison to the AIAA Board of Directors will be selected on the basis of the following criteria, which are listed in order of importance:

1) *Candidate Statement*
The candidate should state his/her goals and desires for the position and the benefits for the young professional membership if chosen.

2) *Resume/Biography*
The candidate should submit a short resume or biography listing AIAA participation and current position.

3) *Letter of Management Endorsement*
The candidate and his/her managers should discuss the shared commitment associated with selection as the Young Professional Liaison to the AIAA Board of Directors. The applicant must include a letter of recommendation from his/her immediate supervisor in support of candidacy.

4) *Phone Interview*
A phone interview may be requested by the Young Professional Committee after the applications have been submitted and before the final selection.

All application materials must be received at AIAA Headquarters by 1 February 2013. All documents should be typewritten, in English.

ADMINISTRATION OF THE PROGRAM

1) *General*
A selection committee made up of the voting members of the institute's AIAA Young Professional Committee will select the liaison. Final approval of the appointment is made by the AIAA president. AIAA headquarters shall serve as the custodian and disbursing agency for the travel funds and will be responsible for handling the administrative details of the program.

2) *Publicity*
The Young Professional Liaison to the AIAA Board of Directors will be publicized in *Aerospace America* and in various AIAA newsletters or the *AIAA Bulletin*. The program will also be publicized in other appropriate AIAA publications.

3) *Young Professional Committee*
It is expected that upon selection as the Young Professional Liaison to the AIAA Board of Directors, the candidate will become an active voting member of the AIAA Young Professional Committee. The candidate will report directly to the Chair of the YPC. Information about the Young Professional Committee can be found at **https://info.aiaa.org/SC/YPC/default.aspx**.

4) *Submittal of Applications*
The completed application must be received by **1 February 2013**, for consideration for the May 2013–May 2015 position. The application and related materials should be addressed to:

AIAA Young Professional Liaison Application
c/o Christopher Horton
Membership Programs Manager
1801 Alexander Bell Drive
Suite 500
Reston, VA 20191-4344

It is the responsibility of the applicant to ensure receipt of all required materials by the submission date.

5) *Selection of the Young Professional Liaison to the AIAA Board of Directors*
The decision of the selection committee is considered to be final and all candidates will be advised of the outcome by **15 March 2013**.

6) *Disbursement of the Travel Reimbursement*
AIAA will incur the cost of travel for the Young Professional Liaison to the AIAA Board of Directors to travel to the three AIAA Board of Directors meetings each year. The AIAA Board of Directors Meetings are usually held each January, May, and July or August. Travel support will include the cost of airfare, hotel, and meals during the program dates.

7) *Questions*
All questions can be directed to Christopher Horton, phone 703.264.7561, or email chrish@aiaa.org.

2012 BEST PAPERS

During 2012, the following papers were selected as a "Best Paper." Authors were presented with a certificate of merit at an appropriate technical conference. Congratulations to each author for achieving technical and scientific excellence!

AAS/AIAA Astrodynamics Specialist Best Paper
AAS-11-437, "Sequential Probability Ratio Test for Collision Avoidance Maneuver Decisions Based on a Bank of Norm-Inequality-Constrained Epoch-State Filters," J. Russell Carpenter, NASA Goddard Space Flight Center.

AAS/AIAA Space Flight Mechanics Best Paper
AAS 11-134, "Attitude Parameterizations as Higher Dimensional Map Projections," Sergei Tanygin, Analytical Graphics, Inc.

AIAA Aerodynamic Measurement Technology
AIAA 2012-1193, "Development of a Dual-Pump CARS System for Measurements in a Supersonic Combusting Free Jet," Gaetano Magnotti and Andrew Cutler, George Washington University; and Paul M Danehy, NASA Langley Research Center.

AIAA Aerospace Measurement Technology Best Paper
AIAA 2011-0362, "Requirements, Capabilities and Accuracy of Time-Resolved PIV In Turbulent Reacting Flows," Mirko Gamba, Stanford University; and Noel Clemens, University of Texas at Austin.

AIAA Aerospace Power Systems Best Paper
AIAA 2011-5576, "Overview of Heat Addition and Efficiency Predictions for an Advanced Stirling Convertor," Scott Wilson, Terry Reid, Nicholas Schifer, and Maxwell Briggs, NASA Glenn Research Center.

AIAA Aerospace Power Systems Best Student Paper
AIAA 2011-5900, "Design and Analysis of a Multi-Window Aperture Structure for a Small Particle Solar Receiver," Ionna Broome and Fletcher Miller, San Diego State University.

AIAA Air Breathing Propulsion Systems Integration Best Paper
AIAA 2012-0275, "Addressing Corner Interactions Generated by Oblique Shock-Waves In Unswept Right-Angle Corners and Implications for High-Speed Inlets," Dan Baruzzini, Daniel Miller, and Neal Domel, Lockheed Martin Corporation.

AIAA Applied Aerodynamics Best Paper
AIAA No. 2011-3500, "Joint-Based Low-Boom Design With Cart3D," Michael Aftosmis, Marian Nemec, and Susan Cliff, NASA Ames Research Center.

AIAA Atmospheric Flight Mechanics Best Papers
AIAA 2012-1050, "Efficient Global Aerodynamic Modeling From Flight Data," Eugene Morelli, NASA Langley Research Center.

AIAA 2011-6672, "Flight Test Maneuvers For Efficient Aerodynamic Modeling," Eugene Morelli, NASA Langley.

AIAA David Weaver Best Student Paper
AIAA 2012-1013, "Aerodynamic Interactions of Reaction Control System Jets on Mars Entry Aeroshells," Hicham Alkandry and Iain Boyd, University of Michigan; and Erin Reed, Joshua Codoni, and James McDaniel, University of Virginia.

AIAA Electric Propulsion Best Paper
AIAA 2011-5661, "In-Flight Operation of the Dawn Ion Propulsion System Through Orbit Capture at Vesta," Charles Garner, Marc Rayman, John Brophy, and Steven Mikes, Jet Propulsion Laboratory.

AIAA Fluid Dynamics Best Paper
AIAA 2011-3908, "Large-Eddy Simulation Of An Over-Expanded Planar Nozzle," Britton Olson and Sanjiva Lele, Stanford University.

AIAA Gossamer Spacecraft Forum Best Paper
AIAA 2011-1887, "Mission Report on The Solar Power Sail Deployment Demonstration of IKAROS," Hirotaka Sawada, Osamu Mori, Nobukatsu Okuizumi, Yoji Shirasawa, Japan Aerospace Exploration Agency; Yasuyuki Miyazaki, Nihon University; N. Natori, Waseda University; and Saburo Matunaga, Hiroshi Furuya, Hiraku Sakamoto, Tokyo Institute of Technology

AIAA Ground Testing Best Paper
AIAA 2012-0929, "Application of Additive Manufacturing to Rapidly Produce High-Resolution Total Pressure Distortion Screens," Anthony Ferrar, William Schneck, Justin Bailey, Kevin Hoopes, and Walter O'Brien, Virginia Tech.

AIAA Guidance, Navigation, and Control Best Paper
AIAA 2011-6238, "Decentralized Information-Rich Planning and Hybrid Sensor Fusion for Uncertainty Reduction in Human-Robot Missions," Sameera Ponda, Brandon Luders, and Jonathan How, MIT; Nisar Ahmed, Eric Sample, Rauhira Hoossainy, Danelle Shah, and Mark Campbell, Cornell University.

AIAA High Speed Air Breathing Propulsion Best Paper
AIAA-2012-0330, "Particle Image Velocimetry in an Isothermal and Exothermic High-Speed Cavity," Steven Tuttle, Campbell Carner, and Kuang-Yu Hsu, Wright Patterson AFB.

AIAA Hybrid Rockets Best Paper
AIAA 2011- 5680, "Ballistic and Rheological Characterization of Paraffin-Based Fuels for Hybrid Rocket Propulsion," Luciano Galfetti, Filippo Maggi, Luigi De Luca, L. Merott, and M. Broiocchi, Technical University of Milan.

AIAA Hybrid Rockets Best Student Paper
AIAA 2011-5538, "A Numerical Model to Analyze the Transient Behavior and Instabilities on Hybrid Rocket Motors," Francesco Barato, Nicolas Bellomo, Martina Faenza, Marta Lazzarin, Alberto Bettella, and Deniele Pavarin, University of Padova.

AIAA Hypersonics Program Best Papers
AIAA 2011-2392, "An Overview of NASA'S Integrated Design and Engineering Analysis (IDEA) Environment," Jeffrey Robinson, NASA Langley Research Center.

AIAA 2011-2279, "Overview of the Advanced Propulsion Test Technology Hypersonic Aero Propulsion Clean Air Testbed," Thomas Fetterhoff, Arnold Engineering Development Center; and Jon Wade Burfitt, MIRATEK.

AIAA Hypersonics Technology Best Papers
AIAA 2011-2303, "CIRA Activities On UHTC's: On-Ground And In Flight Experimentations," Roberto Gardi, Antonio Del Vecchio, and Giuliano Marino of Italian Aerospace Research Center (CIRA); and Gennaro Russo, AIDAA DIAS, Dept Aerospace Engineering.

AIAA 2011-2356, "Measurement of Aerothermal Heating on HIFiRE-0,"Andrew Neely, Rishabh Choudhury, and Hans Riesen, University of New South Wales; Daniel Paukner, Technical University of Munich; and Judy Odam, Defence Science and Technology Organisation.

AIAA Intelligent Systems Best Paper
AIAA 2011-1506 "Formal Synthesis of Embedded Control Software: Application to Vehicle Management Systems,"

Tichakorn Wongpiromsarn, Singapore-MIT Alliance for Research and Technology; Ufuk Topcu and Richard Murray, California Institute of Technology.

AIAA Liquid Propulsion Best Paper
AIAA 2011-5682, "Heat Exchange and Pressure Drop Enhanced by Sloshing," Takehiro Himeno, Daizo Sugimori, Katsutoshi Ishikawa, Seiji Uzawa, Chihiro Inoue, University of Tokyo; Toshinori Watanabe, Satoshi Nonaka, Yoshihiro Naruo, Yoshifumi Inatani, Kiyoshi Kinefuchi, Ryoma Yamashiro, Toshiki Morito, and Koichi Okita, JAXA.

AIAA Modeling and Simulation Best Paper
AIAA 2011-6674, "Modeling Braking Friction Between An Aircraft Tire And The Runway," Logan Jones, Airbus Opeations SAS; and Jean Luc Boiffier Institut Supérieur de l'Aéronautique et de l'Espace.

AIAA Multidisciplinary Optimization Best Paper
AIAA 2010-9191, "Multi-Fidelity Multidisciplinary Design Optimization of Metallic and Composite Regional and Business Jets," Antoine DeBlois and Mohammed Abdo, Bombadier Aerospace.

AIAA Nuclear and Future Flight Propulsion Best Paper
AIAA 2011-5846, "Lower Thrust Engine Options Based on the Small Nuclear Rocket Engine Design," Bruce Schnitzler, Idaho National Laboratory; Stanley Borowski and James Fitije NASA Glenn Research Center.

AIAA Plasmadynamics and Lasers Best Paper
AIAA Paper 2011-3280, "Flight Measurements of Aero-Optical Distortions from a Flat-Windowed Turret on the Airborne Aero-Optics Laboratory (AAOL)" Christopher Porter, Stanislav Gordeye, Mike Zenk, and Eric Jumper, University of Notre Dame.

AIAA Plasmadynamics and Lasers Best Student Paper
AIAA 2012-0822, "Fundamental Processes of DBD Plasma Actuators Operating at High Altitude," Timothy Nichols and Joshua Rovey, Missouri University of Science and Technology.

AIAA Propellants and Combustion Best Paper
AIAA 2011-0319, "Ignition and Near-Wall Burning in Transverse Hydrogen Jets in Supersonic Crossflow," Mirko Gamba, M. Godfrey Mungal, and Ronald Hanson, Stanford University.

AIAA Shahyar Pirzadeh Memorial Award for Outstanding Paper in Meshing Visualization and Computational Environments
AIAA 2011-3539, "Efficient Hybrid Surface and Volume Mesh Generation for Viscous Flow Simulations," Yasushi Ito, Alan Shih, and Bharat Soni, University of Alabama at Birmingham; Mitsuhiro Murayama and Kazuomi Yamamoto, JAXA.

AIAA Solid Rockets Best Paper
AIAA 2011-5956, "Unanticipated Problems and Misunderstood Phenomena in and Around Solid Rockets," Mark Salita, Salita Consulting.

AIAA Space Architecture Best Paper
AIAA 2011-5018, "Habitat Water Wall for Water, Solids, and Atmosphere Recycle and Reuse," Michael Flynn, Lance Delzeit, Mona Hammoudeh, Hali Laraelizabeth Shaw, and Alex Polonsky, NASA Ames Research Center; Sherwin Gormly, Hydration Technologies Innovations LLC; Kevin Howard, Dynamac Corp/NASA Ames Research Center; A. Scott Howe, Jet Propulsion Laboratory; Monica Soler, Bionetic Corporation; and Joe Chambliss, NASA Johnson Space Center.

AIAA Terrestrial Energy Systems Best Paper
AIAA 2012-0930, "Mixture Preparation Effects On Distributed Combustion For Gas Turbine Applications," Ahmed E. E. Khalil Hasan and Ashwani Gupta, University of Maryland; Kenneth Bryden, University of Iowa; and S.C. Lee, Kyungnam University.

AIAA Thermophysics Best Paper
AIAA 2011-3128, "DSMC Modeling of High-Temperature Chemical Reactions in Air," Yevgeniy Bondar, Alexander Shevyrin, Mikhail Ivanov, and Alexander Kashkovsky Khristianovich, Russian Academy of Sciences.

ASME/Boeing Best Paper
AIAA 2011-1876, "Measurement of Deformation of Rotating Blades Using Digital Image Correlation," Michael Lawson and Jayant Sirohi, University of Texas-Austin.

ASME Propulsion Best Paper
AIAA 2011-5636, "Second Generation Air-to-Air Mechanical Seal Design and Performance," Nathan Gibson, Ron Takeuchi, Tina Hynes, Honeywell International; and Malak Malak, Allied Signal Aerospace Co.

AIAA Student Paper Competitions

Aeroacoustics
AIAA 2012-2152, "A Computational Study Of The Effects Of Liner Damage On Zero-Splice Turbofan Intake Liners," Prateek Mustafi, Rie Sugimoto, and Jeremy Astley, University of Southampton.

Atmospheric Flight Mechanics
AIAA 2012-4957, "Store Separation Equations of Motion," Ryan Carter, University of Florida.

American Society For Composites Student Paper In Composites
AIAA 2012-1701, "Experimental Study on Low-Velocity Impact Behavior of Foam-Cored Sandwich Panels," Jie Wang and Hai Wang, Shanghai Jiao Tong University; Anthony Waas, University of Michigan.

Guidance, Navigation, and Control
AIAA 2012-4610, "Optimization of Single-Satellite Operational Schedules Towards Enhanced Communication Capacity," Sara Spangelo and James Cutler, University of Michigan.

Harry H. and Lois G. Hilton Student Paper Award in Structures
AIAA 2012-1612, "A Thermodynamically-Based Mesh Objective Work Potential Theory For Predicting Intralaminar Progressive Damage and Failure in Fiber-Reinforced Laminates," Evan Pineda, NASA Glenn Research Center; Anthony Waas, University of Michigan.

Environmental Systems
AIAA 2012-3548, "Developing a Spacesuit Injury Countermeasure System for Extravehicular Activity: Modeling and Analysis," Allison Anderson, Ana Diaz, Dava Newman, Jeffrey Hoffman, and Ryan Kobrick, Massachusetts Institute of Technology; Michal Kracik, Academy of Fine Arts; Guillermo Trotti, Trotti and Associates, Inc.

Intelligent Systems
AIAA 2012-2603, "Use of Discretization Approach in

Autonomous Control of an Active Extrados/Intrados Camber Morphing Wing," Vishesh Gupta, Harker School.

Jefferson Goblet
AIAA 2012-171, "Subgrid-Scale Dynamics For A Nonlinear Beam," Allen Labryer, Peter Attar, and Prakash Vedula, University of Oklahoma.

Lockheed Martin Student Paper Award In Structures
AIAA 2012-1949, "Homogenization of Slender Periodic Composite Structures," Julian Dizy Suarez, Silvestre Pinho, and Rafael Palacios, Imperial College.

Multidisciplinary Optimization Student Paper
AIAA 2012-5605, "GeoMACH: Geometry-Centric MDAO of Aircraft Configurations with High Fidelity," John Hwang and Joaquim Martins, University of Michigan.

OBITUARY

Former American Rocket Society Member Berch Died in July 2012

Julian P. Berch (aka Jay) passed away on 7 July. He was just shy of his 81st birthday.

Mr. Berch attended New York University (Undergraduate and Graduate degrees in Engineering) and Tulane University (MBA). He spent his career working in the aeronautical industry and his free time attending track and field events worldwide and spending time with his family and pets. He was an avid dog lover and volunteered his time at a local animal shelter.

Mr. Berch joined the American Rocket Society in March 1959 and was a member of the Institute of Aeronautical Sciences

Memorial donations can be made to the: Town of Babylon Animal Shelter, 51 Lamar Street, West Babylon NY 11704.

MARS MISSION DESIGN STRATEGY GAME FOR ATTRACTING STEM STUDENTS

Ramana M. Pidaparti, Professor of Mechanical Engineering, Virginia Commonwealth University

The recent successful landing of NASA's *Curiosity* rover on Mars presents an opportunity to capture the imagination of young minds and excitement to pursue STEM fields. This is especially true for aerospace and defense fields where most STEM students/engineers are needed. In its 2009 report, the National Academy of Engineering (NAE) emphasized that "engineering design" should be taught to STEM students in schools promoting engineering education following the engineering habits of mind. As a professor of mechanical engineering at Virginia Commonwealth University teaching design, I have been working on the idea of creating a design strategy board game for about two years or so with a view to demonstrating the design process to elementary/middle school children. Board games represent one example of using non-traditional means to educate students about design innovation concepts and promote interest in STEM fields.

Virginia Commonwealth University undergraduate students and faculty (Ben White, Alex Tatom, Matthew Proietti, Patrick Profitt, Sarah Cunningham, and Dr. Pidaparti) developed the Mars Mission Design Strategy board game with the overall goal of illustrating the various phases of the design process. The Mars Mission board game is intended for school-age children (ages 8–12 years). It takes them on a fun and educational journey along four loops as they visit different aspects of the design process (research, design, engineering, and build) and answer questions related to understanding the Mars rover design specifications, engineering calculations, securing funding, and selecting components for their design. Finally, the players/teams evaluate their design against the criteria set forth before the beginning of the game mission related to cost, weight, efficiency, maneuverability, durability, and speed. After evaluation of their design, students/players build a physical model of their design by assembling the components. The winning design will have the highest score during the evaluation.

A prototype of the Mars Mission board game was developed and pilot test completed at St. Catherine's school to verify the game's appeal and ease of use, and most importantly confirm design engineering aspects of the Mars Mission board game. A major objective of the Mars Mission board game is to educate and provide awareness at an early stage so that all children will start practicing design innovation strategies and develop interest in STEM fields. With the help of sponsors, the Mars Mission board game can be mass produced and distributed to teachers/students to implement in the school curriculum in Virginia and beyond. Please contact Dr. Pidaparti at 804.827.3742 or email: rmpidaparti@vcu.edu for additional information.

St. Catherine's School 5th grade class (teacher: Mrs. Evelyn Boatwright) playing the Mars Mission game.

CALL FOR NOMINATIONS

Nominations are now being accepted for the following awards, and must be received at AIAA Headquarters no later than **1 February**. Awards are presented annually, unless other indicated. However AIAA accepts nominations on a daily basis and applies them to the appropriate year.

Any AIAA member in good standing may serve as a nominator and strongly are urged to read award guidelines carefully to view nominee eligibility, page limits, letters of endorsement, etc. AIAA members may submit nominations online after logging into **www.aiaa.org** with their user name and password. You will be guided step-by-step through the nomination entry. If preferred, a nominator may submit a nomination by completing the AIAA nomination form, which can be downloaded from www.aiaa.org.

Beginning in 2013, all nominations, whether submitted online or in hard copy, must comply with the limit of 7 pages for the nomination package. The nomination package includes the nomination form, a one-page basis for award, one-page resume, one-page public contributions, and a minimum of 3 one-page signed letters of endorsement from AIAA members. Up to 5 signed letters of endorsement (include the 3 required from AIAA members) may be submitted and increase the limit to 9 pages. Nominators are reminded that the quality of information is most important.

Aerospace Guidance, Navigation, and Control Award is presented to recognize important contributions in the field of guidance, navigation, and control. (Presented even years)

Aerospace Power Systems Award is presented for a significant contribution in the broad field of aerospace power systems, specifically as related to the application of engineering sciences and systems engineering to the production, storage, distribution, and processing of aerospace power.

Aircraft Design Award is presented to a design engineer or team for the conception, definition, or development of an original concept leading to a significant advancement in aircraft design or design technology.

Daniel Guggenheim Medal honors persons who make notable achievements in the advancement of aeronautics. AIAA, ASME, SAE, and AHS sponsor the award.

de Florez Award for Flight Simulation is presented for an outstanding individual achievement in the application of flight simulation to aerospace training, research, and development.

Energy Systems Award recognizes a significant contribution in the broad field of energy systems, specifically as related to the application of engineering sciences and systems engineering to the production, storage, distribution, and conservation of energy.

F. E. Newbold V/STOL Award recognizes outstanding creative contributions to the advancement and realization of powered lift flight in one or more of the following areas: initiation, definition, and/or management of key V/STOL programs; development of enabling technologies including critical methodology; program engineering and design; and/or other relevant related activities or combinations thereof that have advanced the science of powered lift flight.

George M. Low Space Transportation Award, honors the space transportation achievements of Dr. Low, and is presented for a timely outstanding contribution to the field of space transportation. (Presented even years)

Haley Space Flight Award is presented for outstanding contributions by an astronaut or flight test personnel to the advancement of the art, science, or technology of astronautics. (Presented even years)

Hap Arnold Award for Excellence in Aeronautical Program Management is presented to an individual for outstanding contributions in the management of a significant aeronautical- or aeronautical-related program or project.

Hypersonic Systems and Technologies Award recognizes sustained, outstanding contributions and achievements in the advancement of atmospheric, hypersonic flight and related technologies. (Presented every 18 months)

J. Leland Atwood Award recognizes an aerospace engineering educator for outstanding contributions to the profession. AIAA and ASEE sponsor the award. ***Note: Nominations due to AIAA by 1 January.***

Mechanics and Control of Flight Award is presented for an outstanding recent technical or scientific contribution by an individual in the mechanics, guidance, or control of flight in space or the atmosphere.

Multidisciplinary Design Optimization Award is given to an individual for outstanding contributions to the development and/or application of techniques of multidisciplinary design optimization in the context of aerospace engineering. (Presented even years)

Otto C. Winzen Lifetime Achievement Award is presented for outstanding contributions and achievements in the advancement of free flight balloon systems or related technologies. (Presented odd years)

Piper General Aviation Award is presented for outstanding contributions leading to the advancement of general aviation. (Presented even years)

Space Automation and Robotics Award recognizes leadership and technical contributions by individuals and teams in the field of space automation and robotics. (Presented odd years)

Space Science Award is presented to an individual for demonstrated leadership of innovative scientific investigations associated with space science missions. (Presented even years)

Space Operations and Support Award is presented for outstanding efforts in overcoming space operations problems and assuring success, and recognizes those teams or individuals whose exceptional contributions were critical to an anomaly recovery, crew rescue, or space failure. (Presented odd years)

Space Systems Award is presented to recognize outstanding achievements in the architecture, analysis, design, and implementation of space systems.

von Braun Award for Excellence in Space Program Management honors outstanding contributions in the management of a significant space or space-related program or project.

William Littlewood Memorial Lecture, sponsored by AIAA and SAE, perpetuates the memory of William Littlewood, who was renowned for the many significant contributions he made to the design of operational requirements for civil transport aircraft. Lecture topics focus on a broad phase of civil air transportation considered of current interest and major importance.

For further information on AIAA's awards program, please contact Carol Stewart, Manager, AIAA Honors and Awards, carols@aiaa.org or 703.264.7623.

Upcoming AIAA Professional Development Courses

7 November 2012
This 60-minute webinar will take place at 1300–1400 EDT

To register, go to **www.aiaa.org/CourseListing.aspx?id=3200.**

AIAA Members	Nonmembers	Students
$89	$129	$40

Flight Dynamics and Einstein's Covariance Principle

(Peter Zipfel, Ph.D.)

The great divide between Newtonian dynamics and Einstein's Relativity is a chimera. Einstein had great respect for Newton and made sure that his theory would converge to Newton's three laws as conditions approach classical proportions. Flight dynamics, which is based on Newton's laws, is no exception. During a one-hour perambulation, I will acquaint you with Special and General Relativity as it applies to classical dynamics. Modeling of flight dynamics benefits greatly from such a vantage point. The physics of the problem are separated from its computational aspects. Tensors—independent of coordinate systems—model the physics, while matrices, created from these tensors by introducing coordinate systems, are coded for execution.

14 November 2012
This 90-minute webinar will take place at 1300–1430 EDT

To register, go to **www.aiaa.org/CourseListing.aspx?id=3200.**

AIAA Members	Nonmembers	Students
$99	$139	$50

Risk Analysis and Management **(Dr. Vincent L. Pisacane)**

This course is intended for technical and management personnel who wish to gain an understanding of techniques that can be implemented to minimize premature failure of space systems. It first identifies selected typical space system failures and their causes. Failure analyses includes the Weibull distribution and its failure rate, mean time to failure, hazard function reliability (survival) function, and conditional, reliability function. Mitigation techniques discussed includes burn in and risk management techniques that includes failure identification, fault tree analyses, event tree analyses, failure modes and effects analyses, failure modes and effects analyses, and risk matrices.

6 December 2012
This 90-minute webinar will take place at 1300–1430 EDT

To register, go to **www.aiaa.org/CourseListing.aspx?id=3200.**

AIAA Members	Nonmembers	Students
$99	$139	$50

Advanced Composite Materials and Structures

(Carl Zweben, Ph.D.)

Advanced composites are critical, and in many instances enabling, materials for a large and increasing number of aerospace and commercial applications. Historically considered primarily structural and thermal protection materials, they also have great potential in virtually all subsystems, including propulsion, mechanisms, electronics, power, and thermal management. Physical properties are increasingly important. For example, composites with low densities, low CTEs and thermal conductivities higher than copper are now in production. Materials of interest include not only polymer matrix composites (PMCs), currently the most widely used class of structural materials, and carbon-carbon composites (CCCs), which are well established for thermal protection, but also ceramic matrix composites (CMCs), metal matrix composites (MMCs) and other types of carbon matrix composites (CAMCs). In this presentation we consider key aspects of the four classes of composites, including properties, key manufacturing methods, design considerations, analysis overview, lessons learned and applications. We also consider future directions, including nanocomposites.

5–6 January 2013
The following Continuing Education courses are being held at the 51st AIAA Aerospace Sciences Meeting in Grapevine, TX. Registration includes course and course notes; full conference participation: admittance to technical and plenary sessions; receptions, luncheons, and online proceedings.

To register for one of the ASM 2013 courses, go to
www.aiaa.org/asm2013.

	Early Bird by 10 Dec	*Standard (11 Dec–4 Jan)*	*On-site (5 Jan)*
AIAA Member	$1295	$1395	$1495
Nonmember	$1400	$1500	$1600

Specialist's Course on Flow Control **(Instructor: David Williams, Professor of Mechanical, Materials & Aerospace Engineering Department, Director of Fluid Dynamics Research Center, Illinois Institute of Technology, Chicago, IL; Daniel Miller, Technical Lead and PI for Propulsion Integration R&D, Lockheed Martin Skunk Works, Bainbridge Island, WA; Dr. Kunihiko Taira, Assistant Professor, Department of Mechanical Engineering, Florida A&M/Florida State University, Tallahassee, FL)**

The techniques of active flow control are becoming more sophisticated as fluid dynamics, control and dynamical systems theory merge to design control architectures capable of solving challenging flow control applications. The two-day course will examine advanced topics in active flow control, placing particular emphasis on "how to do flow control." This new course will complement the more fundamental AIAA Short Course on "Modern Flow Control." Modern dynamical systems and control theory related to closed-loop flow control and performance limitations will be discussed. State-of-the-art actuator and sensor design techniques will be covered. Two case studies will be presented that describe recent success stories about the implementation of active flow control on advanced aircraft. The six course lecturers have extensive backgrounds in flow control, coming from industry and academia.

Six Degrees of Freedom Modeling of Missile and Aircraft Simulations (Instructor: Peter Zipfel, Adjunct Associated Professor, University of Florida, Shalimar, FL)
As modeling and simulation (M&S) is penetrating the aerospace sciences at all levels, this two-day course will introduce you to the difficult subject of modeling aerospace vehicles in six degrees of freedom (6 DoF). Starting with the modern approach of tensors, the equations of motion are derived and, after introducing coordinate systems, they are expressed in matrices for compact computer programming. Aircraft and missile prototypes will exemplify 6 DoF aerodynamic modeling, rocket and turbojet propulsion, actuating systems, autopilots, guidance, and seekers. These subsystems will be integrated step by step into full-up simulations. For demonstrations, typical fly-out trajectories will be run and projected on the screen. The provided source code and plotting programs lets you duplicate the trajectories on your PC (requires FORTRAN or C++ compiler). With the provided prototype simulations you can build your own 6 DoF aerospace simulations.

Systems Engineering Verification and Validation (Instructor: John C Hsu, CA State University, The University of CA at Irvine, Queens University and The Boeing Company, Cypress, CA)
This course will focus on the verification and validation aspect that is the beginning, from the validation point-of-view, and the final part of the systems engineering task for a program/project. It will clarify the confusing use of verification and validation. Familiarize yourself with validating requirements and generating verification requirements. Start with the verification and validation plans. Then learn how to choose the best verification method and approach. Test and Evaluation Master Plan leads to test planning and analysis. Conducting test involves activities, facilities, equipments, and personnel. Evaluation is the process of analyzing and interpreting data. Acceptance test assures that the products meet what intended to purchase. There are functional and physical audits. Simulation and Modeling provides virtual duplication of products and processes in operational valid environments. Verification management organizes verification task and provides total traceability from customer requirements to verification report elements.

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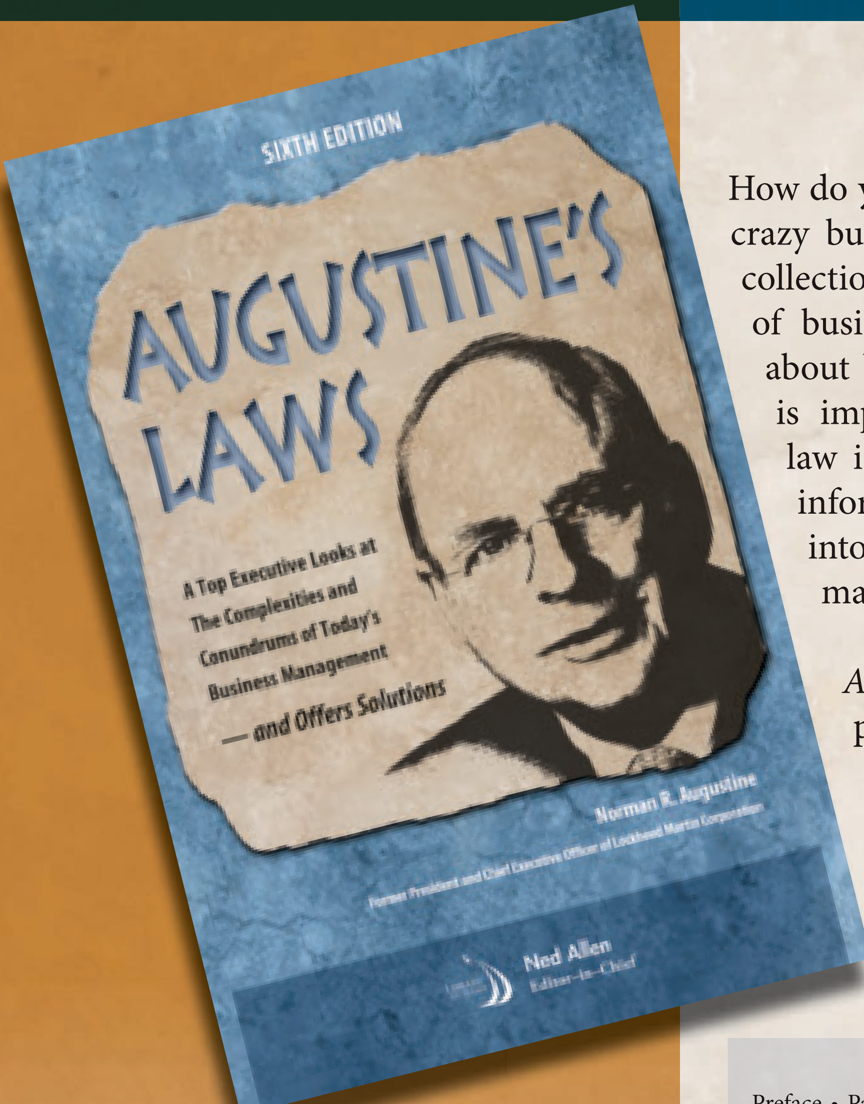

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Standard Information for all AIAA Conferences

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.