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November 2011

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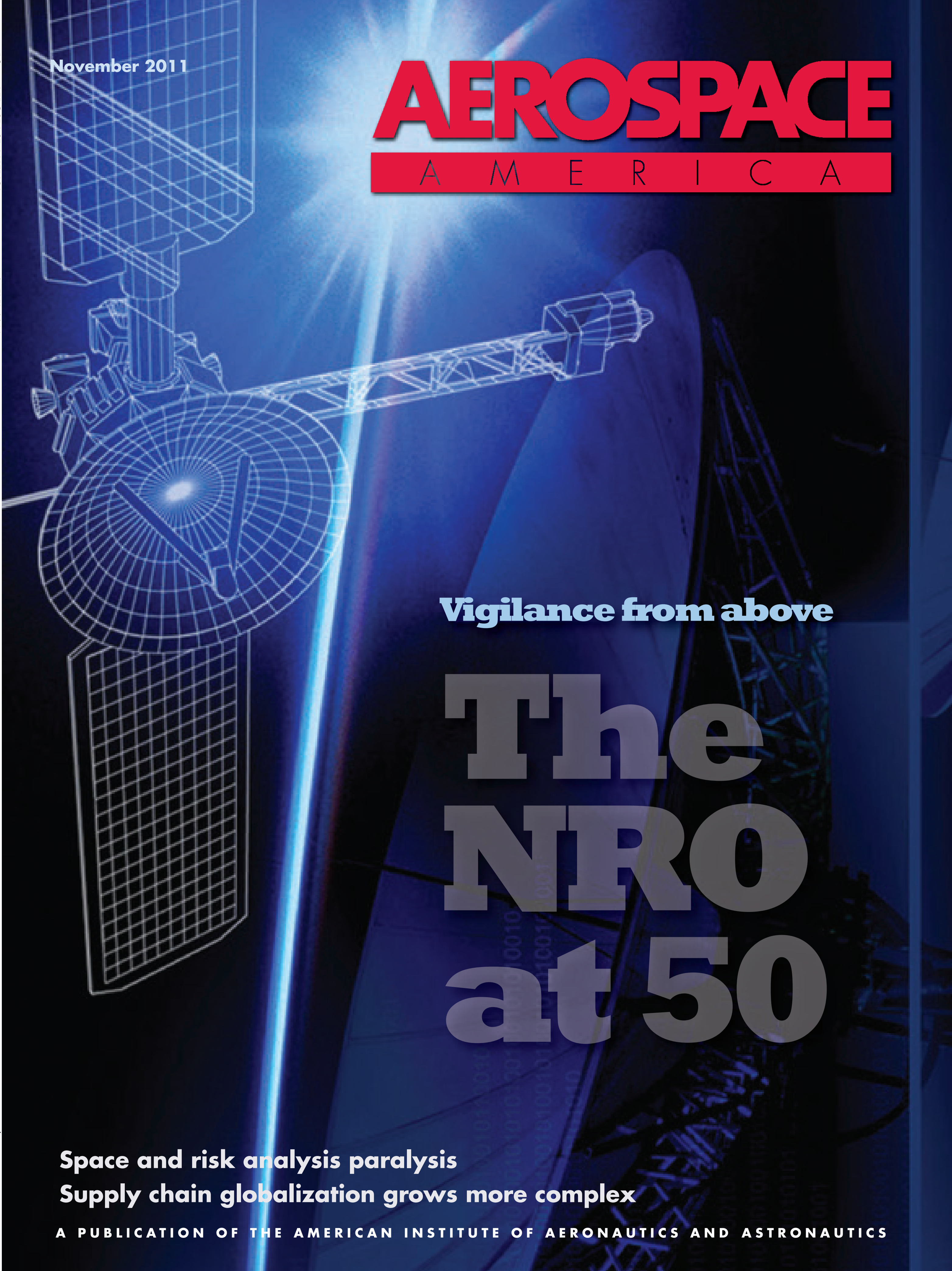

Vigilance from above

The NRO at 50

Space and risk analysis paralysis

Supply chain globalization grows more complex

A PUBLICATION OF THE AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS


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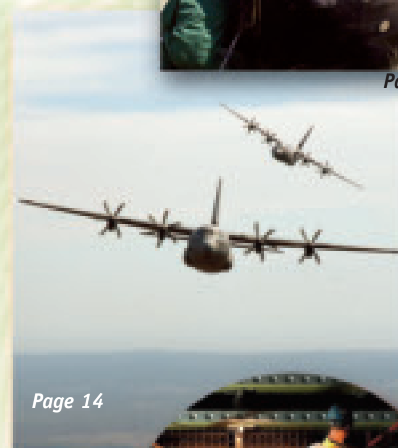
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COVER

Once an agency so secret that its very existence was not acknowledged, the National Reconnaissance Office has marked its 50th anniversary by drawing the curtains back—a bit. Turn to page 20 to learn about the NRO's history.

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Editorial

A price too high

As Atlantis touched down at Kennedy Space Center on July 21, STS-135, and the U.S. space shuttle program, came to an end. For months before that flight, and ever since, conversations and often heated debate about the end of the nation's human space transportation system, and what it means for our future in space, have held the attention of those commited to seeing the nation remain in space beyond the lifetime of the international space station.

Word of the final go for developing the heavy-lift SLS, or space launch system, brought its own set of questions, as many argued that it was a 'rocket without a destination.' Continuation of work on the Orion multipurpose crew vehicle did little to assuage those angry over either the cancellation of the Constellation program or a 'premature' standdown of the shuttle.

But a possibly larger issue looms over all of this discussion. As the Constellation program received its cancellation notice and it began to be dismantled, and work started on preparing the shuttles for their new role as museum artifacts, the agency's most valuable asset was also being dispersed.

A day after the shuttle touched down for the last time, 2,800 workers in the area were to receive layoff notices. In the last few months, hundreds of others have been laid off, both at NASA centers and at contractors such as ULA. These layoffs cross all levels of skills and capabilities, and include designers, engineers, scientists, and technicians.

At NASA Headquarters, some at the top levels of management are opting for retirement or employment elsewhere. In the last several months, Jon Morse, director of the Science Mission Directorate's Astrophysics Division; Doug Cooke, associate administrator for the Exploration Systems Mission Directorate; his deputy Laurie Leshin; and Bryan O'Connor, chief of safety and mission assurance, have announced their departure.

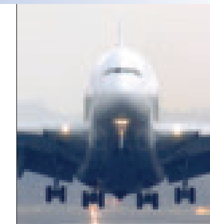
When Chief Technologist Bobby Braun resigned, effective Septemer 30, he had held the position less that two years. In announcing his departure, he said, "While…change is difficult, I believe that the more desperately an organization tries to hold on to today, the more likely it is that this same organization will not have a tomorrow. Please remember that the future starts today."

But our 'tomorrow' in space depends not only on having a clear vision of where we want to go and how to get there. If Edison is right, genius is one percent inspiration, ninety-nine percent perspiration. The job cannot be done by vision alone.

The resignations and layoffs at NASA and its contractors may have effects far beyond today. As this highly skilled workforce disperses; as astronauts depart, believing fewer opportunities exist to do what they were trained for, there will be a void that will be difficult to fill when the next, inevitable, uptick in space activities comes. Those in school now, who once dreamed of exploring the high frontier, may now set their sights on other goals. And those who still cling to their dreams may find the road a bit rockier, as the mentors who are so valuable to those just beginning the journey will be harder and harder to find.

When the loss is talent, not treasure, the price is too high.

Elaine Camhi
Editor-in-Chief



Supply chain globalization grows more complex

The world's aerospace industry is entering a new phase of globalization. Instead of seeking new partners down the supply chain with the lowest possible wage rates, airframe and engine manufacturers are now looking closer to home for partners that can add value. They are concentrating on increasing the productivity—and reducing the numbers—of their key legacy suppliers, and looking to shorten their supply chain links. The secret to building profitable and complex aircraft, it seems, is to simplify the production process.

Unfortunately for manufacturers, in this new era of globalization the supply chain is about to become a great deal more complex.

Management challenges

In Seattle and Toulouse, the imminent production ramp-up in short- and long-haul twin-engined airliners has accelerated the process of prioritizing reliability of suppliers. There are still advantages to having a well-educated and low-wage supplier workforce (backed by generous government investments) available in fast-growing emerging markets. But it is becoming clear that a global supply chain brings with it a host of infrastructure issues that make it complex and expensive to manage at times.

This is particularly true when new aircraft, new tooling systems, new materials, and new supplier relationships are being introduced, and when demand peaks and troughs widely. The major civil airframe manufacturers have been able to avoid some of the worst extremes of underdemand and oversupply in recent years by very careful management of their production lines—replacing lost orders from European and U.S. airlines struggling through the recent recession with new orders from Far East and Middle East airlines.

The complexity of new programs such as the Boeing 787 and Airbus 380 makes them vulnerable to capacity and technology problems in the distant supply chain. This has added to the attractiveness of keeping as much work as possible close to home.

According to a report on global logistical issues ("Trends in Global Manufacturing, Goods Movement and Consumption, and Their Effect on the Growth of United States Ports and Distribution"), issued recently by the U.S. Commercial Real Estate Development Organization, "Global shifts in manufacturing have occurred as supply chain tracking systems and logistics networks better support remote production sites that offer lower labor costs. However, challenges with the extra distance—including efforts to deliver parts for production and the delivery of the finished product—make it more difficult to retain predictability in the supply chain. Additionally, managing the longer and more complex supply chain adds expense, which must be tracked to make sure it does not erase lower-cost labor benefits."

In any case, for many large aircraft programs, all that can reasonably be outsourced has already been outsourced. "It is estimated that the amount of manufacturing outsourcing in the aerospace industry is close to about 80% of the airplane," according to a recent WIPRO (Bangalore, India) Council for Industry Research report, "Aerospace Manufacturing Transfer Systems."

In this second phase of aerospace manufacturing globalization, the emphasis for major manufacturers is on adding value to manufacturing processes, to ensure the key technologies that will deliver the 18% performance improvement over current aircraft types remain close to home.

Who benefits

The beneficiaries of this new phase in outsourcing so far have been mature aerospace economies, not the newcomers. "The reason why the U.K. has been successful in improving productivity in recent years has been that we outsourced a great deal of this work some time ago," explains Matthew Knowles of the U.K. aerospace and defense trade association ADS. "This last year we saw productivity per employee increase by 6%. With Rolls-Royce engines on board, around half the value of an Airbus A380 is based in the U.K. and a quarter of the value of a Boeing 787."

The U.K. is not alone—most North American and European suppliers have been able to make substantial productivity gains in recent years. The current revenue per aerospace employee in the U.S., for example, is around $34,600, up from $28,900 in 2006 and $24,636 in 2002, based on current dollar values. This compares to an average of $33,000 for the top 10 aerospace manufacturing countries where figures are available, or an average of $31,700 from the eight core supply countries when the highest and lowest are removed.

When carrying Rolls-Royce engines, about half the value of an Airbus A380 is based in the U.K.

These figures have to be treated with some caution, because not all countries are measuring exactly like with like—some include defense and security with aerospace turnover, for example. But the broad picture is generally indicative of what is happening in the global market.

Multiple approaches

Outsourcing work to companies in neighboring economies where the risks are low and the traveling distances short is being done in several ways. The mergers and acquisitions process, for example, is an indication of how fast consolidation in regional markets is occurring down the supply chain, and it is an activity that has blossomed for aerospace and defense companies in North America and Europe over the past few months.

"The aerospace sector saw a total of 173 deals, valued at $10,997 million, during the first 11 months of 2010, surpassing the total number of deals (166) that took place during 2009," said U.K. financial analysts Clearwater Corporate Finance LLP. "Among countries, the U.S. recorded the highest transaction value of $8,485 million [$8.485 billion] from a total of 68 transactions, during the first 11 months of 2010. Russia was a distant second with a value of $218 million from 17 transactions. Among regions, Europe was the clear leader in terms of the number of transactions announced. However, in terms of transaction value, U.S. trumped the rest of the world hands down."

This process is also running parallel to a process of consolidation of tier-one and tier-two companies, as they seek to increase their access to capital, lower their costs, and develop greater integration capabilities. This is exactly what their airframe and engine customers want—fewer, more reliable, and more capable suppliers to manage. The growing complexities of integrating entire subsystems—such as fuel, engines, landing gear, or air conditioning—have given a few major suppliers a more or less dominant share of the high-value part of the civil airframe and engine markets, no matter where the airframe company is based.

But this new age of globalization could soon start to change the market dynamics for European and U.S. integrators. Aerospace suppliers in important emerging markets are starting to demand more and more of the high-value manufacturing work, and not just composite structures.

"The aviation supply chain will continue to globalize," says Neil Hampson, global leader, aerospace and defense, at U.K. aerospace and defense consultants PWC, "and not just in manufacturing but in research and development and other areas. Gulf state airlines are owned by states who want to increase the level of value aviation brings to the country, and that means increasing the value of their manufacturing assets. They are doing this through the acquisition of businesses in North America and Europe; China and India are doing the same."

BRAZIL'S AEROSPACE INDUSTRY FORTUNES

	2007	2008	2009	2010
Annual turnover[1]	6.2	7.55	6.7	6.76
Exports[1]	5.6	6.74	5.14	5.03
Employment	25,000	27,100	24,000	22,600

Source: Aerospace Industries Association of Brazil [1]U.S. billions

Country	Annual sales (Billions local curr.)	Annual sales ($ billions)[1]	Year	Direct employees	Source	Industries	Productivity Index
U.S.	$216.46	$216.46	2010	625,000 est.	AIA	Aerospace	$34,600
France	€36.8	$50.4	2010	157,000[2]	GIFAS	Aerospace, defense, electronics, security	$23,400
U.K.	£23	$36.15	2010	100,000[3]	A|D|S	Aerospace and defense	$36,150
Germany	€24.7	$33.8	2010	95,400	BDLI	Aerospace	$35,000
Canada	C$26	$26.0	2008	80,000	AIAC	Aerospace	$32,500
Italy	€13	$17.8	2010	52,000	AIAD	Aerospace and defense	$34,000
Japan	J¥1,356	$17.7	2010	31,561	SJAC	Aircraft and space	$56,000
China	C¥900	$13.0	2008	-	Market Avenue	Aerospace	-
Spain	€8.5[4]	$11.7	2009	40,500	Paris Air Show, Spanish Pavilion	Defense, aeronautics, and space	$28,000
Brazil	$6.7	$6.7	2010	22,600	AIAB	Aerospace	$30,000
Mexico	$6.6[5]	$6.6	2010	31,000	MexicoNow	Aerospace	$21,000

[1]Exchange rate at September 2011.
[2]157,000 direct employees, 120,000 subcontract employees.
[3]100,000 direct, 260,000 indirect employees.
[4]2009 figures.
[5]Comprising $5 billion of annual exports and $1.1 billion of annual investment.

Intellectual property factors

What this means, according to Hampson, is that Western suppliers some time in the next 10 years will let go of their intellectual property rights over some key high-value components, rights that until now have been locked away in North America and Europe. Not the turbine blades, perhaps, but the low-pressure combustion chamber.

"Keeping these assets will simply not be defensible," says Hampson.

Mexico has built its aerospace industry up partly as a result of a commitment to intellectual property protection and has been the major winner of the globalization process—both in the initial phase of outsourcing to low-wage economies and in this second phase of developing supplier bases in neighboring countries. The number of aerospace manufacturing companies in Mexico is forecast to grow from 232 in 2010 to more than 350 in 2015. As part of the 'U.S. dollar' zone and with a short transport link to key manufacturing plants in North America, Mexico has also attracted heavy investment from European companies, partly because they want to spread their euro-dollar currency exchange risks.

In theory, U.K., French, German, and U.K. companies should have been looking at developing major manufacturing sites in North Africa and the low-wage economies of Eastern Europe. While there is a small buildup of activity in these areas—mainly in the maintenance and overhaul market—European companies have preferred instead to invest in Mexico.

Japan and Brazil

Japan and Brazil are other countries that have struggled to come to terms with the new market conditions. Both have vibrant, advanced aerospace manufacturing capabilities, but their activities are concentrated high up in the supply chain and rely on narrow market segments. Japanese firms have sought to spread the risk of an overreliance on domestic defense programs, which currently account for 46% of airframe business. So for these companies, a major investment in the Boeing 787 program has proved a doubled-edged sword, with the delays and disruptions encountered.

For some Japanese suppliers, a major investment in the Boeing 787 program has been both beneficial and problematic.

"In recent years, overall output has been reduced based on slow rate of production of the commercial aircraft," according to a recent statement for the Society of Japanese Aerospace Companies. "We expect a favorable increase in production once the issues related to various tests carried out as part of the Boeing 787 type certification are resolved."

Brazil is also facing a major imbalance of its aerospace activities: 82% of these are dedicated to civil programs (regional and business jets, two highly volatile markets) and only 12.8% to defense work. The recent economic downturn in North America and Europe has hit the country's business aviation sector particularly hard.

Volatility and risk

The process of globalization is uneven and, given the current economic stresses and strains, likely to become even more volatile in the coming years. Smaller component manufacturers are finding it harder to access finance, and this impacts the entire supply chain. "Small companies are being asked to take increasing amounts of risk—technical, financial, and program risk," says Hampson. "But there's not a lot of finance available, and a two-year delay to a major program caused by another supply issue can create serious problems for them."

Major airframe and engine manufacturers will therefore probably be frustrated in their search for a simpler, more secure supply base. Global economic forces are pushing the supply chain in different directions, and one likely consequence is that North America and Europe will have to give up some of their dominance of key technology areas to better capitalized companies from emerging aerospace economies. **Philip Butterworth-Hayes**

Phayes@mistral.co.uk

Correspondence

In **All dressed up with nowhere to go?** (July-August, page 3), Elaine Camhi pointed out a problem that has hampered decisions about the space program for a long time. Without a longer term goal, the next step may be a direction that does not help as much as it could have. As was pointed out, the Apollo program provided important Cold War political gains, and the ISS provided important international cooperation that helped the new Rus-sian democracy. Now is the time to select a longer term space goal. One I have suggested in the past is a human space colony that can support itself. An easier goal could be a colony that supports itself economically, while still needing some supplies from Earth; Gordon Woodcock showed how that might be feasible in a recent AIAA paper. Other goals could relate to finding one product from beyond Earth orbit that can be pursued successfully by a commercial organization. Only when there is a clearly-stated longer term goal can the space program escape being between a rock and a hard place for public support. **James A. Martin**

Huntington Beach, California

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

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While **Wings of Gold** (September, page 22) by Edward Goldstein is in general an excellent summary of the history of naval aviation, one omission is glaring. The efforts of Rear Admiral William A. Moffett, first chief of the Bureau of Aeronautics (1921-1933), were essential to the development of NavAir in the 1920s and early 1930s and his legacy extended up through WW II.

At an early stage he was successful in blocking efforts by Army Gen. Billy Mitchell to combine NavAir with Army aviation to form an independent air force like the RAF in Britain. His initiative at the 1922 Washington Naval Conference resulted in the conversion of the soon-to-be scrapped battle cruisers Lexington and Saratoga to large-deck aircraft carriers that formed the backbone of the carrier force up to WW II. As a member of the NACA he encouraged the development of aeronautic technology for application to NavAir and he established the training programs which proved essential to the expansion of NavAir in WW II. Finally, he worked with the operational commanders of NavAir to develop the tactics and material so essential to victory in that war. He is in fact an unrecognized hero of that war.

Robert C. Whitten
National Director-Emeritus,
Navy League of the U.S.

As a former flight officer with many memories from my 30-year career (some pleasant, some frightening), **Wings of Gold** means a lot to me because it superbly acknowledges the centennial of naval aviation.

Alger L. Wilson
Captain, U.S. Navy, Ret.
Burke, Virginia

Having worked at the Navy's Bureau of Aeronautics back in the early 1950s, I was thrilled to read **Wings of Gold**, the history of 100 years of naval aviation. However, not much was said about the transition from propeller to jet aircraft for carrier landings. It should not be lost to history that there was a fundamental change in landing technique that became necessary.

The cockpits on propeller aircraft were amidships and there was no visibility over the nose at high pitch angles. Also, power-on stall speeds were lower than with power off. Therefore, those planes made a tight turn from the downwind leg close to the stern. With the left wing down as it neared final, the pilot could see the landing signal officer. When the LSO signaled a cut, the pilot straightened the flight path, leveled the wings, and cut power, dropping like a rock. There were up to 12 arresting cables on the old straight-deck carriers and then the barriers.

When the jets came along, several things changed. First, the 'spool-up' time for the engines, especially the early ones, is considerably longer than the time for a piston engine to go back to full power, in the event of a wave-off. Second, there was no reduction in stall speed with power on. While the piston-engine airplanes simply dropped when power was taken off, the jets had to be essentially flown onto the deck. Also, the cockpits were now forward and the pilot could see the deck over the nose. Therefore, the new landing technique was to turn base leg much farther aft of the carrier and set up a glide path at a nominal angle toward the deck. The design limit sink speed for land planes is 10 ft/sec, but the average for carrier aircraft is around 12 ft/sec, depending on forward speed at landing. The glide slope of 4 deg, changed later to 3.5, was intended to produce the average sink speed.

The British innovations of the mirror system to establish the proper glide slope and the angled (originally called 'canted' in the U.S.) deck were in response to the demands of the new landing approach technique. With the angled deck and no barriers, the pilot applies full power as soon as he hits the deck, ready to make a 'touch and go.' As soon as he feels the deceleration from catching an arresting cable, he pulls off the power. At that time, there was considerable discussion and trials at NAS, Patuxent River, to determine the best landing technique for jets.

Hubert I. Flomenhoft
Palm Beach Gardens, Florida

Editor's note: Roger Krone's name was misspelled on the cover of the November issue. We regret the error.

Events Calendar

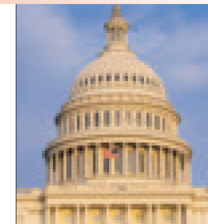
NOV. 28-DEC. 1
Japan Forum on Satellite Communications and 29th AIAA International Communication Satellite Systems Conference, Nara, Japan.
Contact: http://www.ilcc.com/icssc2011

JAN. 9-12, 2012
Fiftieth AIAA Aerospace Sciences Meeting, including the New Horizons Forum and Aerospace Exposition, Nashville, Tennessee.
Contact: 703/264-7500

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

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

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



Feuding, fighters, and the future

"Gloom grows as Congress feuds," headlined the *Washington Post* on September 24 after partisan rancor prevented lawmakers from resolving a line item that was an obscure sidelight to the federal budget.

A week before the end of the fiscal year, Congress had no strategy for keeping the government running temporarily after October 1, the start of FY12. "If we can't do this," asked Rep. Phil Roe (R-Tenn.), "how do we do the heavy lifting?" A rushed short-term piece of legislation prevented the federal government from shutting down on October 1—at least temporarily. The heavy lifting ahead includes a Thanksgiving deadline for the so-called Super Committee, the congressional panel tasked with proposing a compromise on deficit reduction. The 12-member, bipartisan House and Senate panel must find at least $1.2 trillion of fresh deficit reduction that Congress can vote on before the end of the year.

NASA unveiled its 'acquisition overview' for its new space launch system in September.

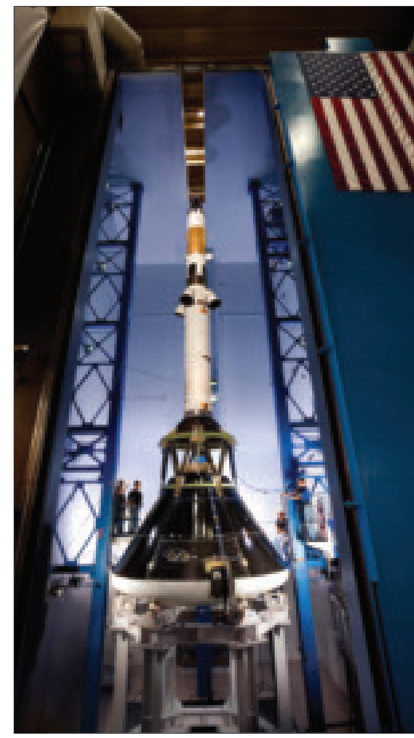
Key leaders in both parties are already being distracted by next year's elections. Sen. Roy Blunt (R-Mo.) says Washington is "in a holding pattern" until the elections take place.

"It's not surprising that Americans wonder if we can get anything done," says Rep. Steny Hoyer (D-Md.), acknowledging that no one in either party has taken significant action on the jobless economy or the deficit crisis. Some lawmakers, even in his own party, question whether President Barack Obama is making practical proposals or merely mouthing campaign rhetoric. With government now perceived by citizens as dysfunctional, hardly anyone in the nation's capital seemed to notice that the war in Afghanistan entered its 11th year on October 7.

NASA's 'rocket to nowhere?'

This autumn may be "the most difficult time in Washington in many years," as Hoyer suggests, but those who chart the nation's future in air and space were doing their best. In late September, NASA unveiled its 'acquisition overview' for its SLS (space launch system), the rocket booster intended to propel astronauts into deep space. Critics of the agency say NASA is pursuing the SLS because Congress ordered it to do so, and not as an integral part of a larger program.

To space writer Randy Simberg, an artist's concept of the SLS "looks like a photoshopped Saturn V from the sixties with a couple [of] modified shuttle solid rocket boosters bolted to its sides." The largest U.S. booster ever built, and neither intended nor needed to launch today's evolving Orion multipurpose crew vehicle, the SLS is an easy target for critics who see it is a rocket that has no vehicle associated with it, but is the result of legislation intended to preserve the engineering and scientific infrastructure that produced the space shuttle program.



Work continues on the multipurpose crew vehicle, commonly called Orion.

While NASA continues to develop SLS and the Orion, the agency insists it is looking to the private sector to get U.S. astronauts into space again. This is not good enough, said a panel of experts who testified before the House Committee on Science, Space and Technology on September 22.

Led by Apollo astronauts Neil Armstrong and Eugene Cernan, the first and last men on the Moon with Apollo 11 in 1969 and Apollo 17 in 1972, the panel said that NASA needs to invest in a clear plan for the future and to invest directly in human spaceflight. Armstrong, who rarely makes public appearances, told House members, "The absence of a master plan that is understood and supported by government, industry, academia, and society as a whole frustrates everyone."

Cernan, like others on the panel, supports development of the SLS but perhaps because it is the only option available at this time. Until NASA announced that it was moving ahead with SLS, said Cernan, the agency "continued to disregard, ignore, and flaunt the law and the mandate of the Congress while continuing to pursue its own agenda of disabling our nation's space program. It had become obvious that NASA as directed by the administration has had no interest in following the law and the mandate of Congress in the development of a heavy-lift launch vehicle."

Cernan continued: "It is only now, after mandates, requests, investigations, a subpoena, and a stinging rebuke of the administration by two very prominent senators, that NASA has retreated on its delaying tactics to move forward with the development of SLS. This is certainly good news forced upon the administration by concerned and wiser members of Congress."

The lunar astronauts said Congress should reconsider the retirement of the shuttle fleet and should call on NASA and the administration to craft a coherent and understandable plan for human spaceflight. They warned that SLS will become a "rocket to nowhere" unless it is part of a broader, integrated policy. Their testimony was reported by media that typically follow space developments but did not receive wide attention elsewhere.

Neil Armstrong and Eugene Cernan

Future fighter of the past?

With the two 'fifth-generation' U.S. fighters facing challenges, many in Washington believe the future has just gotten better for so-called 'legacy' fighters that can still be manufactured in new versions.

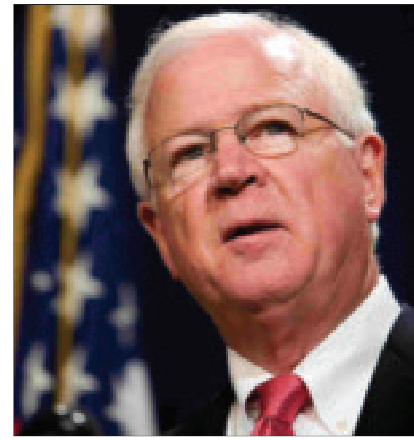
The F-22 Raptor was grounded between May 3 and September 21 because of toxins found in the blood of pilots, apparently caused by a flaw in the plane's oxygen system. The Air Force has not identified or solved the problem, prompting Mark Thompson of *Time* magazine to write, "The problem was serious enough to ground the planes but not serious enough to fix." Just 158 F-22s are in service, and production will end next year at 187.

The F-35 Lightning II JSF for the Air Force, Marine Corps, and Navy was grounded briefly earlier this year with a less serious problem, and the Marine version remains officially on probation until technical and fiscal issues can be resolved. With massive spending cuts apparently ahead, and some of the nine JSF partner nations questioning their commitment, the aircraft will not be able to immediately fill gaps in the services' and overseas fighter inventories.

Former Pentagon analyst Pierre Sprey said in an interview for this column that the F-22 and F-35 are "irrelevant" because neither is effective at air-to-air combat or close air support. "We should go back and build a really hot version of the F-16 with jammers and electronic gear and our most powerful engine," said Sprey. The F-16 Fighting Falcon, which dates to 1974, is still in production, but the last U.S. version was delivered in 2005. Current, more advanced versions are going to Oman and the UAE.

Both Gen. Norton Schwartz, Air Force chief of staff, and Lt. Gen. Harry M. 'Bud' Wyatt, head of the Air National Guard, have consistently said the Pentagon will not buy more F-16s.

Dennis Muilenburg, CEO of Boeing's defense businesses, has a view not unlike Sprey's but believes the answer is the F/A-18E/F Super Hornet.



Sen. Saxby Chambliss

Dating to 1995, the Super Hornet has been rejected by some potential overseas customers (India and South Korea) but is a hot sales prospect to others (Australia and Malaysia).

The aircraft may not be a panacea, but it is promising enough to have a formidable adversary.

Sen. Saxby Chambliss (R-Ga.) sent a September 1 letter to Secretary of Defense Leon Panetta urging the Pentagon to stop buying Super Hornets.

(Continued on page 17)

There have been suggestions that the Air Force purchase some F-18s to supplement their fighter squadrons.

Preparing NASA's astronauts for the High Frontier

In the predawn darkness, double sonic booms sent a shiver up my spine: A spaceship was coming home. Scant minutes later, the xenon searchlights flickered at the approach end of Runway 15, Kennedy Space Center. Atlantis, back on Earth, streaked past us at midfield, drag chute filling at the end of her final voyage.

But STS-135's landing was *not*—no matter how many times the media said it—'the end of America's space program.' This oft-repeated hyperbole ignores the two NASA astronauts and their four international crewmates who were living and working aboard the international space station.

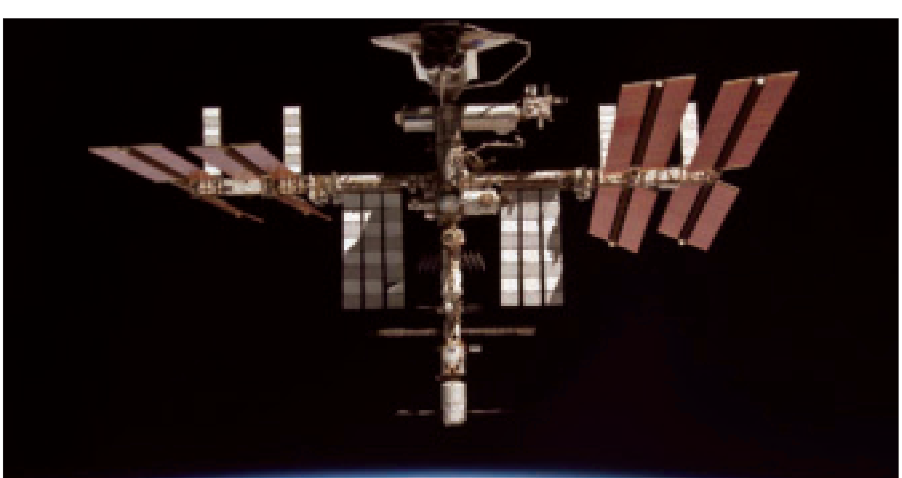
For the next decade or more, the ISS will be the focus of the U.S. human spaceflight program. Shifts of astronauts will supervise an array of experiments at the national laboratory and conduct tests of next-generation systems and operations techniques to prepare for expeditions into deep space.

Now that the station is substantially complete, crews are deeply involved not only in systems operations and maintenance, but in interactive science operations conducted in the Destiny, Columbus, and Kibo laboratories. Focused for three decades on short-duration shuttle flights, will NASA's Astronaut Corps be prepared to meet the demands of steady-state ISS operations (and anomalies) through 2020 and beyond?

Corps questions for astronauts

That question prompted NASA to ask the National Research Council of the National Academies to examine the future roles and size of the corps, and the proper training facilities needed to preserve U.S. human spaceflight excellence. Early this year, the NRC commissioned a study panel to address these topics. The 13-member panel was cochaired by Joe Rothenberg, former NASA associate administrator for spaceflight, and Fred Gregory, former astronaut and NASA deputy administrator. Dwayne Day, NRC senior program officer, directed the study.

In early September, the panel issued its final report, entitled "Preparing for the High Frontier: The Role and Training of NASA Astronauts in the Post-Space Shuttle Era" [http://www.nap.edu/catalog.php?record_id=13227].



The ISS and the docked space shuttle Endeavour, flying at an altitude of 220 mi., were captured by Expedition 27 crewmember Paolo Nespoli from the Soyuz TMA-20 following its undocking on May 23. ISS and Soyuz training are the current focus for NASA's Astronaut Corps.

NASA asked our panel to address three major questions:

- How should the role and size of the activities managed by the NASA Johnson Flight Crew Operations Directorate change following shuttle retirement and completion of the assembly of the ISS?
- What are the requirements for crew-related ground-based facilities after the shuttle program ends?
- Is the fleet of aircraft used for training the Astronaut Corps a cost-effective means of preparing astronauts to meet the requirements of NASA's human spaceflight program? Are there more cost-effective means of meeting these training requirements?

We'll discuss only the first and third of these questions here. The reader can find a full discussion of the second within the report itself.

Post-shuttle roles

For the past three decades, NASA's astronauts have prepared mainly for space shuttle operations. In this ISS and Soyuz era, what should be the central roles and responsibilities of the Astronaut Corps?

Based on NASA information and our own research, the panel found that the Astronaut Office (the Astronaut Corps is the subset of people within that office eligible to fly in space) should support six tasks in priority order:

- Provide well-trained spaceflight operators to support the NASA flight manifest.
- Supply ground support personnel for unique tasks required to support the NASA flight manifest.
- Provide support for new program development, ranging from relatively small payloads and equipment to whole new spaceflight designs.
- Be a source of operational knowledge and corporate memory of human spaceflight.
- Provide for collaboration with other governmental and private organizations

as needed and directed by NASA.

• Provide support for public and educational outreach to society.

Flying is why astronauts sign up for this hazardous job. Once Soyuz crew launches resume, probably this month, NASA's astronauts will continue serving space station tours lasting an average of six months. They will also serve as flight engineers during Soyuz launch and reentry (commanded by a Russian cosmonaut). These fundamental tasks drive most of the training requirements for ISS crewmembers.

Flying is an obvious and core priority, but even when not actively training for a mission, astronauts directly support their colleagues in space. In Mission Control, they work as capcoms (capsule communicators), help flight controllers develop procedures for on-orbit research or maintenance, and verify proposed workarounds for in-flight anomalies by executing them in simulators or in the Neutral Buoyancy Laboratory at Johnson.

NASA also assigns astronauts to assist future spaceflight programs. They track the work of commercial spacecraft developers and provide operational input to designers of NASA's Orion multipurpose crew vehicle, new heavy-lift Space Launch System, and advanced concepts for asteroid, lunar, and Mars exploration.

Heat damage is evident on the Soyuz TMA-11 descent module after landing on April 19, 2008. Astronauts will have to respond to similar in-flight emergencies in the era of ISS, Soyuz, and commercial crew spacecraft. (Photo: Novosti/Aleksandr Pantyukhin)

As an invaluable national reservoir of knowledge and corporate memory on effective operations practices, the Astronaut Office fosters the spread of a vigorous safety culture within NASA.

Astronauts also work with U.S. government departments and international space agencies, providing technical expertise and coordination of common human spaceflight activities.

Finally, they are often the highly visible public face of NASA. Speaking with everyone from David Letterman to thousands of eager students, astronauts between flight assignments spend several days each month crossing the country to represent NASA and its mission to taxpayers.

Progress 44 launched from Baikonur on August 24 on a Soyuz U rocket, bound for the ISS. The Soyuz experienced a third-stage engine shutdown due to a faulty gas generator. (Photo: RSC Energia.)

Sizing up the Right Stuff

In contrast to the 40 or more astronauts who crewed shuttle launches every year, steady-state ISS operations require the launch of roughly a dozen crewmembers each year: six Russian and six U.S. and international partner astronauts. That manifest drives the overall size of the Astronaut Corps and the need for new hires.

As the end of the shuttle program neared, Johnson's Flight Crew Operations Directorate shrank the corps size through attrition and reduced hiring. From a high of nearly 150 in 2000, by early 2011 NASA had just 61 astronauts. That total may drop further as some shuttle astronauts depart and others are disqualified by medical problems. NASA says it needs a corps, through 2016, of 55 to 60 astronauts.

That number, based on the directorate's model of the so-called 'minimum manifest requirement,' includes a managers' margin above the corps size required to meet the six or so crewmembers flying each year. FCOD has recently dropped this margin from 50% to 25%. But that cushion may still not be enough to enable the Astronaut Office chief to deal with real-world factors affecting astronaut supply and demand.

For example, each ISS crew slot has a specific skill requirement, such as EVA and robotics qualifications, Russian language skills, scientific research experience, or flight experience required to serve as an ISS commander

The 2009 class of NASA, JAXA, and CSA astronauts never flew on the shuttle, but will fill the ISS flight manifest for the coming decade. They are Jeremy Hansen, Scott D. Tingle, Michael S. Hopkins, Gregory R. Wiseman, Mark T. Vande Hei (front row); Jack D. Fischer, Serena M. Auñón, Kathleen Rubins, Jeanette J. Epps (middle row); and David Saint-Jacques, Takuya Onishi, Norishige Kanai, Kimiya Yui, and Kjell N. Lindgren.

or Soyuz flight engineer. But astronauts are not interchangeable; they have different strengths, and levels of proficiency vary as they move through their careers. Some may not be eligible for long-duration flight due to medical factors: cumulative radiation exposure, recovery from injury, or temporary health problems. (Recently, some ISS astronauts have experienced inflight vision degradation from swelling of the eye's optic disc.)

The result is that the office chief has in the past year had trouble finding the right astronauts. Of 60 or more eligible astronauts on the books, only six were actually qualified to step into a pair of pending ISS assignments. That's too shallow a talent pool.

Providing qualified crewmembers is vital to the safe and successful operation of the ISS. Our panel found that a corps size of just 55-60 poses a risk to U.S. human spaceflight capability. Future attrition is difficult to predict, but some returning station crewmembers will decide that the family stresses of another two to three years of intense training, followed by a six-month deployment, preclude another expedition assignment.

New hiring is not a magic bullet either, given the long lead times necessary to train astronauts for flight (two years from hiring to flight eligibility). For example, an inexperienced astronaut will be unable to help NASA mount a surge of missions responding to a serious ISS orbital emergency.

We recommended that NASA management increase corps size to comfortably exceed the calculated minimum needed for flight requirements. We think NASA should increase the managers' margin, hiring more astronauts to protect against unexpected attrition or renewed spaceflight development tasking in the coming decade.

Astronaut wings

Since 1959, NASA has used high-performance jet aircraft to help prepare its astronauts for spaceflight. The Mercury Seven flew F-102s, F-106s, T-33s, and other jet trainers. By the mid-1960s, NASA had acquired a small fleet of T-38 Talon trainers from the Air Force, and astronauts have honed their physical and mental skills in these sleek, two-seat, twin-engine jets for nearly 50 years. But given that the Soyuz is highly automated and lands under a parachute after a near-ballistic reentry profile, are high-performance jets really an effective way to train for ISS and the Soyuz flight regime?

Ground-based mission simulators, in facilities at Russia's Star City, NASA Johnson, and international partner facilities in Europe, Japan, and Canada, provide approximately 90% of ISS and Soyuz task training. NASA also requires crewmembers to fly the T-38N for what it calls 'spaceflight readiness training,' or SFRT.

Although jet flying amounts to just 10% of the training activity for unassigned astronauts, shrinking to 5% for those assigned to an ISS expedition, it does expose crewmembers to a fast-paced operational environment that parallels the dynamic, stressful, and always dangerous spaceflight environment. It's not just the hands-on jet flying that is important, though that has application to Soyuz flying, robotics operations, and delicate EVA tasks. Making real-time judgments in the cockpit—dealing with conflicting traffic, hazardous weather, and actual aircraft failures or emergencies—builds experience that helps astronauts react coolly and deliberately when exposed to emergency situations in orbit.

SFRT is accepted by the ISS international partners as a key element in training qualified spaceflight crews. Our panel found that ground simulators, while improving in fidelity, can-

T-38A Talons fly over NASA Dryden. NASA's upgraded T-38N trainers provide astronauts with spaceflight readiness training, a close analog to the dynamic, high-stress, and risky environment of spaceflight.

not provide the full spectrum of physical and psychological stresses seen in an actual aircraft cockpit.

One example of SFRT's value came from Astronaut Office Chief Peggy Whitson, who related her own experience on April 19, 2008, when returning on Soyuz TMA-11 from Expedition 16. The station commander and a Ph.D. biochemist, Whitson was serving as Soyuz flight engineer during reentry; both she and Soyuz commander Yuri Malenchenko had extensive aviation experience. Failure of the Soyuz instrument section to separate fully from the descent module led to a sustained 7-*g* ballistic reentry, with heat damage to the crew hatch and radio antennas. During descent, smoke penetrated the crew cabin and the crew promptly executed the emergency checklist steps for an electrical fire. After an unusually hard landing, the crew could not immediately exit the Soyuz—the landing retrorockets had started a grass fire. Whitson believes this real-world emergency might have ended less successfully if she had not trained extensively in the T-38.

During Expedition 23 in August 2010, during crew sleep, an ISS external ammonia coolant pump failed and shut down half of the solar array output. Responding to alarms, the crew executed a swift reconfiguration of the core station systems, working closely with ground teams to reach a stable power and cooling configuration. They conducted three critical spacewalks in the following weeks to replace the pump with a spare, restoring full cooling and power. The initial stages of the emergency required high situational awareness, crisp communications, timely response, and proper crew resource management, all skills exercised during NASA's high-performance aircraft training.

In September, the Expedition 28 crew lost communications with Moscow just before Soyuz reentry yet made a safe and successful landing. I've had similar experiences, from last-second launch pad aborts to jammed EVA hatches to time-critical external coolant leaks on the station. In each case, thanks to piloting experiences in the Air Force and in NASA's T-38s, I had a strong sense that "I've been here before." I was able to think clearly yet react quickly.

Simulators augmented that experience, but did not provide the instinctive ability to react rapidly and appropriately in a dynamic emergency. Particularly for those astronauts who come to NASA without professional flight experience, SFRT brings potential crewmates up to a similar, confident level of operational skill—high assurance to NASA that they are ready to meet and exceed the mission's safety and mission requirements.

High flight

That astronauts have dealt successfully with hundreds of similar anomalies on the shuttle and the station—all having had SFRT—made the case to our panel that high-performance aviation contributes to preparing certified crews who can get the job done in the demanding, unforgiving, and hazardous spaceflight environment.

Our panel recommended that NASA retain its T-38N fleet for use in spaceflight readiness training, and ensure that the fleet size (projected to shrink to 16 aircraft in 2013) matches corps training requirements. More modern aircraft could also serve NASA in the SFRT role, but it is very unlikely the agency will be able to afford a new fleet of high-performance jets in the coming decade. The T-38s have undergone cockpit, safety, and performance upgrades in the last decade, and are poised to provide another 10 years or more of reliable service.

With $100 billion in hardware and operational effort having gone into the space station's construction and activation, and given its importance to the agency's research and human exploration plans, continuing astronaut high-performance aviation training will assure NASA and its partners that their orbital investment will always be in capable hands.

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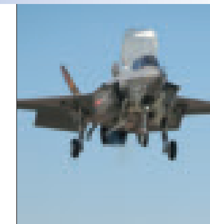


Defense cuts set to impact aircraft

THE PAST 10 YEARS WERE VERY GOOD for defense. U.S. military budgets enjoyed a decade of major increases, and defense contractors had a strong period of growth and profits as well. Between FY03 and FY12, weapons procurement grew at a 6.1% compound annual growth rate (CAGR).

The broad political consensus is that a serious budget deficit, a growing national debt, and the reduction of combat operations in Iraq (to be followed by reduced operations in Afghanistan) mean that the current high defense plateau is unsustainable. While the delta of the anticipated defense spending downturn is quite uncertain, changing budget dynamics will have a strong impact on aircraft programs.

More than just numbers

The U.S. defense budget is not historically cyclical. That is, there has been no correlation between defense spending and any economic trend, such as economic growth or national debt. Yet with a record national debt and an FY11 budget deficit of around $1.6 trillion (over 10% of GDP), political pressure has emerged and will likely force a budget reduction over the next few years.

So far, the 2011 Debt Reduction Act mandates minimum cuts of $350 billion-$474 billion, spread between FY12 and FY21. Under the worst-case debt reduction plans, this could rise to $850 billion-$1 trillion, or up to $100 billion a year.

These proposed cuts hit anticipated and planned growth, not current fiscal year budget levels. But the big unanswered question concerns how this top-line cut is distributed. Will it fall on the investment accounts (R&D, procurement) that fund the development and production of new weapons? Will it fall on operations and maintenance? (Part of O&M funds the sustainment of weapons, but much of it funds fuel and other commodities needed to deploy and move forces.) Will it hit personnel (which has no real impact on weapons)?

At this point, it is too soon to know, but the defense industry is bracing for at least half of the cuts to hit weapons procurement. And given the difficult experience of the post-Cold War defense downturn, this caution is quite understandable.

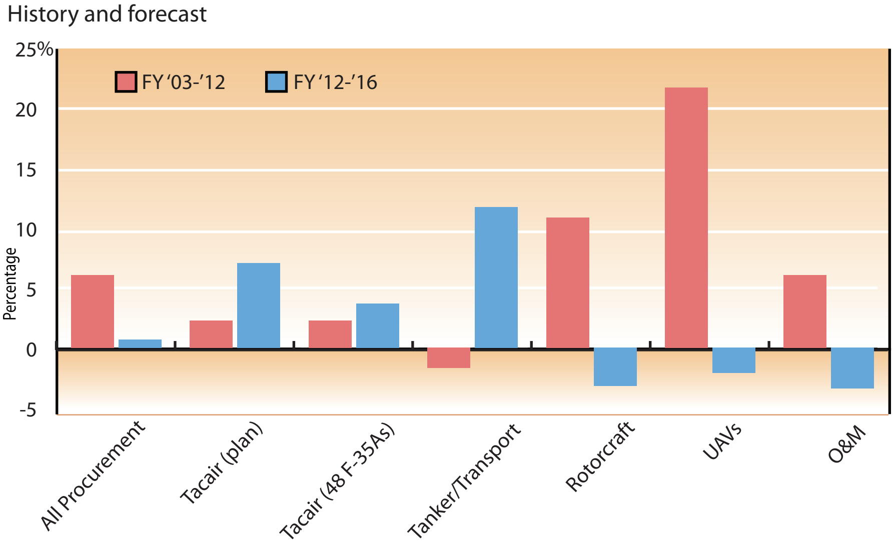
Even with a serious hit to the investment accounts, these look set to stay above their pre-FY07 levels. Also, assuming the Republican Party wins back the Senate in 2012 (and quite possibly the White House), these cuts might not happen at all. In fact, for purposes of Teal Group's forecast, we assume that the procurement budget will stay roughly flat through FY16, although that is using nominal, not real, dollars.

But top-line budget trends matter less than the changing dynamics of defense spending. Here, three trends threaten to make the impact of budget cuts much greater than the numbers indicate.

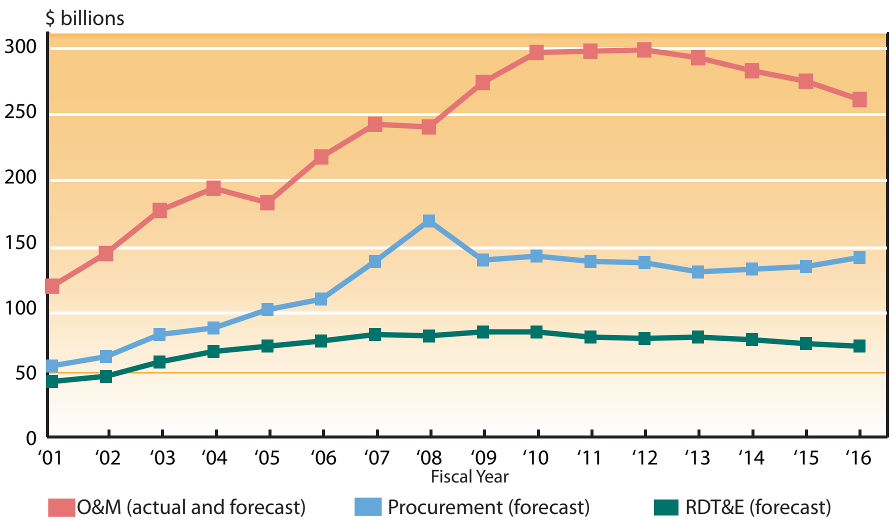
The first problem is inflating costs. Higher costs reduce DOD's buying power and threaten profits at contractors. The nation's sluggish economy is generally not threatened by inflation, but costs for energy, health care, and materials prices have remained stubbornly high. These three costs are among the top expenses for weapons contractors. Thus, even a freeze of investment accounts at present levels would still result in a likely erosion of DOD buying power and/or defense contractor profits.

The second problem is changing DOD contract terms. The accepted weapons acquisition contracts model—cost-plus contracts for development and early production, fixed-price contracts for full production—is giving way to a different approach that shifts a greater risk and cost burden to the contractors. The best illustration of this is Lockheed Martin's F-35 low-rate initial production four (LRIP-4) contract. Historically, procurement contracts at

DOD SPENDING AND GROWTH RATES
History and forecast



DOD INVESTMENT, O&M FUNDING
History and forecast



FY11 base procurement request: $104.8; $134.2 with OCO; FY12 base procurement request: $113.0; $128.0 with OCO Budget Authority; forecasts include supplementals.

this early stage of a program have been cost-plus, but F-35 LRIP-4 mandates a high level of overrun risk sharing. Similarly, Boeing's KC-46 aerial refueling tanker program was begun with a largely fixed-price contract, including development and production of about half of the aircraft covered in the program of record.

Meanwhile, the profit model is changing. Aircraft program profits typically go from small at the development phase, to medium at the procurement phase, to high at the sustainment and upgrade phase. Not only are procurement contracts changing, but smaller programs also mean smaller procurement phases. And a declining O&M budget means less sustainment activity—less money for upgrades, spares, and other high profit sustainment activities.

The biggest problem with the budget is that there are too many new programs that require funding. Another related problem facing DOD and industry is how to fund important new programs that fly in the face of perceived military needs. An unpleasant legacy of the past decade is the belief that the military is no longer a tool of superpower diplomacy but rather something to be used for fighting insurgencies in regions of marginal strategic importance.

Thus, over the past 10 years, procurement for body armor, ambush protection vehicles, helicopters, and UAVs did very well. Procurement cash for UAVs, for example, grew at a 21.8% CAGR in FY03-FY12, while rotorcraft grew at 10.9%. Traditional big power capabilities such as fighters, cargo aircraft, and ships basically got the crumbs.

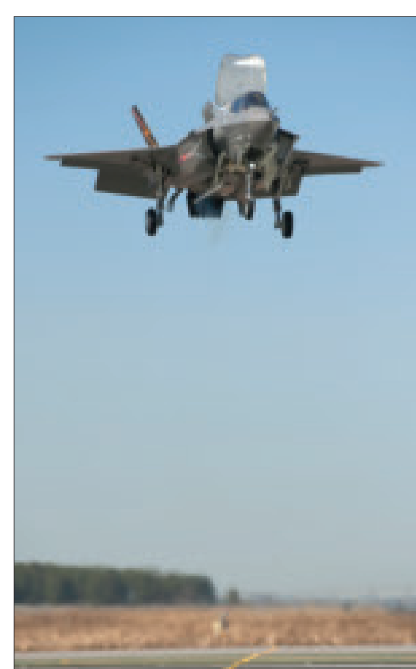
Yet many of these capabilities, particularly fighters, were badly taxed by high utilization rates. Unless cash is provided to recapitalize the fleet, there will be difficult force structure choices ahead.

F-35 and tacair: Big questions

Tactical aircraft (tacair) present the biggest single challenge. The Lockheed Martin F-35 JSF, the biggest defense program in world history, is at the center of the debate.

The question vexing tactical aircraft funding is whether it can attract a higher share of a declining funding plan. To sustain the current program of record, tacair would need to grow at a 7.1% CAGR. This assumes a maximum procurement rate by the Air Force of 70 F-35A aircraft a year. Teal Group's forecast calls for a maximum F-35A procurement rate of 48 a year, which still requires a 3.7% CAGR. By comparison, FY03-FY12 saw a mere 2.3% tacair CAGR.

Our forecast assumes the F-35B and F-35C programs will continue as per plan. But conceivably, budget concerns could derail either of these altogether. In July, Navy Undersecretary Robert Work instructed the Navy and Marine Corps to look at alternatives to the F-35B and F-35C. This was the first time a senior DOD official im-



The forecast assumes that both the F-35B (above) and C programs (left) will continue as planned, but budget concerns could derail either of them.

plied that an F-35 variant was vulnerable to budget cuts.

This F-35B and C discussion complicates many other areas of defense procurement. In 2010 DOD requested $1.9 billion for 22 additional F-18E/Fs and $2.6 billion more for 28 in FY12. The Navy is concerned that any slowdown in the F-35C program would threaten its carrierborne fighter force. The Navy says that in 2015 it will begin seeing a shortfall in the number of fighters needed for its 11 aircraft carriers, a problem exacerbated by high levels of F/A-18C utilization.

Obviously, killing the F-35C would increase F/A-18E/F/G procurement, but it goes deeper than that. If the F-35B is killed, the Marines will not be able to use their amphibious assault ships for fixed-wing air power. Instead, they will need to share deck space on large USN carriers, complicating any plans to cut the current force of large carriers or to delay acquisition of the next one.

Other programs, other problems

Strategic lift programs face a budget outlook that is similar to tacair's. Like tacair, military lift did not benefit from the FY03-FY12 trend, with procurement funding falling at a 1.7% CAGR. This is largely due to the end of USAF C-17 procurement.

However, even finding the cash for the current C-130J procurement, C-5M reengining, and KC-46 tanker programs of record will be a major challenge. To afford all three under their current funding schedule, military lift procurement cash will need to grow at an 11.8% CAGR.

Given these budget pressures, and looking at the precedent of past budget downturns, there are three useful guidelines to remember for programs.

The first, inevitably, is that serious performance problems make a program a target for eager budget-cutters. After the Cold War, the two 'easiest' budget kills were the two most troubled programs, Lockheed's P-7 maritime patrol aircraft, and the General Dynamics/McDonnell Douglas A-12 carrier stealth attack jet.

The F-35's performance problems make a bad budget situation worse. The one virtue of the KC-46's fixed-price contract is that this program will be tougher to kill because of development problems, since most serious cost overruns will be borne by Boeing, not DOD.

Finding cash for C-130J procurement may present a challenge.

A second guideline might just be, 'Don't seek resurrection.' The high-profile program kills of recent years—Lockheed Martin's F-22 fighter, Boeing's C-17 lifter, General Electric's F136 alternate fighter engine—are not likely to be reversed. It is worth noting, however, that prospective Republican presidential candidate Rick Perry has strongly criticized the F-22 line shutdown decision.

Finally, new program starts have fared very poorly in past defense budget downturns, so a third guideline is that new starts are the most vulnerable. New fixed-wing starts scheduled for the next few years include the Air Force T-X advanced trainer replacement requirement (to replace the current T-38 fleet) and the next generation bomber. The latter has already been effectively deferred, and is now subsumed by a concept exploration effort called long-range strike. The KC-46 will likely survive because of the long-delayed and overdue nature of the requirement; but again, looking at the challenge of funding military lift in this budget environment, it is still far from safe.

The KC-46 program is long overdue, so it should survive budget trimming.

Rotorcraft programs scheduled to begin in the next few years are more numerous. They include the Army Armed Aerial Scout, the USAF Common Vertical Lift Support Platform, and the USAF HH-60 replacement program (CSAR-2). Beyond these, in 2010, the Army launched its joint multirole technology demonstration program, a JAST-like effort that could develop new concepts and systems for future requirements. But unlike fixed-wing platforms, rotorcraft did benefit enormously from the recent budget downturn. Many rotorcraft programs are only now reaching full procurement, and at least these current recapitalization efforts will likely be sustained.

In the case of both fixed- and rotary-wing new start programs, the odds are heavily against their happening on time, implying a continued reliance on aging legacy fleets. Yet operating legacy aircraft is also an expensive proposition as these systems age. This means that new capabilities and technologies are effectively driven out by the costs associated with legacy capabilities and the need to maintain current military effectiveness. In downturns, 'transformational' systems become bill-payers for older ones.

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In short, given the difficult budget environment, there are risks ahead for all military aircraft programs, big or small. Maintaining military capabilities during the post-Iraq and Afghanistan defense drawdown will not be easy. But the nation's fixed-wing aircraft force, which failed to benefit from the FY03-FY12 spending upturn, is uniquely vulnerable. And although current rotorcraft programs are probably safe, funding for new program starts are highly uncertain. **Richard Aboulafia**

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(Continued from page 9)

Chambliss wrote that the F/A-18E/F is "of limited to no value in any future threat scenario" and "will only drain scarce budgetary resources from [other] systems."

Except for the production lines of the F-22 and JSF, both of which are Lockheed products (as is the F-16), the Boeing facility in St. Louis, Missouri, is now the only place where fighters are assembled in the U.S. In 1951, 24 production lines in this country were manufacturing fighters.

The Navy recently increased its planned Super Hornet purchase from 493 aircraft to 550. Even the Marine Corps, which has never operated the plane, could become a customer.

Australia will decide next year whether to continue with a $16.8-billion purchase of 100 JSFs and could switch to the Super Hornet. The country is currently taking delivery of the last four of 24 Super Hornets from an existing purchase.

Schwartz, Wyatt, and Chambliss notwithstanding, some in Washington are hinting that the Air Force could buy a version of the F/A-18 optimized for the air sovereignty alert mission.

Supporters of the Super Hornet (and the F-16) like to debunk the notion that fighters are developed in generations. "I think it's fair to say that the 'fifth-generation' terminology is a marketing terminology," Muilenburg told Reuters. "We don't operate in a world today where it's an individual airplane against an individual threat. It's the combined forces and bringing all of those forces and their capabilities together."

If the software, sensors, and control systems under the skin of a fighter are more important than its external shape, the F-16 or F/A-18E/F could overcome resistance in Washington and, thanks to their lower cost and proven capabilities, could become part of the future for cash-strapped U.S. fighter squadrons.

Air Force chief talks

Gen. Schwartz delivered a long-anticipated speech at the Air Force Association convention in Maryland on September 20. His talk contained no dramatic revelations but was the most thorough policy-oriented address he had given in some time.

Gen. Schwartz promised that Air Force leaders will not allow budget pressures to create a future force that "merely appears on paper to be effective, but in reality is reduced substantially in depth and breadth."

Obama administration policy is to reduce $400 billion in defense spending by FY23. However, the Pentagon could face significantly larger cuts if the White House and Congress cannot agree on a plan to address budget deficits when the Super Committee submits its findings in November.

Schwartz acknowledged that the Air Force will be smaller than in the past and that service leaders "may have to carefully consider reduced capacities in some areas." But, he said, the service needs the JSF and a new bomber.

"In any budget scenario, we will be required to continue providing capabilities that offer the nation's leaders a wide range of strategic options for rapid and flexible power projection," the chief of staff said. "Our core contributions enable America's global perspective and result in appropriately tailored effects at times and places of our choosing."

Advocates for a new Air Force bomber were heartened by the general's assertion that the nascent program is crucial to the nation's industrial base. "Until last year, there was not a new development aircraft effort in the United States of America in any company," Schwartz said, referring to both military and commercial aircraft programs.

Gen. Norton Schwartz

Staff Sgt. Robert Gutierrez, who will be awarded the Air Force Cross for valor in Afghanistan, meets President Barack Obama at the White House in September.

Hard decisions and "difficult choices," are part of the Air Force's procurement programs, Schwartz said. Future development efforts will have to be less ambitious, and government and industry must appraise and adhere to genuine operational requirements and evaluate manufacturability early. "We require straight talk from everybody."

The general used his speech to introduce Air Force Staff Sgt. Robert Gutierrez and to announce that the award of the Air Force Cross to Gutierrez has been approved.

Gutierrez, who has been selected for promotion to technical sergeant, is a joint terminal attack controller who, despite suffering serious wounds, helped save his Special Forces team in Afghanistan during a 2009 Taliban attack by calling in air strikes within a few yards of his own position. The Air Force Cross is the nation's second highest award for valor. Schwartz will travel to Hurlburt Field, Florida, in October to present the award.

Despite fiscal and operational challenges, Schwartz said he is still confident that the Air Force will remain ready to defend the nation and its freedoms. "The U.S. Air Force will be prepared for whatever the nation requires of us," Schwartz said. "We will do it, or we'll die trying."

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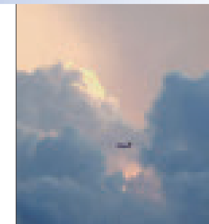


From ice to flameout

GOVERNMENT AND INDUSTRY ENGINEERS have a theory about why corporate jets and airliners flying over or near deep convective weather systems sometimes suffer harrowing engine flameouts.

The theory goes like this: Water vapor rises from thunderstorms and turns into clouds of ice crystals that are undetected by radars because they are below the minimum sensitivity threshold of 20 dBZ—a measure of radar reflectivity. With the air ahead showing low updraft velocities, a pilot has no idea he is about to fly into trouble. Pilots who have experienced loss of power sometimes report being surprised by heavy rain pelting their windshields, but engineers suspect this is actually ice liquefying on impact.

Those ice crystals are also being ingested by the airplane's engines. The warm air in the engine turns the crystals into a mixed-phase slush that flows over components upstream of the combustion chamber. The thinking is that if the slush flows long enough, it can cool the surface of the components below freezing, allowing ice to accrete. If the ice breaks off in just the right way, it can quench the flame in the combustion chamber.

Government and industry engineers are now racing to prove this theory and unravel the physics behind it before a jet crashes. Boeing, for example, reports there is a loss-of-power incident, ranging from reductions in thrust to flameouts, about once over four months.

"Anything that we can do to make flying safer, everyone goes home and feels good about it," says mechanical engineer Dan Fuleki of the National Research Council of Canada, who is a member of a U.S.-Canadian team that is researching the suspected engine icing phenomenon.

If engineers can pin down the physics, manufacturers might be able to tweak engine designs or operations to make them less susceptible to icing.

Conclusively proving the ice crystal theory has been impossible for engineers because of limitations in their test facilities. A breakthrough could be on the horizon, however, because NASA Glenn has begun a year-long, $15-million project to upgrade its Propulsion Systems Lab (PSL) to spray ice crystals into engines. One of the lab's two cells will get the new equipment. This cell can accommodate small to medium-sized commercial jet engines, typically those with diameters from 36 to 42 in.

Test evolution

When engineers think about an upgraded lab, they are excited about the combination of ice crystals, a full-scale engine, and most important, the ability to simulate high-altitude pressures. "That's a really key aspect because that's where the phenomenon occurs," says Fuleki.

So far, Fuleki and his NASA and Boeing teammates have conducted icing tests at Canada's Gas Turbine Laboratory in Ottawa. This facility produces ice crystals and simulates high-altitude flight, but only for components or small engines like those that might power an unmanned aircraft. The facility's high-altitude cell can only accommodate an engine that sucks in 10 lb of air/sec, compared to 300 lb/sec for its sea-level cell.

"PSL is a natural evolution of testing in this field," Fuleki says.

The best the team has been able to do in Ottawa is spray a slushy mix of ice and water at static engine components in what are known as rig tests. Those tests were fine for initial experiments. In fact, Fuleki points out that the simplicity of rig tests offers some advantages compared with trying to monitor what is happening inside a rotating engine.

"It's a lot less expensive to run a rig," Fuleki explains. "You've got a lot of visibility, and you can highly instrument it," he adds.

In the Ottawa tests, NASA's high-speed Phantom camera, which captures 32,000 frames a second, has photographed ice accumulating on static engine components and then shedding. Results from a first round of tests in 2009 are reported in the April 2011 article, "Understanding Ice Crystal Accretion and Shedding Phenomenon in Jet Engines Using a Rig Test," by Fuleki and engineers Jeanne Mason and Philip Chow of Boeing Commercial Airplanes. The paper appears in the *Journal of Engineering for Gas Turbines and Power.*

Until the Ottawa tests, engineers could only speculate about how ice might manage to build up in a warm engine. For a long time, engineers thought supercooled water—which stays liquid below 0 C—might be turning to ice inside engines, causing the loss of power. Fuleki and his team have documented that a mixed phase of ice and water can indeed cool a surface enough to cause accretion.

Without a complete engine, they cannot be sure that the effect will be the same inside an engine with rotating compressor stages and a turbine. They also cannot document what happens after accretion and shedding, or figure out the exact conditions that cause loss of power.

The team suspects chunks of ice can damage compressor blades—indeed, postflight inspections have shown bent blades—and in some scenarios cause flameouts.

"There's no way of proving that at this point. It's just kind of an evaluation of how things occurred and whether or not [aircraft] were in that kind of environment or not, and deducing that those events may have been what caused the incident," says Mark Potapczuk, an aerospace engineer in Glenn's icing branch.

Fuleki and the team do not disagree: There remains a "lack of understanding of the fundamental physics of ice crystal icing inside the engine," they wrote in the April paper.

At the PSL, engineers would be able to study the entire chain of events.

"Component tests are inferior, since you have to introduce the hot air, rather than having the engine naturally produce the hot air," says Boeing's Mason by email.

Results of the PSL tests could lead to engine design changes. "There's a number of mitigation strategies. It could be geometry; it could be operation. But the fundamental starting point is to understand what causes the [icing] so you can start to strategize how to mitigate it," Fuleki says.

Safety push

Also at stake are the industry's preparations for a set of aggressive new icing safety regulations. The FAA and European Aviation Safety Agency have informed the industry of plans to establish new certification requirements for aircraft and engines operating in icing conditions. An industry/government working group suggested in 2003 that FAA regulations might need modification.

The new icing requirements will not be entirely about tolerance to ice crystals at high altitudes, however. The rules also will address the problem of flying through supercooled large droplets, called SLDs. These drops remain liquid below freezing temperatures but freeze on impact with a plane. Icing researchers dug into the SLD phenomenon after an ATR-72 flying through rain nosedived into a bean field in Rose-lawn, Indiana, in 1994, killing all 68 aboard.

As yet, there is no 'Roselawn incident' for ice crystals, but researchers and regulators are determined not to wait for one. Research on SLD events, which occur at altitudes below 20,000 ft, has been a greater focus than the suspected ice crystal ingestion. That is starting to change, however.

"We've traditionally done the one, and now we're starting to look at the ice crystal environment and how to deal with tools for that," said Potapczuk of the Glenn icing branch.

In addition to the Ottawa lab tests, regulators have years of reports from pilots to go on. Most of the incidents have happened around the tropics, presumably because of the convective weather there. The closest call came in 2006, when a Qatar Airlines jet reportedly experienced a dual flameout on a flight to Shanghai. The crew was able to restart the engines, but the incident was the biggest wake-up call yet for aviation regulators and the industry.

It came after an incident in 2005 in-

(Continued on page 38)

Workers install spray bars in the Propulsion Systems Laboratory at NASA Glenn in preparation for engine icing tests. The bars will spray ice crystals toward the engine during the testing. Credit: NASA Glenn.

Vigilance from above
The NRO at 50

The National Reconnaissance Office came into being 50 years ago, on Sept. 6, 1961, as steward of the supersecret spy satellites that saw the U.S. safely through the Cold War. NRO's clandestine air and space systems still stand guard against a broad array of threats today.

The NRO was established early in President John F. Kennedy's administration in response to the successful launch of Sputnik, which demonstrated that the Soviet Union had the rocket power to boost its nuclear-armed ICBMs into space and on course to North America. U.S. defense and intelligence leaders, who were left in the dark after aircraft reconnaissance of the Soviet Union was forced to a halt, had an urgent need to know what was going on inside that country.

Secretary of Defense Robert McNamara created the National Reconnaissance Program, which consisted of "all satellite and overflight reconnaissance projects whether overt or covert," and set up the NRO to manage it. The Central Intelligence Agency and the Defense Dept. were assigned joint operational responsibility for the NRO.

by James W. Canan
Contributing writer

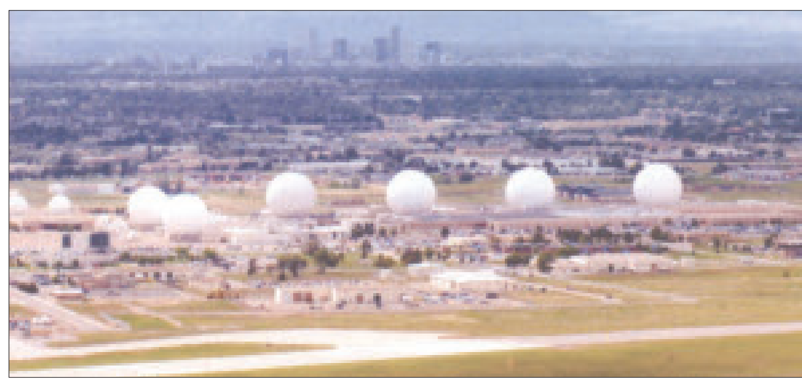
Born out of urgent national need and once cloaked in secrecy, the National Reconnaissance Office is marking a half-century of vital contributions to the peace and security of the U.S. and its allies. Today its expanding roles range from tracking weapons of mass destruction to supporting humanitarian relief efforts to assessing damage from storms, tsunamis, and other disasters.

Details of the new arrangement were spelled out in a memo from Deputy Secretary of Defense Roswell Gilpatric to CIA Director Allen Dulles. It specified that the NRO would be overseen by the undersecretary of the Air Force and the CIA's deputy director of plans—at that time Joseph Charyk and Richard Bissell, respectively.

The Gilpatric memo also designated the undersecretary of the Air Force as the defense secretary's special assistant for reconnaissance, with full authority in all DOD reconnaissance matters. Eight months later, in May 1962, the CIA and DOD agreed to establish a single NRO director, and Charyk became the first.

The DOD and the CIA are said to have clashed in the early years over their respective areas of responsibility and influence within the NRO, but such matters have been settled for some time. The NRO director, a civilian Air Force official (usually the undersecretary), is ultimately responsible for executing NRO programs.

Secrecy was tight from the beginning in the covert world of the NRO. For more than three decades, the NRO's Satellite Operations Center occupied quarters in the Pentagon basement in partnership with the Air Force Office of Space Systems four floors above. No one entered those domains without top clearance and credentials. Hardly anyone knew, and no one openly talked about, what was going on there.



The NRO maintains ground stations in several areas in the U.S. and abroad.

Existence revealed

The NRO was declassified on September 18, 1992, and a few years later moved to Chantilly, Virginia, on the outskirts of the nation's capital. Its current surveillance and reconnaissance programs remain highly classified, but its intents and purposes are no longer secret. The NRO now proclaims that it "develops and operates unique and innovative overhead reconnaissance systems and conducts intelligence-related activities for U.S. national security," with the motto: "Vigilance from above."

Space historian Jeffrey T. Richelson wrote that the declassification of the NRO was advocated by several prominent government officials, including Martin C. Faga and Robert Gates, directors of the NRO and CIA, respectively. Other persuasive factors were "the much wider use in government of the products of NRO systems, pressure from the Senate Select Committee on Intelligence, [and] the suggestion of a review panel chaired by former Lockheed chief operating officer Robert Fuhrman and commissioned by [Gates] that the organization's existence should be declassified," he wrote.

"The mission of the NRO," its 1992 declassification memorandum noted, "is to ensure that the U.S. has the technology and spaceborne and airborne assets needed to acquire intelligence worldwide, including to support such functions as monitoring of arms control agreements, indications and warning, and the planning and conduct of military operations. The NRO accomplishes this mission through research and development, acquisition, and operation of spaceborne and airborne data collection systems."

The agency also maintains ground stations at Buckley AFB, Colorado, Fort Belvoir, Virginia, and White Sands Missile Range, New Mexico. It maintains a presence at the Joint Defense Facility in Pine Gap, Australia, and the RAF base at Menwith Hill Station, U.K., and also has launch offices at Cape Canaveral and Vandenberg AFB.

"The National Reconnaissance Office's systems are critical to national security, U.S. policy makers, and war fighters," another NRO document asserts. "These systems provide the foundation for global situational awareness and address the nation's toughest intelligence challenges. Frequently, NRO systems are the only collectors able to access critical areas of interest, and data from overhead sensors provides unique information and perspective not available from other sources."

The organization says its top priorities now are "monitoring the proliferation of weapons of mass destruction, tracking international terrorists, drug traffickers, and criminal organizations, developing highly accurate military targeting data and bomb damage assessments, supporting international peacekeeping and humanitarian relief operations, [and] assessing the impact of natural disasters, such as earthquakes, tsunamis, floods, and fires."

Shadowy past

Those missions are a far cry from the singular, extremely urgent one that preoccupied the NRO in its earliest days: keeping an eye on the growing number and variety of ICBMs on launch pads in the USSR, some in places where clouds shielded them from overhead cameras much of the time.

The secrecy surrounding reconnaissance from space had begun to loosen a bit at high levels of government not long before the NRO was formed. President Dwight D. Eisenhower had implied the existence of U.S. spy satellites in May 1960, noting that he had just ordered a halt to U-2 reconnaissance flights over the Soviet Union, not only because the Soviets had just shot down the U-2 spy plane flown by U.S. pilot Gary Powers, but also because "considerable progress was now being made in the photography of the earth from satellites."

After pilot Francis Gary Powers was shot down over Soviet territory on May 1, 1960, U-2 flights came to a halt.

In 1967, with the NRO barely past infancy, President Lyndon Johnson, in an off-the-record speech to a group of educators in Nashville, implicitly acknowledged the reality and the mission of U.S. spy satellites and their vital importance to national security. He also noted that the satellites had given the lie to the presumed "missile gap" with the Soviet Union.

"We've spent $35 [billion] or $40 billion on the space program," Johnson said, "and if nothing else had come of it except the knowledge we've gained from space photography, it would be 10 times what the whole program cost. Because tonight we know how many missiles the enemy has, and it turned out our guesses were way off. We were doing things we didn't need to do. We were building things we didn't need to build. We were harboring fears we didn't need to harbor."

Much later, in October 1978, President Jimmy Carter, in a speech at Cape Canaveral, became the first chief executive to acknowledge in public that the U.S. was indeed operating spy satellites. At the time, Carter was trying to persuade the U.S. Senate to ratify the proposed Strategic Arms Limitation Treaty (SALT) with the Soviet Union, and wanted to display satellite photos of the Soviet ICBM sites to show Senate skeptics that the U.S. would be capable of confirming Moscow's compliance with the terms of SALT.

Neither Johnson nor Carter went so far as to mention the NRO or its particular systems by name. Those satellites had their beginnings as far back as the mid-1950s, well in advance of NRO's creation, in an Air Force development program called WS (weapon system) 117L, a seminal effort that embodied fundamental space reconnaissance technologies in a planned family of electronic intelligence (Elint) and imagery intelligence (Imint) space systems.

By mid-1960, WS117L had evolved into two programs to build and deploy satellites capable of photographing the Soviet land mass—Samos (satellite and missile observation system), an Air Force program, and the CIA-led Corona. Samos, which evolved into the Sentry program, reportedly developed Imint satellites designed to radio their imagery to ground stations or drop film capsules into the atmosphere for retrieval by aircraft, and Elint 'ferret' systems to collect radar emissions and identify their sources. Corona focused solely on photoreconnaissance. Its Discoverer satellites stored their film in capsules that were jettisoned and retrieved by Skyhook aircraft.

WS117L also gave rise to the Midas (missile defense alarm system) program to produce early warning, infrared-sensing satellites. Midas in turn spawned the defense support program, or DSP, satellites that served the U.S. through most of the Cold War, and then the SBIRS (space-based infrared system) satellites just now starting to form up in space.

Through the years, the NRO and its contractors developed and operated successively more capable overhead reconnaissance systems across the signals intelligence (Sigint) spectrum, which included Elint and communications intelligence capabilities. By all accounts, the NRO-operated Sigint spacecraft, including various radar detection and communications intercept satellites, have always been more closely guarded than its Imint systems. The NRO has always worked closely with the Sigint-specialized National Security Agency, headquartered at Fort Meade, Maryland.

At its creation, the NRO took control of all overhead reconnaissance assets and programs, including the Navy's Galactic Radiation and Background (Grab) program. Grab space systems were designed to collect Sigint of Soviet air defenses. A Grab satellite is said to be the first successful U.S. reconnaissance satellite. Grab evolved into an Elint program called Poppy.

The NRO and its programs were 'black' right off the bat. A DOD document of the time noted that "the title NRO is classified SECRET and the existence of the National Reconnaissance Program within the U.S. government is classified TOP SECRET."

Corona's photoreconnaissance

The CIA's pioneering Corona photoreconnaissance program got off to a rocky start in the 1950s, as it experienced a series of launch and operational failures. The discouraging pattern was finally broken in August 1960, when the Corona/Discoverer 14 launch vehicle, satellite, and Keyhole (KH) camera all performed flawlessly on launch and in orbit.

In an unclassified speech last August, NRO director Bruce Carlson noted that Discoverer 14's "KH-1 camera provided more photographic coverage of the Soviet Union than [had] all of the previous U-2 missions combined.

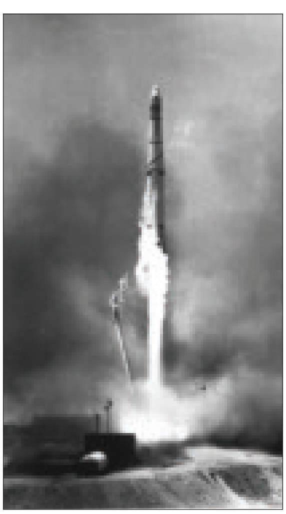
"More importantly," Carlson declared, "Corona's 40-ft resolution provided hard evidence of the pace and scope of Soviet ballistic missile deployments, and allowed analysts to count Soviet heavy bombers. The data from this first [successful Corona] mission also disproved the existence of a 'missile gap' in favor of the Soviet Union, and contributed to the overall stability of the nuclear balance" between the U.S. and the USSR, Carlson declared.

Carlson hailed Corona, which ended in 1972, as the first program to recover objects from orbit, deliver intelligence infor-

Grab has been described as the first successful U.S. reconnaissance satellite.

A Samos satellite is launched by an Atlas booster. The program never proved successful.

This image of the Severodvinsk shipyard was captured on February 10, 1969.

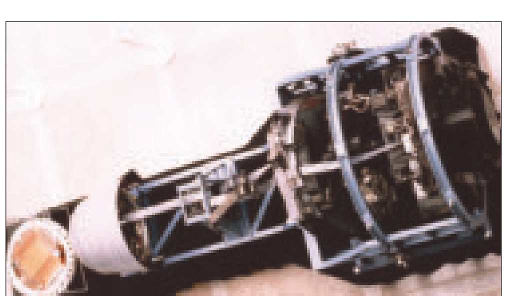


After a rocky start, the Corona program proved to be extremely valuable.

mation from a satellite, produce stereoscopic satellite photography, and employ multiple reentry vehicles. It also was "the first satellite reconnaissance program to pass the 100-mission mark," having launched 145 satellites, the NRO director declared.

Corona's results were mixed for many years. In a recently declassified document NRO notes that the cameras of Corona space systems "swept the Soviet land mass for signs of missile development and nuclear testing activity" and made "virtually immeasurable" contributions to U.S. intelligence. The KH-1, KH-2, and KH-3 cameras aboard the first generation of Discoverer satellites did a sequentially better job, but still left a lot to be desired.

"Corona imagery…had limitations," the declassified NRO document says. "In 1961, for example, it could resolve no object smaller than 10-15 ft. U.S. photointerpreters and U.S. planners needed, and demanded, higher resolution imagery for their intelligence estimates relating to Soviet weapons systems and target identification."



Corona cameras improved over the years, providing progressively sharper imagery, with ground resolution of objects reduced to less than 5 ft.

Corona's satellites grew larger and its camera systems got better over the years. Images became progressively sharper, and ground resolution of objects was reduced to less than 5 ft. Late-model Corona/Discoverer satellites reportedly carried two film recovery systems instead of just one.

Keyhole into a new dimension

"Analysis would improve if photo interpreters could perceive a third dimension," space reconnaissance chronicler Jeffery A. Charlston writes. "This could be accomplished with stereo imagery, and stereo capability soon emerged as a desired goal for the Corona program." To meet the goal, engineers combined two KH-3 cameras in a single payload, he explains.

"Pointed forward and aft of the spacecraft to provide overlapping coverage from different angles, the two cameras could create stereo images. The system would be known as Mural–KH-4," Charlston writes. "Mural became the workhorse of the Corona family after its first mission on August 30, 1961."

After Mural came Lanyard—the KH-6

camera system that could be aimed independently without aiming the spacecraft itself, thus enhancing its photographic flexibility and spatial coverage. That system gave way to a high-resolution spotting satellite system called Gambit, also known as the KH-7, which brought satellite photoreconnaissance into the computer age.

Gambit was just declassified in September of this year. An NRO paper calls it "a surveillance system" that "covered far less area than Corona" but "produced photography with a much better resolution. Objects as small as 6 ft could now be located and observed."

"By early 1962," Charlston writes, "it became clear that KH-7 would be different from all its predecessors in one important way. Its required precision, for both targeting and basic procedures, meant that its operations would need to be designed on computer."

The Gambit 3 satellite, also known as the KH-8, was launched in 1967. It was "capable of stereo photography" and was highly successful, an NRO document says.

"The Gambit program eventually flew 54 missions over 20 years, concluding in 1984. It provided U.S. officials with unique, highly detailed imagery of sensitive targets, and became a major tool for photo analysts during the Cold War," the document adds.

Big Bird follows Gambit

Film-recovery payloads culminated with the Hexagon satellites. Declassified in September simultaneously with Gambit, Hexagon was designed in the 1960s and launched in 1971 to provide both high-resolution and wide-area coverage from on high.

"It was one of the largest and most complex reconnaissance satellites ever built," the NRO paper says. "Known to the American public as 'Big Bird,' it was 10 ft in diameter and 55 ft long. It rivaled NASA's Space Lab in size."

According to the NRO, Hexagon featured two panoramic, counterrotating, optical-bar cameras and four recovery capsules. The later model Hexagon satellites also contained a fifth capsule to return film from a camera devoted to mapping.

"Stellar and terrain cameras in Hexagon made it possible to extract mapping, charting, and geodetic data for the Defense Mapping Agency and other organizations in the intelligence community," the NRO

Gambit-1 KH-7 was the first successful surveillance system that carried a pointing or 'spotting' camera with high-resolution capability. It conducted close-in surveillance of denied territories in the USSR with a primary intelligence focus on ICBM silos.

A leader looks back

Martin C. Faga provides his intimate perspective on the 50-year history of the National Reconnaissance Office, which he directed from 1989 to 1994, as follows:

"The history of the NRO breaks into three major phases, each of about 15 years. The beginning years were roughly 1961-1975. These years were technically difficult because everything was new: the launch systems, the collection systems, the analysis and production systems. Capabilities were modest, and most collection and its initial analysis took place over a period of months.

"Volumes of information were small compared to today. Nonetheless, they offered tremendous, continuous reconnaissance of the Soviet Union and other areas of interest, and provided great strategic intelligence sufficient to assure our leadership that we knew, top level, what weapons the Soviets had, how they were deploying, and how they were evolving over time.

"The 'missile gap' concern came to an end early in this period. While the NRO's information was enormously valuable, it was relatively limited in scope and its consumers probably numbered in the few thousands.

"The second period was the mid-'70s through the first gulf war in early 1991. Almost all NRO systems became real-time systems during this period, and they enabled a robust 'indications and warning' effort. This meant that the intelligence community could daily sample activity in the Soviet Union and in other countries of long-term or short-term concern, and could assure the president daily that activity that could lead to large-scale war with the United States was not occurring.

"This 'nothing significant happening' reporting [by the intelligence community] was immensely valuable to the leadership of the government, and allowed it to constantly assess the response of the Soviets and others to diplomatic, military, or other initiatives of the United States. Consumers [of intelligence] during this period rose into the tens of thousands, at least.

"The third period began during the first gulf war and continues to today. NRO systems were not only near real time, but their collection capacity had grown enormously, and processing equipment became fast enough and portable enough to be placed in the field. This was the basis for significant use of satellite reconnaissance by deployed military forces in the field. It caused the gulf war to be called the first space war.

"Interestingly, when the Russians assessed the basis for the overwhelming U.S. success in that war, they attributed it to precision-guided munitions and real-time intelligence, which, in fairness, was more than satellite reconnaissance.

"French Defense Minister Pierre Joxie, having heard of U.S. imaging capabilities from his forces, asked after the war for the opportunity to see such imagery. Upon seeing it, he exclaimed, and later publicly stated: 'No nation can be a strategic power unless it possesses modern satellite reconnaissance.'

"Despite myriad problems with data volumes and distribution of satellite reconnaissance during the gulf war, the military didn't miss the message. During the period that followed, they became huge—and probably the primary—consumers of satellite reconnaissance, and they invested heavily in infrastructure to acquire output from the NRO and its mission partners NGA (National Geospatial-Intelligence Agency) and NSA (National Security Agency) to deliver raw and finished intelligence to field units at every level.

"In 1989, then [U.S. Army] Lt. Gen. Carl Stiner was largely alone in declaring that his special forces 'couldn't go to war without space systems.' Today, every commander would say that. And all of them would be talking about more than satellite reconnaissance—also about the incredible success of the GPS, missile warning, and weather and communications satellites on which all modern military actions heavily depend."

Hexagon KH-9, the last of the U.S. national reconnaissance film-return systems, was developed as a replacement for the Corona. It conducted 19 successful missions.

Corona cameras have improved over the years, providing progressively sharper imagery, with ground resolution of objects reduced to less than 5 ft.

document says. It notes that the NRO launched 20 Hexagon Big Birds from June 1971 to April 1986, and that the program's only failure happened on its 20th and final flight, April 18, 1986, when the launch booster exploded above Vandenberg AFB.

"Gambit and Hexagon proved invaluable to U.S. policymakers," the NRO declares. "For much of the Cold War, these systems kept watch over the Soviet Union and other communist block areas. They proved critical to U.S. security by providing detailed intelligence on U.S. adversaries. Their search and surveillance capabilities also made possible arms limitation negotiations and the verification of nuclear reduction treaties."

KH-11: Instant gratification

By the mid to late 1970s, the NRO had come within reach of a long-sought goal: getting satellite imagery from space to ground stations and into the hands of national security decision-makers in near real time. This finally happened—made possible by the advent of digital electronics and programmable computers—when Gambit and Hexagon systems were replaced by the next generation of photoreconnaissance satellites that radioed their imagery to Earth and eliminated the need for film return.

"On December 19, 1976, the first U.S. near-real-time imagery intelligence satellite launched into space," Charlston writes. "The camera it carried abandoned the [previous] film-readout concept, using an electrooptical technology developed by the NRO's Program B."

That satellite reportedly was the first of the vaunted KH-11 series that made the Soviet Union and other denied areas of the globe far more—and more sharply—discernible than ever before. By all accounts, exceptionally large volumes of KH-11 imagery were transmitted to ground stations and national security decision-makers with unprecedented speed and clarity.

Keeping the war cold

Fifteen years ago, former NRO Director Martin C. Faga met Lt. Gen. Georgiy Polischuk, deputy director of the Russian GRU (Foreign Intelligence Directorate) and former director of the Soviet equivalent of the NRO. Polischuk was in the U.S. as part of a Russian delegation to discuss the potential environmental applications of classified satellites.

As recalled by Faga, here is what his former Soviet counterpart said to him on that occasion:

"I am proud of my service and of yours. We both labored during the Cold War to keep our leaders informed. Every time our leaders feared the worst, our hard evidence showed that the intentions of the other side were not so dire. I know that we both helped prevent the Cold War from becoming a hot one."

Faga adds that Polischuk "was, of course, speaking of the thousands of people who were involved on both sides."

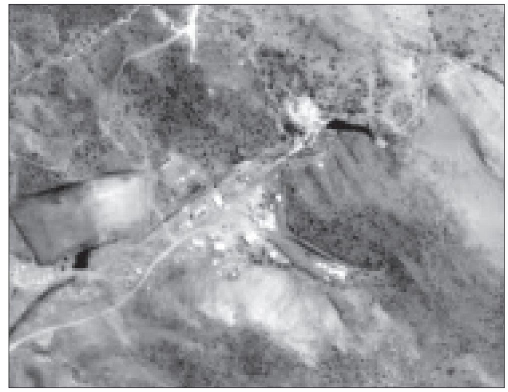
Big or small, a huge legacy

Through most of the NRO's first 50 years, its spaceborne reconnaissance systems grew progressively larger and more complex. Today, the NRO strives for smaller, less complex, less expensive satellites capable of working in concert to do the same missions while cutting launch costs and response times.

In his speech last August, NRO director Carlson noted that "small satellites have already proved invaluable since the earliest days of space reconnaissance and the NRO. The Navy's Grab and Poppy satellites of the 1950s fit the description, he said, with the largest Poppy measuring only 27 in. x 34 in. and weighing just 282 lb.

Carlson said the NRO will continue to use small satellites to develop and demonstrate innovative technologies, help maintain the space industrial base, and sustain and develop the space industry workforce.

"Perhaps we will fly many small satellites in formation in order to produce large synthetic apertures for higher resolution [of images]," the director said. "Or maybe we'll be able to rapidly change on-orbit configurations and formation geometry in response to evolving mission/sensing requirements."



This photograph of the Zhawar Kili Al-Badr Camp (West), Afghanistan, was used by Secretary of Defense William S. Cohen and Gen. Henry H. Shelton, U.S. Army, chairman, Joint Chiefs of Staff, to brief reporters in the Pentagon on the U.S. military strike on a chemical weapons plant in Sudan and terrorist training camps in Afghanistan on Aug. 20, 1998.

Today's small reconnaissance satellites are designed to work together on orbit by virtue of highly advanced communications systems in and from space, officials note. Skeptics contend, however, that no matter how capable small satellites may be in isolation or as a team in space, they will be hard-pressed to match the prowess of the larger systems that evolved as steadfast Cold War sentinels through the first half-century of the NRO.

Viewpoint

Space AND risk analysis paralysis

Aversion to failure or loss has become so endemic to our space enterprise that programs are often very late, deeply over budget, or canceled. Acknowledging that the possibility of loss or failure is part of the space equation is the only way to break this cycle.

by Col. Fred G. Kennedy

Col. Kennedy is senior materiel leader, C2ISR Division, Aerospace Sustainment Directorate, Warner Robins Air Logistics Center, Robins AFB, Georgia. He was previously the space lead for the Capabilities and Acquisition Division, Joint Staff, J-8. The views presented here are those of the author and do not necessarily represent the views of the Joint Chiefs of Staff, the United States Air Force, or the Department of Defense.

In November 2010, the deputy secretary of defense approved the establishment of a Defense Space Council, a high-level forum chaired by the executive agent for space (the Air Force) and chartered to provide a central coordinating mechanism for the numerous space activities the DOD oversees.

Why was this necessary? From our senior leadership's perspective, the national security space community is suffering from a profound diffusion of authority, an inability to collectively plan for the long term or set priorities, and the lack of any effective enforcement mechanism for its architectural choices. No one appears to be in charge.

For its part, the Air Force agrees: After undertaking a review of its headquarters functions, the service concluded that space responsibilities "are fragmented…[with] five separate offices…reporting directly to the Undersecretary." Some of the individuals the Air Force chose to interview called the current structure 'confusing.'

To address this fragmentation, the service responded with a reorganization. Among an array of similar measures, space acquisition was realigned under SAF/AQ (assistant secretary of the Air Force-acquisition). This sounds logical, unless you recall that space acquisition resided in SAF/AQ all through the 1990s. It was stripped out of AQ and placed in the undersecretary's office precisely because of the 'fragmented' nature of our space efforts circa 2001. Whatever it is that ails our space enterprise compels us to strive for unity of effort, but try as we might, we cannot seem to achieve it.

So are we barking up the wrong tree? Fragmentation of space, or a diffusion of responsibility among multiple offices and agencies, may be a fact of life, but it is not necessarily a problem in and of itself. Each of the services manages to procure, operate, and maintain air platforms without the intercession of an 'executive agent for air.'

Yet space is somehow different. Without ever quite saying what is wrong with space, senior leaders inside DOD have concluded—repeatedly—that if only we achieved unity of effort (across DOD, or between DOD and the intelligence community, or perhaps among all interested parties within the U.S. government), that 'problem' would dry up and blow away.

This may in fact be true, but isn't it worth a bit more analysis than simply saying, "We have a problem?" Taking steps to ensure that one has "the right structure and relationships in place for space management" implies that one has an inkling that the current structure is not 'right.' What led us to believe that? What, exactly, is the problem we are attempting to solve? And why are we so afraid to write it down?

THE PROBLEM

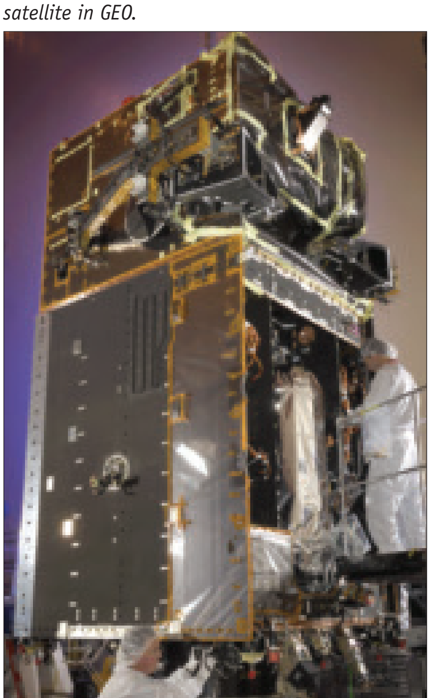
Let's look at the two most blatant symptoms, and see if we can discover an answer.

Building spacecraft takes too long (a lot longer than we thought it would).

Examples are legion. As of this writing, the Space Based Infrared System (SBIRS) program is in its 15th year and has only recently managed to place its first satellite in geosynchronous orbit. SBIRS was originally planned to field its satellites between 1999 and 2004. The nearly decade-long delay we have experienced is beginning to cause significant concern within the missile warning community, as it watches the remaining suite of legacy Defense Support Program satellites degrade while successor satellites drift ever further to the right.

The National Polar-orbiting Operational Environmental Satellite System (NPOESS) program, managed by DOD, NOAA, and NASA, awarded a contract to Northrop Grumman in 2002, with a risk reduction demonstrator satellite launch expected in 2006, to be followed by launch of the first NPOESS satellite in 2009. By the time the White House effected the NPOESS 'divorce' (a program restructuring that leaves NOAA/NASA at the helm of one program and DOD running another) last year, the demonstrator had slipped five years, to 2011, while the first spacecraft would not have been available until 2014. We have been told, unofficially, that were we to stop the program entirely and restart it at a later date, it would take 11 years to build and launch. That's longer than Apollo, yet we are only going as far as LEO and not sending a single human being.

The SBIRS program is in its 15th year and has placed only one satellite in GEO.



The Navy's Mobile User Objective System, the Air Force's Advanced EHF (and its predecessor, Milstar), and the NRO's Future Imagery Architecture have similar stories and serve only to demonstrate that delays are an equal opportunity affliction. If anyone retains the 'recipe' for putting capability on orbit in a timely fashion, they are keeping it to themselves.

Space is too expensive (even more expensive than we could have imagined).

Clearly, programs forecast to take five years to complete that end up requiring 10 are unlikely to cost less. But I submit that there is a common factor driving both cost and schedule, and that it is not just simple delays that drive cost, but something more insidious.

Turn again to SBIRS, since it so clearly demonstrates the point. SBIRS began life in 1996 at an estimated cost of $4.1 billion (then-year) for five satellites. The Air Force recently notified Congress that its estimate has been revised upward to $15.1 billion. In its defense, the Air Force has added a satellite, so they are now buying six. Yet a straightforward calculation of unit cost shows an increase from an already expensive $820 million to an unbelievable $2.5 billion per copy over the course of a decade and a half.

And NPOESS? In 2002, $6.1 billion was supposed to buy DOD, NASA, and NOAA six satellites. That figure had risen to $11 billion by the end of 2009—while the number of satellites was cut to four.

No sector or organization is immune. Despite its eventual on-orbit success, my own space program at DARPA experienced significant cost growth over the nearly seven years of its existence. How much? Well, I now 'multiply by pi' to predict a program's final cost based on an initial contractor estimate.

Sure, you say, but space is different. It is inherently a complex undertaking. Our systems have to operate in an incredibly hostile and unforgiving environment for long periods of time without benefit of repair or upgrade. We no longer properly sustain our space-savvy 'industrial base,' that cadre of engineers and facilities we could not do without. And worse, our requirements (or acquisition, or operations) discipline is absolutely shot.

And yet, who said space has to be complex? Most of what goes onboard a typical satellite—with the exception of propulsion and attitude control effectors (control moment gyros, momentum wheels, magnetic torquers) are sensors and electronics. We have been lapping and polishing (and lightweighting) big pieces of glass for a very long time, and every digital camera on the planet contains the technology that allows you to collect, digitize, store, and transfer sensor data.

We have any number of electrical engineers who can design and implement any circuit you'd care to name, and there is certainly no shortage of software engineers in the U.S., or around the world. How about the space environment? To be honest, it is actually quite benign, even if you have to cope with the Sun's exhalations and unusual thermal effects you rarely encounter on Earth outside a bell jar.

So why the outrageous expense? Why the interminable and apparently unavoidable delays?

In just three words: Rampant risk aversion. More precisely, an endemic, deep-seated inability to accept even the most unlikely of risks, a condition that affects every aspect of the space enterprise, driving cost and schedule beyond all of our most conservative predictions. And it feeds on itself.

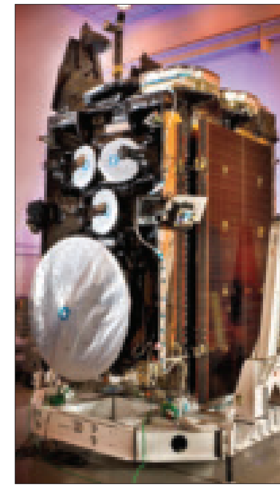
This is the real problem underlying the tripling in cost of SBIRS, the doubling in cost of NPOESS, the tripling in unit cost of Advanced EHF, and build schedules that now occupy the better part of a decade. Pathological risk aversion—the belief that the system must work, at any cost—drives us to perform an exacting sequence of component, subsystem, and system tests, ad nauseam, before we ever attempt to launch a satellite. Acoustical testing (to simulate conditions present immediately following launch), mass properties testing (to precisely determine moments of inertia and allow us to finely tune the pointing of the satellite), modal surveys, vibration testing, thermal balance and thermal vacuum testing, flight software dry runs, clean runs, qualification and acceptance tests, and integrated ground segment—launch—spacecraft tests, are run again and again and again to ensure that our billion-dollar investments do not end up as orbital debris.

A large satellite such as AEHF or SBIRS may spend 18 months or more in its final system-level test campaign. And these programs often carry 1,000 to 1,500 contractor personnel once they begin assembling the satellite and preparing for system test. At a conservative $250,000/contractor/year, a 1,500-person program spends more than half a billion dollars to test just one satellite.

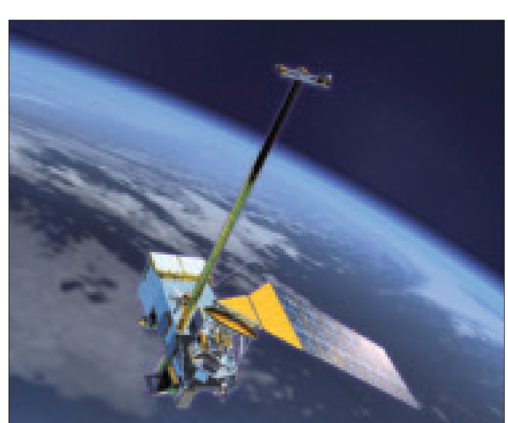
The sequence of events that has led us to this obsessive-compulsive procurement model is well known. It applies to every sector of the enterprise, but is most pronounced in mission areas that have settled on a small number of large platforms, often in expensive-to-achieve orbits.

A requirement—say, for space-based missile warning—is often developed in tandem with the realization that a capability is within (or nearly within) our technological grasp. In this case, the capability was infrared detection of missile plumes, and the emerging requirement was the Air Force's 1955 decision to extend our warning time for Soviet missile launches by complementing the ballistic missile early warning system with a space-based counterpart. The result was MiDAS (missile defense alarm system), a polar-orbiting constellation of 8-12 satellites.

Twelve launches (and three failures) later, the Air Force determined that on-orbit detection of missiles was both feasible and useful. Note that the first nine MiDAS spacecraft were launched in a 3.5-year period between February 1960 and July 1963. The initial program plan was submitted by the Advanced Research Projects Agency (ARPA, the progenitor of today's DARPA) in February 1959. Four years, nine satellites. And one year from program initiation to first launch.



The AEHF satellite system was no stranger to the stretch-out encountered by development of programs. Photo by Jim Dowdall.



As the price tag on the NPOESS satellites continued to rise, the number of spacecraft dropped.

MiDAS led directly to the Defense Support Program (DSP). The Air Force delivered its first DSP satellite to geosynchronous orbit in 1970, the first of an envisioned three-satellite constellation. The last, DSP 23, flew in November 2007. During that time, DSP doubled in weight and nearly tripled in power consumption. An occasional launch vehicle would fail, so we adopted increasingly stringent range safety requirements, culminating in the publication of EWR 127-1, a document that has invigorated an 'industrial base' of bureaucrats on both coasts, dedicated to ensuring that every launcher must work, at any cost.

We adopted cryptological requirements on our radios to ensure that no one but the rightful owner can talk to our satellites, spawning another industrial base at Ft. Meade. We founded the Aerospace Corporation, now 3,700 strong, to augment the not-so-small armies of mission assurance personnel that every contractor now maintains, and to provide "independent verification and validation," in effect overseeing the overseers of the engineers and technicians who build our satellites. We adopted rigid standards for tracking program cost and schedule, and demanded that our contractors use these (validated, approved) tracking systems when they build our spacecraft. Even if individual program managers decide they add little value.

This sensor infrared alarm system was part of the 1950s MiDAS program.

The ninth DSP satellite flew 11 years after program initiation.

The ninth SBIRS satellite is not forecast to fly, assuming we could find the money to build it, before at least the mid-2020s. That's 30 years after program start. This is literally time enough for a generation to grow up, educate itself, and decide that space is too frustrating a career choice to even consider.

Some might argue that it is not (simply) our fear of failure but our insatiable appetite for more capability that drives us over the cost and schedule cliff. Yet in the vast majority of instances, the hardware that we attach to our honeycomb face sheets is several generations behind the times. We use gate arrays and memory and processors that are years old, ostensibly to ensure that we overtest them and generate sufficient statistics to 'space-qualify' them. Rocket engines? The technology is 60 years old, and the fundamentals have scarcely changed. It is difficult to draw a line from increased capability to increased cost and schedule, since in many cases we are not even keeping up with state of the art!

Were we, today, to resurrect the requirements documentation for MiDAS and attempt to design, build, and launch a spacecraft based on it, would anyone in the community dare to present a plan that reaches orbit in 12 months? Of course not. We would recognize that it would take at least 12 months just to get through a proper system test, with another 90-120 days tacked on for launch processing and checkout. And this is with an array of advanced sensors, bus components, analytical and design tools, many off the shelf—a far cry from the situation our predecessors faced back in February 1959.

Risk aversion is a creeping process. It starts with indisputable logic in the wake of a failure—more testing, more checks, more documentation, more oversight might have prevented said failure. So additional personnel are hired, standards and directives are issued, augmented test strategies are implemented—and everyone breathes a sigh of relief when it appears to work. That is, until the next failure, and the cycle begins anew.

This vicious cycle spawns other, pathological, strategies: Since any single launch is now expensive, and there are few opportunities, programs will be banded together on a single spacecraft in the hope of harmonizing the requirements of multiple payloads and their parent organizations in the name of efficiency and cost containment. Yet the eggs-in-one-basket approach only strengthens calls for increased oversight, testing, and proper documentation, as the organizations quickly realize that everything is riding on that single launch. Moreover, those multiple payloads are likely to have competing (and in some cases, mutually exclusive) requirements, forcing design compromises and—as we have seen in cases such as NPOESS—program termination and restructure, but only after the expenditure of billions of dollars.

We are over a half-century removed from the trial-and-error, try-again-if-it-fails mentality of our forebears. Risk aversion is firmly in control of our culture. In multiple mission areas (communications, missile warning, environmental monitoring), the 'community' has decided that a capability—in many cases, a single asset—is irreplaceable or indispensable, and will take any action, expend any amount of manpower, time, and money that can be made available, to ensure mission success. Is it too much to point out that this is an absurdity?

The ninth DSP satellite flew just 11 years after program initiation.

THE FIX

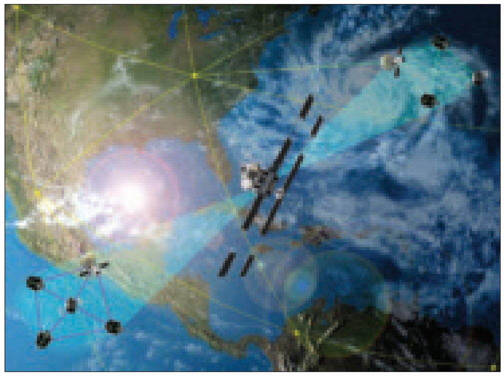
The solution (like the problem), is cultural. Within the DOD's space portfolio, we need to find approaches that allow us to embrace risk, and not simply avoid it or beat it down through repetitive test loops. That requires top-down direction and a firm hand on the wheel. We have come full circle to the question of appropriate space governance, unity of effort, and the problem we wish to solve. That problem is risk aversion, and the solution is aggressively pursuing solutions that will not feed the beast.

What does it mean to allow ourselves to accept risk? First, we must do away with classical "Battlestar Galactica" strategies in key mission areas, where we assign a handful of satellites to perform critical missions. This is consistent with the president's national space policy, and speaks to a stated need for 'resiliency.' We need to approve only those concepts of operations and acquisition strategies that eschew the 'indispensable node' in favor of dispersed or disaggregated capabilities. We should strive for a scenario in which a launch failure evokes no soul-searching, backbiting, or blue-ribbon panels bent on assigning blame.

Failure should not simply be tolerated, it should be accepted as part and parcel of the space business. But that cannot happen in an environment and architecture where a single launch or on-orbit failure compromises national security.

So should we replace SBIRS with 12 'MiDAS-like' satellites in LEO? Or 50? Does it imply that we ought to dispense with wideband global SATCOM in favor of Teledesic (the 800+ constellation conceived of in the 1990s to provide worldwide broadband Internet services)?

Not necessarily. It might take the form of DARPA's F6—a concept that 'fractionates' a satellite into individual subsatellites, each launched separately, with an eye to spreading risk among the various launches. Or it might take the form of on-orbit refueling, repair, and upgrading, another DARPA concept tested on orbit in 2007 and perhaps soon to be adopted by commercial industry. The impossibility of repair is one driving force behind our risk-averse mentality: A spacecraft, and all of its critical subsystems, has to last for its planned mission life. An on-demand repair service would blunt



DARPA's F6 concept 'fractionates' a satellite into individual subsatellites, each launched separately.

that risk aversion, allowing a satellite operator to accept levels of failure that would today be labeled 'catastrophic.'

A strong, centralized space governance construct—with a charter to specifically fight risk aversion and its stranglehold on the culture of space—could halt our downward spiral and encourage the community to refocus its efforts on resilient constellations of satellites providing many of the same capabilities we have today.

Architectures—or analyses of alternatives—that propose 'indispensable nodes' must be forcefully rejected. Requirements that drive such architectures need to be questioned, and acquisitions that rely on 'all-eggs-in-one-basket' approaches must be returned to the lead agency for rework.

Program managers and their staffs will (slowly) come to realize that exquisite testing regimes will not be worth the added reliability or performance they provide. Bureaucracies that subsist on mission assurance will, over time and as their utility noticeably subsides, fade (although they will likely require a little prodding).

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On the heels of a new national space policy, and in an era of increasing fiscal austerity, we have a unique opportunity to reconfigure the culture of the space enterprise, and for the better. If the DOD can, at a high level, insist on resilient, 'no indispensable node' architectures for these and other areas, we may be able to beat back the forces of risk aversion and finally recapture the innovation and agility that were the hallmark of our earliest years in space.

This will be the task of a generation. It will not be easy.

Out of the

25 Years Ago, November 1986

Nov. 10 The 9th Space Warning Squadron, which provides warning for detection of ICBMs and sea-launched ballistic missiles, goes mission operational at Robins AFB, Ga. Later use of the squadron's radar includes supporting the USAF space surveillance network by providing satellite vehicle surveillance, tracking, and radar space object identification. *http://globalsecurity.org*.

50 Years Ago, November 1961

Nov. 1 Thousands watch as the Indian-built Avro 748 turboprop transport, made of British Avro-produced components under license, flies for the first time at the Indian air force station at Kanpur and prepares the way for mass production of the aircraft at the station. The pilot is Sqn. Ldr. Kapil Bhargava of the Indian air force. *The Aeroplane*, Nov. 9, 1961, p. 589; *Flight*, Nov. 9, 1961, p. 720.

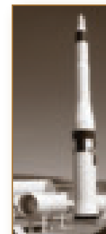
Nov. 9 The X-15 breaks another speed record, flying 4,093 mph, or Mach 6.04, at an altitude of 95,800 ft. This is the fastest speed yet reached by a man-controlled aircraft and the first to exceed Mach 6. The plane, piloted by Air Force Maj. Robert M. White and technically called an 'aerospacecraft,' had previously flown at 3,920 mph. D. Baker, *Flight and Flying*, pp. 377-378.

Nov. 16 Britain's Hatfield Man-Powered Aircraft (HMPA) Puffin makes its first flight. Built by the HMPA Club, a group comprising de Havilland Aircraft employees, the Puffin has an 80-ft wingspan and a total weight of about 100 lb. It consists of a light-alloy tube frame and a body made mainly of balsa skin covered with a heavy grade of tissue. It is a pusher plane whose single propeller is driven by a muscle-powered bicycle arrangement, also consisting of light alloy tubing and a single 24-in. wheel. *Flight*, Nov. 30, 1961, p. 843.

Nov. 16 The Nike-Zeus antimissile missile is successfully flown in a test flight from Point Mugu, Calif., over the Pacific Ocean. *The Aeroplane*, Nov. 23, 1961, p. 662.

Nov. 16 The Discoverer 35 satellite, launched from Vandenberg AFB, Calif., by a Thor-Agena-B, is successfully recovered in midair 650 mi. west of Hawaii by a specially equipped Lockheed JC-130. The payload includes samples of materials including human and animal cells and tissues to be studied for how they are affected by radiation in space. *Flight*, Nov. 23, 1961, p. 791; *Aviation Week*, Nov. 27, 1961, p. 30.

Nov. 16 W.J. O'Sullivan of NASA Langley receives a $5,000 award from the agency's administrator, James E. Webb, for inventing the inflatable satellite. Used in two successful NASA spacecraft, Echo 1 and Explorer IX, the idea is said to have been first introduced by the British spaceflight authorities Kenneth W. Gatland, A.M. Kunesch, and A.E. Dixon, in a 1951 paper presented at the second International Astronautical Federation Congress. *The Aeroplane*, Nov. 30, 1961, p. 701.



Nov. 17 A Minuteman ICBM is successfully fired from a silo at Cape Canaveral, Fla. In the previous attempt, the missile exploded after exiting the silo. *Aviation Week*, Nov. 27, 1961, p. 25.

Nov. 18 The mission of the Ranger II spacecraft fails when the last stage of the Atlas-Agena-B launch vehicle does not restart in its Earth parking orbit of 115 mi. The craft was meant to leave Earth orbit after a coast period, then project into a long elliptical orbit to test basic attitude control, solar power, and communications systems technology for lunar and planetary missions for later lunar landing craft in the Ranger series. This is the second failure of the Ranger craft. *Aviation Week*, Nov. 27, 1961, p. 27; *Flight*, Nov. 23, 1961, p. 791.

Nov. 19 On the occasion of Artillery Day, Soviet military leaders announce that Russia has developed 100-megaton nuclear rocket warheads. *Aviation Week*, Nov. 27, 1961, p. 23.

Nov. 22 A Navy F-4H Phantom II piloted by Lt. Col. Robert B. Robinson sets a new world speed record of 1,606.3 mph at an altitude of about 45,000 ft over a 15-25-km course at Edwards AFB, Calif. *United States Naval Aviation 1910-1980*, p. 243; *Aviation Week*, Dec. 4, 1961, p. 33.

Nov. 28 In a special ceremony at the White House, President John F. Kennedy presents the prestigious 1961 Harmon International Aviator's Trophy to three pilots who made pioneering flights in the X-15 rocket research aircraft: A. Scott Crossfield, Joseph A. Walker, and Robert M. White. *The Aeroplane*, Dec. 21, 1961. p. 781.

Past

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

Nov. 29 A chimpanzee named Enos is launched in the MA-5 with an Atlas booster from Cape Canaveral, Fla.,

and is safely recovered after two orbits, in effect becoming the first living being to be sent into orbit by the U.S. However, the flight, which was supposed to make one more orbit, is cut short following an attitude control malfunction. *Flight*, Dec. 7, 1961, p. 872.

75 Years Ago, November 1936

Nov. 2 Pilot John H. Shobe sets a new speed record flying from New York to Boston. Averaging 227.5 mph in his Beechcraft 17, he covers the 190 mi. in 50 min 30 sec. *Aircraft Year Book 1937*, p. 413.

Nov. 4 The Pan American Airways Hawaiian Clipper, a Martin M-130, arrives at Alameda, Calif., completing its first regular passenger flight to Manila and back. *Aircraft Year Book 1937*, p. 413.

Nov. 7 Robert H. Goddard launches a four-chambered liquid propellant rocket, probably the first in the world, at Roswell, N.M. It reaches an altitude of about 200 ft. It would have gone higher, but before it began to rise from the launch tower one of the chambers burned out. The rocket is 13 ft, 6.5 in. long, and each combustion chamber is 5.75 in. in diameter. E. Goddard and G. Pendray, eds., *The Papers of Robert H. Goddard*, pp. 1036, 1666.

Nov. 10 Franklin D. Roosevelt issues a presidential order forbidding the latest-designed U.S. military and naval airplanes from being exported to foreign countries. *The Aeroplane*, Nov. 18, 1936, p. 633.

Nov. 17 Huiting Aviation is founded at Tientsin, China, as a part Chinese, part Japanese firm to help establish joint Chinese-Japanese air service between Dairen, Chinchow, Tientsin, Peking, Kalgan, and Johol City. The company, which has a Chinese president and a Japanese vice president, uses Japanese airplanes and pilots. The central government of Gen. Chiang Kai-Shek, at Nanking, is ignored in these dealings and has objected to the Japanese regularly flying over Chinese territory. *The Aeroplane*, Dec. 2, 1936, p. 725.

Nov. 18 Pilot Andre Japy establishes a new Paris-to-Hanoi record while en route to Tokyo in his Caudron Simoun. He arrives in Hanoi in 51 hr, greatly exceeding the previous mark of 140 hr. He is believed to have set an additional record by flying 2,200 mi. nonstop between Paris and Damascus in 14 hr. *Aero Digest*, December 1936, p. 69.

Nov. 18 Prince Alfonso of Bourbon-Orleans, a great grandson of Queen Victoria, is killed landing an airplane behind nationalist lines during the Spanish Civil War. Educated in England, he had been a member of the Coventry Aero Club since June 1935. Qualified as a pilot in August 1936, he had gone to Spain to join the insurgents in October. *The Aeroplane*, Nov. 25, 1936, p. 673.

And During November 1936

—Charles Lindbergh orders a Miles Mohawk, a well-equipped private aircraft for long-distance travel for his personal use now that he lives in Britain. Powering the Mohawk is a Menasco Buccaneer, supercharged to 250 hp, for fast high-level cruising. The four wing tanks give the plane a 2,000-mi. range. Dual controls are provided and may be quickly removed. The plane is also equipped for blind flying and has a homing radio set and an improved parachute flare. Floats may be fitted if required. *The Aeroplane*, Nov. 4, 1936, pp. 576, 577.

100 Years Ago, November 1911

Nov. 25 Britain achieves its first successful seaplane flight over Lake Windermere in Cumbria, England. The two-seater pusher biplane, built as a land plane by A.V. Roe, is a Curtiss-type machine powered by a 50-hp Gnome engine. First tested at Brooklands as a land plane, the aircraft is then taken to Lake Windermere for the use of E.W. Wakefield, who had formed the Lake Flying Co. There the craft is fitted with a single central float and named the Water Bird. It is first flown by the company's manager and only pilot, Stanley Adams, who received his flying certificate six months earlier. The Water Bird later becomes famous and makes many flights. *Flight*, Nov. 30, 1961, p. 857.

(Continued from page 19)

volving a Beechcraft corporate jet over Florida. The aircraft's engines flamed out and the pilots could not restart them, forcing them to glide to an emergency landing in Jacksonville.

Engineers began speculating openly about engine icing: "A change in the airflow's angle of incidence could cause any ice that had accreted on the leading edges of the stators to break away and would result in an engine surging or possibly flaming out," said Pratt & Whitney Canada in its contribution to the National Transportation Safety Board report on the Jacksonville incident. Pratt made the two JT15D-5 engines on the Beechcraft 400A jet.

Even before the Jacksonville and Shanghai incidents, some in the industry knew they had a problem. The Engine Harmonization Working Group, a committee of industry and government officials, counted about 70 loss-of-power incidents from 1988 to 2003. Engineers figure there have now been more than 100. The Jacksonville report cites scientific reports as far back as 1998 warning that "the blowoff" from the tops of storm clouds "can contain significant amounts of ice crystals, which can adversely affect turbine engine operation."

With new icing certification requirements on the way, the engine industry faces a conundrum. Despite years of speculation about high-altitude icing, industry does not have test facilities equipped to simulate those conditions. Engine manufacturers typically demonstrate the ice tolerance of their engines in sea level tests at their own sites, because the infrastructure required to simulate cruising altitudes would be complex and expensive to set up.

"We don't even know for sure yet whether a sea level simulation can take into account all the effects which are important to ice accretion at altitude," Mason emailed. "PSL will tell us: Can we simulate the conditions?"

On top of that, the PSL could become "a future facility where engine companies can demonstrate their engines are tolerant to the ice crystal environment defined" in the forthcoming FAA regulations, Mason said. The industry expects those regulations to be published in 2012.

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As much as anything, it is the uncharted territory represented by ice crystals that has captured the imagination of engineers. "It's very rare that you have a phenomenon you're looking at where you're almost starting from zero," Fuleki says. "This is an issue that a lot of people are really passionate about."

Ben Iannotta
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Aerospace Engineering Faculty
& Postdoctoral Positions
Khalifa University of Science, Technology & Research
Abu Dhabi, United Arab Emirates

The Department of Aerospace Engineering at Khalifa University is seeking candidates for faculty appointments at all levels. While exceptional candidates in any discipline relevant to aerospace engineering are sought, particular emphasis is for top candidates with background in one or more of the following areas: aerospace structures and materials, experimental aerodynamics, propulsion, atmospheric flight dynamics, spacecraft attitude dynamics and control, astrodynamics, air transportation and aerospace design. Also, the Department is seeking candidates for Post Doctoral Fellowships in each of the above mentioned areas.

Successful candidates will join the Department of Aerospace Engineering at KUSTAR, with potential for joint appointments in other units in the College of Engineering, and will pursue research through interdisciplinary. Faculty members will be expected to teach graduate and undergraduate courses, to supervise graduate students, and to initiate and lead funded research projects and teams.
Applicants must have earned a doctoral degree in Aerospace Engineering or a related field. All applicants must demonstrate a proven track record of, or high potential for, high-quality scientific research, as evidenced by their publication records and/or letters of recommendation. Faculty candidates must also demonstrate a clear commitment to education and to curricular development and innovation. Khalifa University offers highly competitive salary and benefits packages.

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For further information and to apply please visit our employment website at: http://khalifauniversity.peopleadmin.com/postings/227

AEROSPACE ENGINEERING AND MECHANICS
UNIVERSITY OF MINNESOTA

The Department of Aerospace Engineering and Mechanics seeks to fill one tenure-track position at the assistant professor level in the area of fluid mechanics. Applications are invited in all areas of fluids particularly those that complement the current research activities in the department, and bridge current and emerging fields.

Current research activities in the fluid mechanics area include turbulent flows, multiphase flows, micro-scale flows, computational fluid dynamics, rarefied flows, and high-temperature gas dynamics.

Successful candidates for the position will participate in all aspects of the department's mission, including teaching at the undergraduate and graduate levels, supervision of undergraduate and graduate students, service responsibilities, and will be expected to develop an independent, externally-funded research program. In particular, the candidates will be expected to teach aerospace engineering courses including service courses in mechanics and undergraduate and graduate courses in fluid mechanics.

Applicants must have an earned doctorate in a related field by the date of appointment. Experience beyond the doctorate degree is desirable. Although our focus will be at the rank of Assistant Professor, exceptional candidates will be considered at the rank of associate or full professor. It is anticipated that the appointment will begin fall 2012.

To apply for this position, candidates must go to http://www1.umn.edu/ohr/employment/index.html and search for requisition no. 168679. Please attach your letter of application, detailed resume, names and contact information of three references and a brief statement of teaching and research interests.

Application Deadline: The initial screening of applications will begin on December 1, 2011; applications will be accepted until the position is filled.

The University of Minnesota is an equal opportunity educator and employer.

The Department of Mechanical Engineering and Materials Science and Pratt School of Engineering at Duke University invite applications for a tenure-track faculty position in the broad area of controls to begin September 1, 2012 or earlier. Applicants working in the area of linear and nonlinear control, optimal control, adaptive control, stochastic control, estimation theory, and control applied to the field of robotics, automated manufacturing, autonomous vehicles, multi-agent systems, and energy systems will be well-suited to apply for this position. We anticipate hiring at the level of Assistant Professor, although truly exceptional candidates may be considered at the Associate or Full Professor level.Mechanical Engineering and Materials Science (MEMS) is one of four departments in the Pratt School of Engineering, an outstanding school within a world-class, top-ranked teaching and research university. The Department currently has 26 full-time faculty members and over 350 students pursuing B.S., M.S., or Ph.D. degrees in Mechanical Engineering and Materials Science. With average annual research expenditures of $6M, the Department was recently ranked 8th nationally for scholarlyproductivity of faculty by the Chronicle of Higher Education (2008). Areas of faculty specialization are: Aeroelasticity, Aerodynamics, Biomechanics, Computational Materials Science, Computational Mechanics, Controls, Energy, Intelligent Systems, Nonlinear Dynamics, Nanoscience, Robotics, Surface and Interface Science, Single Molecule Mechanics,Therapeutic Ultrasound,Thermodynamics and Heat Transfer, and Vibrations. The Department derives strength from cross-disciplinary collaborations in the Pratt School of Engineering, the School of Medicine, and throughout the university. Many MEMS faculty are active in thrust areas such as nanotechnology, bioengineering, and energy research, organized around Dukes hallmark interdisciplinary centers, including the Center for Bioinspired | Materials and Materials Systems (CBIMMS) and NSFs Engineering Research Center for the Environmental Implications of NanoTechnology (CEINT). The Pratt School is committed to the Departments continued growth and excellence, with several faculty hires in progress or planned.The successful candidate should have a track record of high quality scholarly research, and a clear plan to secure research funding. Once hired, the successful candidate is expected to establish a vibrant research program, obtain competitive external research funding,participate actively in teaching at both the undergraduate and graduate levels, and contribute through service to the welfare of the department.Applicants should submit their application packet containing a cover letter, complete curriculum vitae, a two-page statement of achievements in teaching and research, and names and addresses of five references to: http://www.mems.duke.edu/application-for-controls-faculty-position.

Applications received before January 1, 2012 will receive full consideration, but applications will continue to be accepted until the position is filled.Please note that the Pratt School is conducting two searches, one in controls per se and the other in mechanics and controls. Candidates should feel free to apply to either or both searches. If candidates who are presently or potentially part of a team wish to apply together to both searches that is also encouraged. The two searches and the search committees will be closely coordinated. Duke University and Health System is an equal opportunity institution. Duke is committed to recruiting, hiring, and promoting qualified minorities, women, individuals with disabilities, and veterans. If you have a disability requiring reasonable accommodations during the application process, please contact Disability Management Systems at 919-684-8247.

The Department of Civil and Environmental Engineering, the Department of Mechanical Engineering and Materials Science and the Pratt School of Engineering at Duke University invite applicants for a tenure track faculty position in the areas of mechanics and controls to begin September 2012 or earlier. Applicants whose work relates to the areas of adaptive control, stochastic dynamics, or computational simulation with application to nonlinear materials or energy systems are well suited to apply for this position. We anticipate hiring at the Assistant Professor level, although truly exceptional candidates may be suitable at the Associate of Full Professor level. Successful candidates will have a record of high quality scholarly research and a clear plan to secure research funding. Once hired, the successful candidate is expected to establish a vibrant research program, obtain competitive external funding, participate actively in teaching at both the undergraduate and graduate levels, and contribute through service to the welfare of the department. Applicants should submit their application packet containing a cover letter, complete curriculum vitae, a two-page statement of achievements in teaching and research, and names and addresses of five references to: http://www.cee.duke.edu/faculty-position.

Applications received before January 1, 2012 will receive full consideration, but applications will continue to be accepted until the position is filled. Please note that the Pratt School is conducting two searches, one in controls per se and the other in mechanics and controls. See both ads in this publication. Candidates should feel free to apply to either or both searches. If candidates who are presently or potentially part of a team wish to apply together to both searches that is also encouraged. The two searches and the search committees will be closely coordinated. Duke University is an equal opportunity institution. Duke is committed to recruiting, hiring and promoting qualified minorities, women, individuals with disabilities, and veterans. If you have a disability requiring reasonable accommodations during the application process, please contact Disability Management Systems at 919-684-8247.

Sr. Fluid Dynamicist (Physicist)

Position available at FloDesign Wind Turbine Corp. in Wilbraham, MA. Provide innovative solutions to enhance the efficiency and timely development of wind turbines. Responsible for performing analytical modeling of advanced fluid mechanics utilizing multiple Computational Fluid Dynamics (CFD) codes and engineering modeling tools. Perform fluid dynamic analysis utilizing analytical methods, testing, and CFD to support mixer ejector wind turbine design and certification. Send applications to: HRS/Mass Associates, P.O. Box 100, Wilbraham, MA 01095-0100

THE UNIVERSITY OF TEXAS AT AUSTIN
Cockrell School
Aerospace Engineering and Engineering Mechanics

THE DEPARTMENT OF AEROSPACE ENGINEERING & ENGINEERING MECHANICS AT THE UNIVERSITY OF TEXAS AT AUSTIN is hiring two positions in the area of Guidance, Navigation, and Control with a start date of September 2012. We seek applicants who will provide leadership, develop innovative courses, and perform research in promising new topics in control and estimation. We invite applications from qualified candidates for the following positions.

One Tenured Position in Guidance, Navigation, and Control (senior Associate Professor or Full Professor).

- Research topics may include, but are not limited to: advanced estimation, hybrid control, multi-vehicle control, autonomous systems, and cyber-physical systems, with applications to manned and unmanned aerospace vehicles.
- Applicants for this position are expected to have a doctoral degree in engineering or equivalent and to have an established extramurally-funded research program, with a strong publication record and excellence in teaching.

This is a leadership position within the area of Guidance, Navigation, and Control. The successful candidate for this position is expected to supervise graduate students, teach undergraduate and graduate courses, develop and maintain strong broad-based sponsored research programs, collaborate with other faculty, and be involved in service to the university and the engineering profession. Applications received by December 31, 2011 are assured full consideration, but the search will continue until this position is filled. To apply submit an application online at http://www.ae.utexas.edu/facultyjobs; only complete applications will be considered. The University of Texas at Austin is an affirmative action, equal opportunity employer. For more information about The Department of Aerospace Engineering and Engineering Mechanics, please visit http://www.ae.utexas.edu. This position has been designated as security-sensitive, and a criminal background check will be conducted on the applicants selected.

The details of the second position are as follows:

One Tenure-Track Position in the area of Guidance, Navigation, and Control (Assistant Professor)

- We are looking for a candidate with interests that may include, but are not limited to: estimation and control of large multi-scale systems with uncertainty and information theoretic measures for design and analysis of complex aerospace systems.
- Applicants for this position should have received, or expect to receive a doctoral degree in engineering or equivalent prior to September 2012.

The successful candidate for this position is expected to supervise graduate students, teach undergraduate and graduate courses, develop sponsored research programs, collaborate with other faculty, and be involved in service to the university and the engineering profession. Applications received by December 31, 2011 are assured full consideration, but the search will continue until this position is filled. To apply submit an application online at http://www.ae.utexas.edu/facultyjobs; only complete applications will be considered. The University of Texas at Austin is an affirmative action, equal opportunity employer. For more information about The Department of Aerospace Engineering and Engineering Mechanics, please visit http://www.ae.utexas.edu This position has been designated as security-sensitive, and a criminal background check will be conducted on the applicants selected.

THE UNIVERSITY OF ALABAMA

DEPARTMENT OF AEROSPACE ENGINEERING AND MECHANICS

Seeks applications for multiple faculty positions at all ranks

The Department of Aerospace Engineering and Mechanics at The University of Alabama invites applications for four tenure-track faculty positions. Areas of interest include, but are not limited to, computational and experimental structural and solid mechanics, advanced composites and nanomaterials, experimental and computational fluid mechanics, and flight dynamics and controls with a particular focus related to MAVs, UAVs and bio-inspired designs. Successful candidates at the Associate and Full Professor levels must have a strong record of scholarly research with a proven record of extramural funding as well as the capability to advise undergraduate and graduate student research. Candidates at the tenure-track level must demonstrate a clear potential to successfully pursue and attain grants from external funding sources. An ability to collaborate with existing faculty, both within the Department and the College of Engineering, in the key focus areas is also highly desirable.

Applicants must have an earned doctorate in aerospace engineering, engineering mechanics or a closely related field. Appointments will be at the assistant, associate or full professor level, depending on qualifications. Applicants are to submit a resume, teaching interests, a statement of research with future goals and a list of at least three references as soon as possible. Successful candidates will begin employment in 2012. Review of applications will begin immediately and continue until the positions are filled. Electronic submission of application materials via The University of Alabama employment website is required (facultyjobs.ua.edu, requisition number 0806099). For additional information regarding The University of Alabama, the Department of Aerospace Engineering and Mechanics, or this search, please contact **Dr. Mark Barkey, Professor, Department of Aerospace Engineering and Mechanics, mbarkey@eng.ua.edu.**

The University of Alabama, including the College of Engineering, is experiencing unparalleled growth and prosperity. Enrollment has increased by 50% in the last 7 years to over 31,000 students. Two new engineering buildings are currently under construction, including a $5 million structural and materials testing laboratory. The Department of Aerospace Engineering and Mechanics offers an ABET-accredited BS program in aerospace engineering, and MS and PhD degrees in aerospace engineering and mechanics (including an online MS degree program and an alternative residency PhD). Additionally, The University of Alabama has recently joined with Auburn University and The University of Alabama-Huntsville as part of the Aerospace Consortium of Alabama to foster and enhance collaboration, teach joint graduate-level courses and better serve the state and its growing aerospace industry. State-of-the-art facilities include high and low-speed wind tunnels, a water tunnel, as well as advanced composites manufacturing and structural testing laboratories.

The University of Alabama is located on a beautiful 1,000 acre residential campus in Tuscaloosa, a dynamic and resilient community of 90,000 in central Alabama. Tuscaloosa is conveniently located between Atlanta, New Orleans and the Gulf Coast. The area offers excellent climate, minimal urban congestion, and abundant outdoor recreation. The Tuscaloosa community provides rich cultural, educational, and athletic activities for a broad range of lifestyles. More information can be found at www.ua.edu and www.ci.tuscaloosa.al.us.

The University of Alabama is an equal opportunity affirmative action, Title IX, Section 504, ADA employer. Women and minorities are encouraged to apply. Salary is competitive and commensurate with experience level.

The Department of Mechanical Engineering at the University of Wyoming invites applications for a tenure-track faculty position at the Assistant Professor level in the area of **computational fluid dynamics.** The successful applicant will be expected to establish a strong, externally funded research program, and to teach at both the undergraduate and graduate levels. Minimum qualifications include an earned doctorate in mechanical or aerospace engineering or a closely related field. The Department of Mechanical Engineering has 14 full-time faculty members, 300 undergraduate and 45 graduate students. Excellent computational facilities are available through department and campus managed HPC hardware, as well as the Wyoming-NCAR Petaflops Center, located in Wyoming, and managed in collaboration with NCAR in Boulder CO. The successful candidate will benefit from collaborative opportunities with our Wind Energy Research Center, opportunities in other energy related fields through the School of Energy Resources, and through our partnership with the Vertical Lift Rotorcraft Center of Excellence, led by the University of Maryland.

Applications must include: a curriculum vitae, a narrative describing research goals and plans, a description of teaching approaches and objectives, and contact information for at least three professional references. Application reviews will begin on January 15th, 2012 and will continue until the position is filled. Applications should be sent electronically to ME.fac.position@uwyo.edu

The University of Wyoming adheres to the principles of equal employment opportunity and diversity and welcomes applications from qualified individuals, independent of race, color, religion, sex, national origin, disability, age, veteran status, sexual orientation or political belief. We welcome applications from diverse groups, including women and people of color, and international candidates.

Massachusetts Institute of Technology

Come work with us!

Faculty Positions

Department of Aeronautics and Astronautics

The Department of Aeronautics and Astronautics is seeking applicants for tenure track faculty positions with potential starts in September 2012. Department programs encompass aircraft, spacecraft, transportation, information, and communication systems. We are searching for exceptional candidates in any discipline relevant to aerospace. We are particularly interested in identifying top candidates in the following areas: aerospace materials and structures, autonomous systems, aircraft propulsion, and air transportation. Our goal is to hire candidates who have deep expertise in one or more core disciplines, and who have the potential and intellectual flexibility to become world leaders through integration of these disciplines to define and address new opportunities. Faculty duties include teaching at the graduate and undergraduate levels, research, and supervision of student research. Further information on this search and the Department may be found at http://web.mit.edu/aeroastro/about/jobs.html.

Candidates should hold a Ph.D. in Aeronautics and Astronautics or a related field by the beginning of the appointment period. The search is for the Assistant Professor level, but qualified candidates at all levels will be considered.

Applications must be submitted in PDF format online at https://facsearch.mit.edu. Applicants must submit a cover letter, a curriculum vitae, a 2-3 page statement of research and teaching interests and goals, and the names and contact information of at least three individuals who will provide letters of recommendation. Applicants should request that letters of recommendation be submitted online at https://facsearch.mit.edu directly by the recommenders. Applications should be addressed to: Professor Steven R. Hall, Chair, Faculty Search Committee, MIT Department of Aeronautics and Astronautics. Applications will be considered complete when both the applicant materials and at least three letters of recommendation are received. Applicants are encouraged to apply by December 15, 2011.

MIT is an Affirmative Action/Equal Employment Opportunity employer. Women and underrepresented minorities are encouraged to apply.

http://web.mit.edu

POSITION ANNOUNCEMENT

PROFESSOR AND HEAD, SCHOOL OF MECHANICAL AND AEROSPACE ENGINEERING

OKLAHOMA STATE UNIVERSITY

The College of Engineering, Architecture and Technology at Oklahoma State University (OSU) seeks nominations and applications for the position of Professor and Head of the School of Mechanical and Aerospace Engineering (MAE). Candidates are sought who have: an earned doctorate and national reputation in mechanical or aerospace engineering, or a closely related field; an earned bachelor's degree in mechanical or aerospace engineering from an ABET accredited or equivalent program; a distinguished record of teaching and research in an appropriate area of mechanical or aerospace engineering; a strong record of externally funded research; a strong interest in educational programs at both the undergraduate and graduate levels; a record of participation in professional societies and interaction with industry; demonstrated intellectual leadership; strong administrative and financial management abilities; and strong communication and interpersonal skills. The successful candidate must qualify for appointment as a tenured Professor of Mechanical and Aerospace Engineering.

The School of MAE has 25 faculty members, with 950 B.S., 130 M.S., and 55 PhD students, with operations in both Stillwater and Tulsa, OK, together with excellent teaching and research facilities at both locations. Active research programs are conducted in: aerodynamics, aeroservoelasticity, biomedical engineering, computer vision and pattern recognition, heat transfer, dynamic systems and controls, fluid mechanics, materials, manufacturing processes, refrigeration, solid mechanics, thermal and HVAC systems, unmanned aerial systems, and web handling systems.

Screening of applications will begin December 1, 2011 and continue until the position is filled. Target starting date is July 1, 2012. Applicants should send electronically a letter of application, curriculum vitae, list of five references, and a statement of capabilities, qualifications, and interests to: Chair, MAE Head Search Committee, School of Mechanical and Aerospace Engineering, 218 Engineering North, Oklahoma State University, Stillwater, OK 74078-0545. Women and minority applicants are strongly encouraged. OSU is an equal opportunity/affirmative action employer. More detailed information about the School and OSU can be found at: www.mae.okstate.edu.

UC SAN DIEGO
DEPARTMENT OF STRUCTURAL ENGINEERING

Description: The Department of Structural Engineering (http://structures.ucsd.edu) is committed to academic excellence and diversity within the faculty, staff, and student body. The department is seeking outstanding candidates in the area of *Aviation Safety of Composite Structures*. Particular emphasis should be on the full-scale behavior and failure of composite structures, structure design, composites processing, crashworthiness and survivability, static and dynamic large-scale testing, bonded and bolted connections, buckling and stability, and damage tolerance. The successful candidate must hold a doctorate or equivalent degree, demonstrate high-quality research and teaching potential, and is expected to develop a strong externally funded research program. Major large-scale experimentation resources are available via the Structural Engineering Department's Charles Lee Powell Laboratories and Englekirk Center. Additional facility space for fabrication, characterization, and testing of full-scale composite aircraft structures is expected via the new Structural and Materials Engineering Building, currently under construction.

The Department of Structural Engineering offers undergraduate and graduate degrees in structural engineering and emphasizes cross-disciplinary research in aerospace, civil, mechanical, and marine structures. Current related research activities include impact damage of large composite structures, full-scale FAA-certified qualification testing, aircraft ground vibration testing, development of long-range unmanned air vehicles (UAV's), NDE, structural health monitoring and damage prognosis in next-generation aircraft, composite ducted fan blade research, computational mechanics, advanced material structural rehabilitation, explosive blast loading, and innovative nano-materials.

In addition to having demonstrated the highest standards of scholarship and professional activity, the preferred candidates will have experience or demonstrated contributions to a climate that supports equity, inclusion and diversity. Applicants are asked to submit a summary of their past or potential contributions to diversity in their personal statement.

For applicants with interest in spousal/partner employment, please see the website for the UCSD Partner Opportunities Program: (http://academicaffairs.ucsd.edu/aps/partneropp)

Level of appointment will be commensurate with qualifications and experience.

Salary: Salary will be commensurate with qualifications within the University of California published pay scales.

Closing Date: Review of applications will begin November 1, 2011, and will continue until the position is filled.

To Apply: Please upload: 1) a personal statement summarizing teaching experience and interests, leadership efforts and contributions to diversity; and 2) a resume with complete publication list, and names/e-mail contact information of four professional references to: (https://apol-recruit.ucsd.edu/apply).

Apply to the following posted position:

STRUCTURAL SYSTEM FACILITY
Assistant, Associate, or Full Professor (10-303) - Aviation Safety of Composite Structures.

UCSD is an Affirmative Action/Equal Opportunity Employer with a strong institutional commitment to excellence through diversity.

OLD DOMINION UNIVERSITY

Assistant/Associate Professor in Structural Mechanics / Composite Structures & Materials

The Department of Mechanical and Aerospace Engineering at Old Dominion University invites applications for a tenure-track faculty position in structural mechanics, emphasizing composite structures and materials, at the Assistant/Associate Professor level. Candidates should have a Ph.D. degree in Aerospace, Mechanical, or a related engineering field. At the Associate Professor level, substantial post-doctoral experience, either in academia, research, or industry is expected. Successful candidates will be expected to support the Department's academic and research activities, particularly its core programs in aerospace engineering; to develop nationally recognized research programs; mentor graduate students; contribute to instruction within the existing curricula and to develop new courses in their specialty areas. Collaborative work with the National Institute of Aerospace and NASA Langley Research Center will be strongly encouraged. The Department of Mechanical and Aerospace Engineering emphasizes graduate instruction and research as well as a strong undergraduate program; further information can be found at: http://www.eng.odu.edu/mae/

Please forward a letter of application; curriculum vita, including a list of publications, statement of teaching philosophy, statement of research interests/plans, and contact information for three references to the head of the search committee: Dr. Colin P. Britcher, ECSB 1307, Mechanical and Aerospace Engineering, Old Dominion University, Norfolk, VA 23529. Or e-mail to: britcher@aero.odu.edu. Screening of applicants will begin November 15th and continue until the position is filled, with an anticipated appointment effective no later than August 2012.

Old Dominion University is an equal opportunity, affirmative action institution and requires compliance with the Immigration Reform and Control Act of 1986.

Department of Mechanical and Aerospace Engineering

The Department of Mechanical and Aerospace Engineering (MAE) at the University of Florida invites applicants for two tenure-track/tenured faculty positions at the rank of Assistant Professor or Associate Professor in the areas of advanced manufacturing and aerospace engineering. For the advanced manufacturing position, the successful applicant will complement existing research efforts in state-of-the-art precision manufacturing at UF. Potential areas of specialization include rapid manufacturing of advanced materials, precision manufacturing, synthesis and fabrication of novel surfaces and coatings, energy-efficient manufacturing, nanomaterials, and nano-/bio-manufacturing. For the aerospace position, the successful applicant will complement existing research efforts in aerodynamics, flight mechanics, structures, controls, propulsion and design at UF. Applicants whose research program is complementary to teaching interests in aerospace design along with aeronautic/hydronautic/space systems are particularly encouraged to apply. Applicants must have a Ph.D. in mechanical or aerospace engineering or a related field. Successful applicants will be expected to be an effective teacher at undergraduate and graduate levels, and to build a vibrant externally-funded research program.

The MAE Department currently has 50 faculty members, over 400 graduate students, and annual expenditures in excess of $20 million. Persons joining the Department will find outstanding facilities, a collaborative and collegial work environment, and a strong dedication to diversity and excellence in research and education. Potential applicants seeking more information are encouraged to visit our website at http://www.mae.ufl.edu.

Candidates should submit applications electronically to Prof. Renwei Mei, Search Committee Chair, at maesearch@mae.ufl.edu. Applications should include: 1) a cover letter mentioning the specific area, and briefly outlining the candidate's qualifications, research and educational interests, 3-5 year research plan, and potential collaborative activities; 2) a detailed resume; and 3) the names and full contact information for at least four references. Candidates at the Assistant Professor level should also include a 3-5 year teaching plan. The search committee will begin screening of applicants on October 1, 2011, and will continue to accept applications until all positions are filled. The University of Florida is dedicated to building a culturally diverse faculty and staff. We strongly encourage minorities, women, and members of other under-represented groups to apply. The University of Florida is an Equal Opportunity Employer.

Department of Aerospace Engineering
College of 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 full-time faculty positions beginning August 16, 2012 in the following areas:

Professor (Open Rank) – Computational Fluid Mechanics
The Department seeks exceptional candidates for a tenure-track or tenured faculty position with expertise in the fundamental science and engineering of computational fluid mechanics. All areas of specialization will be considered, including: high and/or low-speed flows, reacting and multiphase flows, combustion, propulsion, and computational aerodynamics of large and/or small vehicles. Outstanding candidates with expertise in other aspects of fluid mechanics will also be considered.

Professor (Open Rank) – Space Systems
The Department seeks exceptional candidates for a tenure-track or tenured faculty position in the general area of Space Systems, with particular emphasis given to the disciplines of navigation and guidance, space robotics, orbital mechanics, attitude dynamics and control, spacecraft systems and design, multidisciplinary optimization, space propulsion, space structures, and space communications. Outstanding candidates with expertise in other aspects of Space Systems research will also be considered and are encouraged to apply.

Please visit http://jobs.illinois.edu to view the complete position announcement and application instructions for these 2 positions. For full consideration, applications should be received by November 18, 2011, but applications will be accepted until the positions are filled.

Illinois is an AA-EOE. www.inclusiveillinois.illinois.edu

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

AIAA Bulletin

On 27–28 September, three of the STS-135 crew visited the SPACE Conference in Long Beach, CA, and participated in the Welcome Reception, Education Alley, the Awards Luncheon, media roundtable, and the Exhibit Hall presentations. From left to right: Commander Christopher Ferguson, Mission Specialist Rex Walheim, and Mission Specialist Sandra Magnus.

NOVEMBER 2011

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* Also accessible via Internet. Use the formula first name last initial@aiaa.org. Example: megans@aiaa.org.
† U.S. only. International callers should use 703/264-7500.

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

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

Meeting Schedule

DATE	MEETING (Issue of *AIAA Bulletin* in which program appears)	LOCATION	CALL FOR PAPERS (*Bulletin* in which Call for Papers appears)	ABSTRACT DEADLINE
2011				
2–4 Nov†	**6th International Conference "Supply on the Wings"**	Frankfurt, Germany Contact: Prof. Dr. Richard Degenhardt, +49 531 295 3059; richard.degenhardt@dlr.de; www.airtec.aero	*Feb 11*	**31 Mar 11**
28 Nov–1 Dec†	**Japan Forum on Satellite Communications (JFSC) and 29th AIAA International Communication Satellite Systems Conference (ICSSC)**	Nara, Japan Contact: http://www.ilcc.com/icssc2011		
2012				
9–12 Jan	**50th AIAA Aerospace Sciences Meeting Including the New Horizons Forum and Aerospace Exposition**	Nashville, TN	*Jan 11*	**1 Jun 11**
23–26 Jan†	**The Annual Reliability and Maintainability Symposium (RAMS)**	Reno, NV (Contact: Patrick M. Dallosta, patrick.dallosta@dau.mil; www.rams.org)		
24–26 Jan	**AIAA Strategic and Tactical Missile Systems Conference** **AIAA Missile Sciences Conference** (Oct) **(SECRET/U.S. ONLY)**	Monterey, CA	*Jun 11*	**30 Jun 11**
29 Jan–2 Feb†	**22nd AAS/AIAA Space Flight Mechanics Meeting**	Charleston, SC Contact: Keith Jenkins, 480.390.6179; keith@jenkinspatentlaw.com; www.space-flight.org	*Apr 11*	**3 Oct 11**
3–10 Mar†	**2012 IEEE Aerospace Conference**,	Big Sky, Montana Contact: David Woerner, 626.497.8451; dwoerner@ieee.org; www.aeroconf.org		
21–23 Mar†	**Nuclear and Emerging Technologies for Space 2012 (NETS-2012) held in conjunction with the 2012 Lunar & Planetary Sciences Conference**	The Woodlands, TX Contact: Shannon Bragg-Sitton, 208.526.2367, shannon.bragg-sitton@inl.gov, http://anstd.ans.org/NETS2012.html		
26–28 Mar†	**3AF 47th International Symposium of Applied Aerodynamics**	Paris, France (Contact: Anne Venables, 33 1 56 64 12 30, secr.exec@aaaf.asso.fr, www.aaaf.asso.fr)		
23–26 Apr	**53rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference** **20th AIAA/ASME/AHS Adaptive Structures Conference** **14th AIAA Non-Deterministic Approaches Conference** **13th AIAA Gossamer Systems Forum** **8th AIAA Multidisciplinary Design Optimization Specialist Conference**	Honolulu, HI	*Apr 11*	**10 Aug 11**
14–18 May†	**12th Spacecraft Charging Technology Conference**	Kitakyushu, Japan Contact: Mengu Cho, +81 93 884 3228, cho@ele.kyutech.ac.jp, http://laseine.ele.kyutech.ac.jp/12thsctc.html		
22–24 May	**Global Space Exploration Conference (GLEX)**	Washington, DC	*Oct 11*	**1 Dec 11**
4–6 Jun	**18th AIAA/CEAS Aeroacoustics Conference (33rd AIAA Aeroacoustics Conference)**	Colorado Springs, CO	*Jun 11*	**9 Nov 11**
4–6 Jun†	**19th St Petersburg International Conference on Integrated Navigation Systems**	St. Petersburg, Russia Contact: Prof. V. Peshekhonov, +7 812 238 8210, elprib@online.ru, www.elektropribor.spb.ru		
18–20 Jun†	**3rd International Air Transport and Operations Symposium (ATOS) and 6th International Meeting for Aviation Product Support Process (IMAPP)**	Delft, the Netherlands Contact: Adel Ghobbar, 31 15 27 85346, a.a.ghobbar@tudelft.nl, www.lr.tudelft.nl/atos		
19–21 Jun	**AIAA Infotech@Aerospace Conference**	Garden Grove, CA	*Jun 11*	**21 Nov 11**
25–28 Jun	**28th Aerodynamics Measurement Technology, Ground Testing, and Flight Testing Conferences including the Aerospace T&E Days Forum** **30th AIAA Applied Aerodynamics Conference** **4th AIAA Atmospheric Space Environments Conference** **6th AIAA Flow Control Conference** **42nd AIAA Fluid Dynamics Conference and Exhibit** **43rd AIAA Plasmadynamics and Lasers Conference** **44th AIAA Thermophysics Conference**	New Orleans, LA	*Jun 11*	**17 Nov 11**

DATE	MEETING (Issue of *AIAA Bulletin* in which program appears)	LOCATION	CALL FOR PAPERS (*Bulletin* in which Call for Papers appears)	ABSTRACT DEADLINE
27–29 Jun†	**American Control Conference**	Montreal, Quebec, Canada Contact: Tariq Samad, 763.954.6349, tariq.samad@ honeywell.com, http://a2c2.ort/conferences/acc2012		
11–14 Jul†	**ICNPAA 2012 – Mathematical Problems in Engineering, Aerospace and Sciences**	Vienna, Austria Contact: Prof. Seenith Sivasundaram, 386/761-9829, seenithi@aol.com, www.icnpaa.com		
14–22 Jul	**39th Scientific Assembly of the Committee on Space Research and Associated Events (COSPAR 2012)**	Mysore, India Contact: http://www.cospar-assembly.org		
15–19 Jul	**42nd International Conference on Environmental Systems (ICES)**	San Diego, CA	*Jul/Aug 11*	**15 Nov 11**
30 Jul–1 Aug	**48th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit** **Future Propulsion: Innovative, Affordable, Sustainable**	Atlanta, GA	*Jul/Aug 11*	**21 Nov 11**
30 Jul–1 Aug	**10th International Energy Conversion Engineering Conference (IECEC)**	Atlanta, GA	*Jul/Aug 11*	**21 Nov 11**
13–16 Aug	**AIAA Guidance, Navigation, and Control Conference** **AIAA Atmospheric Flight Mechanics Conference** **AIAA Modeling and Simulation Technologies Conference** **AIAA/AAS Astrodynamics Specialist Conference**	Minneapolis, MN	*Jul/Aug 11*	**19 Jan 12**
11–13 Sep	**AIAA SPACE 2012 Conference & Exposition**	Pasadena, CA	*Sep 11*	**26 Jan 12**
11–13 Sep	**AIAA Systems Development, Integration, and Test Conference**	Pasadena, CA		
17–19 Sep	**12th AIAA Aviation Technology, Integration, and Operations (ATIO) Conference** **14th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference**	Indianapolis, IN	*Oct 11*	**7 Feb 12**
23–28 Sep†	**28th Congress of the International Council of the Aeronautical Sciences**	Brisbane, Australia Contact: http://www.icas2012.com		**15 Jul 11**
24–27 Sep†	**30th AIAA International Communications Satellite Systems Conference (ICSSC) and** **18th Ka and Broadband Communications, Navigation and Earth Observation Conference**	Ottawa, Ontario, Canada Contact: Frank Gargione, frankgargione3@msn.com; www.kaconf.org	*Nov 11*	**31 Mar 12**
24–28 Sep	**7th AIAA Biennial National Forum on Weapon System Effectiveness**	Ft. Walton Beach, FL	*Nov 11*	**15 Mar 12**
1–5 Oct	**63rd International Astronautical Congress**	Naples, Italy (Contact: www. iafastro.org)		
2013				
7–10 Jan	**51st AIAA Aerospace Sciences Meeting** **Including the New Horizons Forum and Aerospace Exposition**	Dallas/Ft. Worth, TX		

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

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

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

DATE	COURSE	VENUE	LOCATION
2012			
7–8 Jan	**CFD for Combustion Modeling**	ASM Meeting	Nashville, TN
7–8 Jan	**Concepts in the Modern Design of Experiments**	ASM Meeting	Nashville, TN
7–8 Jan	**Fluid Structure Interaction**	ASM Meeting	Nashville, TN
7–8 Jan	**Sustainable (Green) Aviation**	ASM Meeting	Nashville, TN
7–8 Jan	**Systems Requirements Engineering**	ASM Meeting	Nashville, TN
7–8 Jan	**Modeling Flight Dynamics with Tensors**	ASM Meeting	Nashville, TN
7–8 Jan	**Best Practices in Wind Tunnel Testing**	ASM Meeting	Nashville, TN
22–23 Jan	**Missile Design and System Engineering**	StratTac Conference	Monterey, CA

**Courses subject to change*

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

From the Corner Office

AIAA'S IT UPGRADES

It seems like every year around this time I'm writing about new IT applications or upgrades. This year is no different, and you've provided plenty of feedback on things that we should address. By far, at the top of the hit parade is the Web site—and that's one of two AIAA's major IT efforts that are underway: the basic aiaa.org Web site and our eLibrary.

The intent with the new eLibrary Web site is to provide a much simpler and rapid interface to the Institute's enormous collection of books, journals, standards, and conference technical publications that now have all been digitized. Our partner is Atypon, an industry leader in that area. As Mike Bragg, our Vice President (Publications) recently stated: "The new platform guarantees that when the highest quality aerospace technical information is needed, it will always be right at the researcher's fingertips, be it through their desktop, laptop, or handheld."

Besides archiving all of our technical publications, the system will have a much improved search capability and all the modern download, alert, suggestions about articles and "other items of interest," and other capabilities found on state-of-the-art sites. The new site is scheduled to come on-line in the first half of 2012.

The other activity, impacting almost all of our membership and many beyond the AIAA family, is the total replacement of the **www.aiaa.org** Web site and its related shopping cart. We've nibbled at pieces of the Web site: fielded several "improvements" to such things as Membership Upgrade and Honors and Awards nominations, changed the overall look, added videos and advertising—but these were all Band-Aids. What was needed was a total rebuild of the Web site, and that's what is underway.

Web sites don't stand alone. Much of their content is drawn from databases, and that's the case for us. Our basic source will be netFORUM, our relatively new Association Management System. However, we continue to find elements of our old home-grown system (called RUFIS) in many of the linkages in the back-end of the Web site. Unfortunately, that means that the new Web site can't simply interface with netFORUM—which makes the problem more complicated.

On the application development side of the project, we have found that while many of our member-related processes are similar, they have evolved to be slightly different and require more of a tailored development approach. For example, the nomination and selection of Fellows, Associate Fellows, Honors and Awards recipients, Service Awards, and even elections follow a similar sequence on the surface: request for nominations, nominations, distribution of information to those who select, voting, and confirmation of the results. However, a deeper dive revealed a common software module won't get us all the way there. The project complexity continues as we look at integration points between the eLibrary and new Web site, such as the shopping cart. We know that Web users have come to expect an Amazon-like experience, and we are working to deliver it.

Writing this in late September for the November *AIAA Bulletin*, I had hoped to be able to brag a little about the new Web site that you would have already seen rolled out, but "not so fast, Dickman." Our target for the roll-out has slipped to December—as with every software thing we've done, there are a lot more complexities than we realized. The full functionality of the Web site won't happen for some time after that; we had always intended to prioritize the work and deliver it in increments. For example, the various nomination processes must be fully functional and tested before the planned opening of the specific nominations, and they tend to be phased over several months.

While I don't know exactly when you will see it, everything that's been going on with the various firms and staff teams working on this project reinforces my confidence that it will be a great change and one that many of you have spoken to me or our volunteer leadership about. So although it's taken awhile, we really have been listening. And we've also taken action. It has taken longer than planned, but we're almost into the final countdown. We're almost there, and it'll be worth it!

On 28 September, the following awards were presented at the SPACE Conference in Long Beach, CA. From left to right: Basil Hassan, Vice President, TAC (presenting the awards); Sustained Service Award: Guy Jette, AFRL (Retired); Space Robotics and Automation Award: Takahisa Sato, JAXA, and Mitsushige Oda, JAXA; Space Operations and Support Award: Junichiro Kawaguchi, JAXA; Space Systems Award: AFRL TacSat-3 Team, award accepted by Tom Cooley; Trevor Sorensen, Director, Space & Missiles; and Sustained Service Award: Peter Kurzhals, The Boeing Company.

Staff Sergeant Trevor Groves; Dr. Brian Dailey, AIAA President; The Honorable Michael Vickers, Under Secretary of Defense for Intelligence, Department of Defense; Ms. Stephanie O'Sullivan, Principal Deputy Director of National Intelligence; Singer Lee Ann Womack; Mr. Bruce Carlson, Director, National Reconnaissance Office; Dr. Peter Jakab, Associate Director for Collections and Curatorial Affairs, National Air and Space Museum; Mr. Robert Dickman, AIAA Executive Director; Technical Sergeant Joanne Moniz.

NRO ANNIVERSARY GALA

For more than half a century, the pioneering and innovative efforts of the men and women of the National Reconnaissance Office (NRO), along with industry and partners, have provided the Intelligence Community, warfighters, and government leaders with the critical and timely information required to make decisions that saved lives and preserved our national security. On 17 September 2011, AIAA took great pride in organizing the NRO 50th Anniversary Gala to commemorate the relentless pursuit of "Vigilance from Above" and to salute the organization, its workforce, alumni, and partners for all of their outstanding efforts.

PRESIDENT OBAMA HONORS NATION'S TOP SCIENTISTS AND INNOVATORS

In September, President Obama named seven eminent researchers as recipients of the National Medal of Science and five inventors as recipients of the National Medal of Technology and Innovation, the highest honors bestowed by the U.S. government on scientists, engineers, and inventors. The recipients will receive their awards at a White House ceremony later this year.

Three of the National Medal of Technology and Innovation honorees are AIAA members. The National Medal of Technology and Innovation was created by statute in 1980 and is administered for the White House by the U.S. Department of Commerce's Patent and Trademark Office. The award recognizes those who have made lasting contributions to America's competitiveness and quality of life and helped strengthen the Nation's technological workforce. Nominees are selected by a distinguished independent committee representing the private and public sectors.

The AIAA members who were recipients of this year's National Medal of Technology and Innovation are:

Rakesh Agrawal, Purdue University (AIAA Fellow)
For an extraordinary record of innovations in improving the energy efficiency and reducing the cost of gas liquefaction and separation. These innovations have had significant positive impacts on electronic device manufacturing, liquefied gas production, and the supply of industrial gases for diverse industries.

C. Donald Bateman, Honeywell (AIAA Member)
For developing and championing critical flight-safety sensors now used by aircraft worldwide, including ground proximity warning systems and wind-shear detection systems.

Yvonne C. Brill, RCA Astro Electronics (Retired) (AIAA Honorary Fellow)
For innovation in rocket propulsion systems for geosynchronous and low Earth orbit communication satellites, which greatly improved the effectiveness of space propulsion systems.

ORBITAL'S DAVID W. THOMPSON RECEIVES THE 2011 INTERNATIONAL VON KÁRMÁN WINGS

David W. Thompson, Orbital's co-founder, Chairman, and Chief Executive Officer, has been awarded the 2011 International Von Kármán Wings Award by the Aerospace Historical Society (AHS) and the Graduate Aerospace Laboratories of the California Institute of Technology (GALCIT). The award was presented to Mr. Thompson for his leadership of Orbital over the past three decades, which has pioneered new classes of rockets and satellites that have helped to make space applications more affordable and accessible to people and enterprises around the world.

Each year, the von Kármán Wings Award acknowledges an individual who has made outstanding contributions to the aerospace community over a sustained period of time as a pioneer, innovator, and leader. For the past 26 years, the AHS has been dedicated to the preservation of the history and achievements of the aerospace industry and those individuals who helped shape its destiny.

"It is an honor for GALCIT and the Aerospace Historical Society to give the International Von Kármán Wings Award to Dave Thompson, whose pioneering work with Orbital continues to transform the space industry," said Dr. G. Ravi Ravichandran, chair of the AHS, director of GALCIT, and the John E. Goode, Jr., Professor of Aerospace and Mechanical Engineering at Caltech. Professor Ravichandran presented the International von Kármán Wings Award to Mr. Thompson at a gala banquet and awards ceremony on 29 September on the Caltech campus in Pasadena.

Previous recipients of the Wings Award include Joanne Maguire of Lockheed Martin Space Systems Company; Abdul Kalam, the former President of India; Yannick d'Escatha, Chairman and CEO of the French space agency, Centre National d'Études Spatiales; Alexis Livanos, Chief Technology Officer of Northrop Grumman; Charles Elachi, Director of the NASA Jet Propulsion Laboratory (JPL); Kent Kresa, former Chairman and CEO of Northrop Grumman and Chairman of Caltech's Board of Trustees; Burt Rutan, aerospace entrepreneur and founder, President and CEO of Scaled Composites; aerospace pioneer Paul MacCready, the "father of human-powered flight"; former JPL director Edward Stone; and NASA astronaut Buzz Aldrin.

Mr. Thompson co-founded Orbital in 1982 with Mr. Scott Webster and Mr. Bruce Ferguson. As a result of his work at Orbital, Mr. Thompson has received many honors including the National Medal of Technology from President George H. W. Bush, the Arthur C. Clarke Lifetime Achievement Award, and the Caltech Distinguished Alumni Award. He is also an AIAA Fellow, served as AIAA President from 2009–2010, and is currently the AIAA Foundation Chair. Furthermore, he is a member of the National Academy of Engineering, and a Fellow of the American Astronautical Society, the Royal Aeronautical Society, and the International Academy of Astronautics.

Mr. Thompson received a bachelor's degree in aeronautics and astronautics from Massachusetts Institute of Technology, where he received the National Space Club's Goddard Scholarship; a master's degree in aeronautics from Caltech, where he held a Hertz Foundation Fellowship; and an M.B.A. from Harvard Business School, where he was a Rockwell International Fellow.

For more information on the International von Kármán Wings Award and the AHS, visit **http://www.galcit.caltech.edu/ahs/index.html**.

Members of the Western Regional Advisory Committee met 24 September to coordinate planning for regional and section programming. Pictured are (L to R): Ranney Adams, Eliza Sheppard, Brian Holm-Hansen, Ryan Carlblom, Matthew Angiulo, Bob Welge, Jane Hansen, Richard Van Allen, Dean Davis, Corinne Cho, Charlie Vono, Jeff Jepson, Sylvee Walenczewski, Oleg Yakimenko, Emily Springer, Karen Thomas, Kirk Hively, Bruce Wilson, and Chris Coyne. Not pictured: Karl Rein-Weston and Steven Cerri. Many thanks to Microcosm, Inc., for providing meeting facilities in their Hawthorne, CA offices.

AIAA JOSEPH FREITAG, SR. AWARD

The AIAA Joseph Freitag, Sr. Award for 2011 was given to **Thomas Meier**, a graduate of the Daimler Vocational Education and Training School, who has completed the high school examinations qualifying him to enroll as an engineering student to earn a Bachelor of Mechanical Engineering. Mr. Meier, the fifth to receive the award, has specialized in model building and foundry technology at Daimler AG. His capabilities include the repair and development of new die casting molds for various parts of the automobile drive chain.

The award is given in honor of Joseph Freitag, Sr., a 1922 graduate of the Daimler Vocational Training School who left Germany in 1926 to become eventually a leader in the field of advanced aircraft instrumentation, flight control, radar, and marine stabilization design at Sperry Gyroscope. He is recognized on The National Aviation Space Exploration Wall of Honor at the Stephen F. Udar Hazy Center of the Smithsonian National Air and Space Museum in Chantilly, VA.

The award is given to foster and recognize the educational values and inspiration acquired by Mr. Freitag from the learning experiences at the Daimler school. The faculty selects a student to receive the award based on the values that characterized his life and admired by family, his colleagues, and friends.

- *Educational Achievement*—dedicated to continuous learning and self-improvement
- *Self-Initiative*—bringing new approaches and ideas to technical problems
- *Craftsmanship*—applied to professional, family, and leisure activities
- *Team Player*—whose contributions adapted to fit the team effort
- *Determination and Perseverance*—to overcome the challenges of life

Joseph Freitag Jr., son of Joseph Freitag Sr., presenting the award certificate to Thomas Meier, who was selected by the instructors of the Daimler Training Institute to receive the award in 2011.

Administration of the award resides mainly at AIAA Headquarters under the auspices of the Student Activities Committee. The award was created through a gift to the AIAA Foundation by Joseph Freitag, Jr. (AIAA Associate Fellow) and John D. Freitag, sons of Mr. Freitag Sr., and family friends.

Previous winners of the award are Mr. Manuel Koelz who has received his Bachelor of Mechanical Engineering Degree, Mr. Tobias Wolf, Mr. Rene Findeisen, and Mr. Michael Lachnit, who are currently Mechanical Engineering students enrolled at different German universities.

For further information, contact Mr. Stephen Brock at 703.264.7536.

OBITUARIES

AIAA Senior Member Erickson Died in October 2010

John W. Erickson passed away on 31 October 2010. He was 75 years old.

Mr. Erickson graduated from the University of Minnesota in 1957 with a degree in aeronautical engineering. While he was in college, he spent one summer working at Champion Aircraft Company in St. Paul and one summer working at Boeing Aircraft Company in Seattle. After graduation, he went to work for General Dynamics Space Systems in San Diego.

An accomplished and respected engineer, Erickson's areas of expertise included missile aerodynamics, turbulent flow and celestial mechanics. He worked on the Atlas missile program, which had some military applications and was also widely used to launch communications satellites.

AIAA Senior Member Madewell Passed Away in June

James "Jim" Madewell died on 16 June 2011.

Mr. Madewell earned a Bachelors degree in Mechanical Engineering from the University of Houston in Texas and an M.S. in Engineering from the University of Alabama. He began his 50-year aerospace career at NASA in 1956, as an engineering manager on Werner von Braun's Apollo-Saturn 5 Launch Vehicle team at Marshall Space Flight Center in Huntsville, AL, during the infancy of the nation's space program.

He was a key player in the development of the Apollo, Skylab, Space Shuttle, International Space Station, B-1, B-2 stealth bombers and the X-33 second-generation Space Shuttle. Mr. Madewell was also the recipient of the "Golden Skunk" award from Lockheed Martin for his contributions to the "Black Ops" Skunk Works division, an award he was very proud of.

AIAA Senior Member Benson Died in June

Allen M. Benson passed away on 19 June 2011. He was a proud member of IAS and then AIAA since his college days at the University of Illinois.

In 1950, he graduated from the University of Illinois, where he was a member of Triangle Fraternity and Tau Beta Pi, as an Aeronautical Engineer. Mr. Benson served in the U.S. Navy during World War II, the Korean War, and the Naval Reserves for 42 years—he retired as a Captain. His career path began in San Diego in the aerospace industry when he worked for Convair and Ryan Aeronautical Co., and finished with Lockheed Missiles and Space Co. in Sunnyvale, CA. He retired in 1986. Mr. Benson belonged to the Military Officers Association of America, Military Order of World Wars, American Legion (60 years), and AIAA.

AIAA Senior Member Atherton Died in August

William H. Atherton died on 30 August 2011. Mr. Atherton received his degree from General Motors Institute of Technology and then joined the Marines. He enjoyed a lengthy career in the aerospace industry as a marketing executive.

AIAA Senior Member Georgian Died in September

Alan Bernard Georgian, age 55, died on 16 September 2011.

He was President of Georgian Aerospace Group, Inc. Mr. Georgian graduated from Parks College of St. Louis University in 1978, earning his B.S. in aircraft maintenance engineering. Subsequently, Mr. Georgian had over 30 years of experience in aircraft repair and modification engineering. He obtained FAA DER (structures) certification in 1989. He began Georgian Aerospace Group, Inc. in 1992.

Industries Professional Berghammer Died in October

Peter Berghammer, a Senior Strategist for independent public relations and marketing firm Public Communications/Worldwide (PC/W) died on 1 October 2011. Mr. Berghammer was an innovator and serial entrepreneur who worked on technology, aerospace, and public-safety accounts for PC/W. He was 51 years old.

Though best known for his marketing acumen, Mr. Berghammer possessed a thorough understanding and appreciation for strategic alliances, acquisitions, and mergers. Through his leadership, The Copernio Holding Company, which he founded in 2001 and in which he served as Chief Executive Officer, quickly grew from an IT solutions provider to an organization with divisions handling consulting, research, warehousing, and logistics. Under his guidance, Copernio expanded from a single location to an international corporation with warehouses and offices in over 18 countries. In 2003, he founded Future Formats, an offshoot of the research arm of Copernio, dedicated to the consumer electronics industry and photonics research.

Immediately prior to founding Copernio, Mr. Berghammer served as Vice President of Sales and Marketing for the online marketplace startup Avolo. Prior to that, he served as Director of Worldwide Communications for aerospace, defense, and industrial fastening systems manufacturer Fairchild Fasteners (now part of Alcoa). He was a pioneer in the mid-1990s in the integration of CAD/CAM with solid modeling, and the integration of solid models with the Internet—effectively building a proof of concept platform, which allowed for models to be designed and deployed in one location and manufactured in locations thousands of miles away.

Later, as an executive at EDS, Mr. Berghammer oversaw Fairchild's web and network implementation strategy and deployment. He was responsible for developing Fairchild's database-driven architecture, and laid the foundation for later integration of MRP, ERP, and ERP2 systems with the internet, joining facilities in over 20 countries.

Mr. Berghammer began his career in the late 1970s with aerospace fastening company Rosan of Newport Beach, CA. Rosan was later acquired by Rexnord, then by Banner Aerospace, and eventually by Fairchild.

Mr. Berghammer was active in a number of industry groups, including being a life member of AIAA, and a 20-year member of the Society of Aerospace and Automotive Engineers (SAE) and the Optical Society of America. He also belonged to The Center for Intelligence Studies, International Association for Cryptologic Research, and The SIIA: Software and Information Industries Association, in which he was an active participant on the Intellectual Property Sub-Committee, Search Engine watch group, and the Software as Service Sub-Committee.

Mr. Berghammer's military associations included, among others, the U.S. Naval Institute and The Navy League, The National Defense Industrial Association (NDIA), and The Air Force Association, all of which he was a life member of.

Among his educational credentials are the University of San Diego, the Goethe Institute, Cal Tech Engineering Management, and Stanford Law Intellectual Property and e-business. In 2005–2006, he was named a non-residential Fellow at Stanford Law: Center for Internet and Society researching security and crypotologic systems.

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

2011 BEST PAPERS

During 2011, 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
AIAA 2010-7975, "Correlation of Optical Observations of Earth-Orbiting Objects by Means of Probability Distributions," Kohei Fujimoto and Daniel Scheeres, University of Colorado-Boulder.

AAS/AIAA Space Flight Mechanics Best Paper
AAS 10-207, "Star-ND: Multidimensional Star-Identification," Benjamin Spratling and Daniele Mortari, Texas A&M University.

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 2010-6924, "Quantifying the Effects of Long-Term Storage on Extended Cycling for Lithium-Ion Batteries," Chris Pearson, John Lopez, Rachel Buckle, and Carl Thwaite, ABSL Space Products.

AIAA Aerospace Power Systems Best Student Paper
AIAA Paper 2010-6688, "Conceptual Design Tool for Micro Air Vehicles with Hybrid Power Systems," Paul Hrad and Frederick Harmon, Air Force Institute of Technology, Wright Patterson AFB.

AIAA Air Breathing Propulsion Best Paper
AIAA 2010-6502, "Powered Model Wind Tunnel Tests of a High-Offset Subsonic Turboprop Air Intake," Luis Ruiz-Calavera, David Funes-Sebastian, and David Perdones-Diaz, Airbus Military, Spain.

AIAA Applied Aerodynamics Best Paper
AIAA 2011-0855, "An Experimental Study Into the Flow Physics of Three-Dimensional Shock Control Bumps," Paul Bruce and Holger Babinsky, University of Cambridge.

AIAA Atmospheric Flight Mechanics Best Papers
AIAA 2011-1161, "Evaluation of Bi-Harmonic Amplitude and Bias Modulation for Flapping Wing MAV Control," Michael Anderson, Richard Cobb, and Nathanael Sladek, Wright-Patterson AFB.

AIAA 2010-7951, "Real-Time Aerodynamic Parameter Estimation Without Air Flow Angle Measurements," Eugene Morelli, NASA Langley Research Center.

AIAA David Weaver Best Student Paper
AIAA 2010-4335, "Vibrational State to State Kinetics in Expanding and Compressing Nitrogen Flows," Alessandro Munafò, Andrea Lani, and Thierry Magin, Von Karman Institute for Fluid Dynamics; Marco Panesi, The University of Texas at Austin; and Richard Jaffe, NASA Ames Research Center.

AIAA Electric Propulsion TC Best Paper
AIAA 2010-6702, "Barium Depletion in the NSTAR Discharge Cathode After 30,472 Hours of Operation," James Polk, Angela Capece, Ioannis Mikellides, and Ira Katz, Jet Propulsion Laboratory.

AIAA Energetic Components and Systems Best Paper
AIAA 2010-7007, "Modeling the Energy Release Characteristics of THPP Based Initiators," Branden Poulsen and Karl Rink, University of Idaho.

AIAA Fluid Dynamics Best Paper
AIAA 2011-0371, "Receptivity of Hypersonic Boundary Layers to Acoustic and Vortical Disturbances," Ponnampalam Balakumar and Michael Kegerise, NASA Langley Research Center.

AIAA Gossamer Spacecraft Forum Best Paper
AIAA 2010-2670, "Wrinkling of Orthotropic Viscoelastic Membranes," Xiaowei Deng and Sergio Pellegrino, California Institute of Technology.

AIAA Ground Testing Best Paper
AIAA 2011-1260, "Comparison of Resource Requirements for a Wind Tunnel Test Designed with Conventional vs. Modern Design of Experiments Methods," Richard DeLoach and John Micol, NASA Langley Research Center.

AIAA Guidance, Navigation, and Control Best Paper
AIAA 2010-7563, "Estimation and Modeling of Enceladus Plume Jet Density Using Reaction Wheel Control Data," Allan Lee, Eric Wang, Glenn Macala, and Antonette Feldman, Jet Propulsion Laboratory; and Emily Pilinski, University of Colorado.

AIAA High Speed Air Breathing Propulsion Best Paper
AIAA 2010-6876, "CFD Enhancements for Supersonic Combustion Simulation with VULCAN," Foluso Ladeinde and Kehinde Alabi, TTC Technologies Inc.; Temitay Ladeinde, Polytechnic Institute of NYU; Douglas Dais and Matthew Satchell, Wright Patterson AFB; and Robert Baurle, NASA Langley Research Center.

AIAA Hybrid Rockets Best Paper
AIAA 2010-7730, "Regression Rate Characteristics and Burning Mechanism of Some Hybrid Rocket Fuels," Satoshi Hikone, Shinya Maruyama, Takahumichiro Isiguro, and Ichiro Nakagawa, Tokai University, Japan.

AIAA Hybrid Rockets Best Student Paper
AIAA 2010-6635, "A Two-Stage, Single Port Hybrid Propulsion System for a Mars Ascent Vehicle," Ashley Chandler, Brian Cantwell, and G. Scott Hubbard, Stanford University; and Arif Karabeyoglu, Space Propulsion Group.

AIAA Hypersonics Best Paper
AIAA 2009-7273, "Heat Balance Of A Transpiration-Cooled Heat Shield," Hannah Bohrk, Olivier Piol, and Markus Kuhn, German Aerospace Center, Institute of Structures and Design.

AIAA Intelligent Systems Best Paper
AIAA 2010-3385, "Static Analysis and Verification of Aerospace Software by Abstract Interpretation," Julien Bertrane, Radhia Cousot, Jerome Feret, Laurent Mauborgne, Antoine Miné, and Xavier Rival, École Normale Supérieure; and Patrick Cousot, New York University.

AIAA Liquid Propulsion Best Paper
AIAA 2010-6660, "NASA Ares I Launch Vehicle First Stage Roll Control System Cold Flow Development Test Program

Overview," Adam Butt, Chris G. Popp, and Kimberly Holt, NASA Marshall Space Flight Center; and Hank M. Pitts, The Boeing Company.

AIAA Modeling and Simulation Best Papers

AIAA 2010-7780, "NDOF Simulation Model for Flight Control Development with Flight Test Correlation," Edward Burnett, Christopher Atkinson, Jeff Beranek, Brian Sibbitt, Brian Holm-Hansen, and Leland Nicolai, Lockheed Martin Corporation.

AIAA 2010-8356, "Modelling Pilot Control Behaviour for Flight Simulator Design and Assessment," Peter Grant, Institute of Aerospace Studies and Jeffery Schroeder, FAA.

AIAA Plasmadynamics and Lasers Best Paper

AIAA 2010-4630, "Experimental Study on the Body Force Field of Dielectric Barrier Discharge Actuators," Marios Kotsonis, Sina Ghaemi, Rogier Giepman, and Leo Veldhuis, Delft University of Technology.

AIAA Plasmadynamics and Lasers Best Student Papers

AIAA 2010-5038, "Electric Oxygen-Iodine Laser Performance Enhancement using Larger Discharge and Resonator Mode Volumes," Joseph Zimmerman, Gabriel Benavides, Brian Woodard, Michael Day, and Wayne Solomon, University of Illinois-Urbana Champaign; and David Carroll, Joseph Verdeyen, and Andrew Palla, CU Aerospace.

AIAA 2010-1079, "Flow Separation Control on Airfoil with Pulsed Nanosecond Discharge Actuator," Giuseppe Correale, Ilia Popov, Aleksandr Rakitin, Steven Hulshoff, and Leo Veldhuis, Delft University of Technology; and Andrei Starikovski, Drexel University.

AIAA Propellants and Combustion Best Paper

AIAA 2010-7152, "Analysis of Flow-Flame Interactions in a Gas Turbine Model Combustor Under Thermo-Acoustically Stable and Unstable Conditions," Adam Steinberg, Isaac Boxx, Michael Stohr, Wolfgang Meier, and Campbell Carter, DLR German Aerospace Centre.

AIAA Solid Rockets Best Paper

AIAA 2010-7075, "Thermochemical Erosion Analysis of Carbon-Carbon Nozzles in Solid-Propellant Rocket Motors," Daniele Bianchi and Francesco Nasuti, University of Rome.

AIAA Thermophysics Best Paper

AIAA 2011-0143, "CFD Implementation Of A Novel Carbon-Phenolic-In-Air Chemistry Model For Atmospheric Re-Entry," Alexandre Martin and Iain Boyd, University of Michigan.

ASME/Boeing Best Paper

AIAA 2010-2715, "X-HALE: A Very Flexible UAV for Nonlinear Aeroelastic Tests," Carlos Cesnik, Patrick Senatore, Weihua Su, Ella Atkins, University of Michigan-Ann Arbor; and Christopher Shearer and Nathan Pitcher, Air Force Institute of Technology.

ASME Propulsion Best Paper

AIAA 2010-6990, "Turbine Engine Temperature Pattern Factor Control System Based on Fuel Modulation and Passive Optical Sensors," Jason Cline, Jamine Lee, Evan Perillo, Neil Goldstein, Spectral Sciences; and Sheree Swenson-Dodge, John Ols, and Stephen Kramer, Pratt & Whitney.

AIAA Student Paper Competitions

Aeroacoustics

AIAA 2011-2784, "Trailing Edge Noise Predictions Using Compressible LES and Acoustic Analogy," William Wolf and Sanjiva Lele, Stanford University.

Aerodynamic Decelerator Systems Technology

AIAA 2011-2520, "High-Altitude Testing of Parachutes; A Low-Cost Methodology For Parachute Evaluation Using Consumer Electronics," Iain Waugh, Edward Moore, Dan Strange, John Cormack, and Fergus Noble, University of Cambridge; and John Underwood, Vorticity Ltd, Chalgrove, United Kingdom.

Atmospheric Flight Mechanics

AIAA 2011-6378, "Effect of Control Surface-Fuselage Inertial Coupling on Hypersonic Vehicle Flight Dynamics," Nathan Falkiewicz, Scott Frendreis, and Carlos Cesnik, University of Michigan-Ann Arbor.

American Society For Composites Student Paper In Composites

AIAA 2011-1736, "Optimization of Bistable Composite Laminates with Actuated State-Change," David Betts, Hyunsun Kim, and Christopher Bowen, University of Bath.

Guidance, Navigation, and Control

AIAA 2011-6296, "Relative Computer Vision Based Navigation For Small Inspection Spacecraft," Brent Tweddle, Massachusetts Institute of Technology.

Harry H. and Lois G. Hilton Student Paper Award in Structures

AIAA 2011-1911, "Macro Scale Independently Homogenized Subcells for Modeling Braided Composites," Brina Blinzler and Wieslaw Binienda, University of Akron; and Robert Goldberg, NASA Glenn Research Center.

Environmental Systems

AIAA-2011-5057, "Evaluation of Sorbents for Acetylene Separation in Atmosphere Revitalization Loop Closure," Morgan Abney, NASA Marshall Space Flight Center; Lee Miller, ECLS Technologies, LLC; and Katherine Barton, University of Alabama.

Infotech@Aerospace

AIAA 2011-1658, "Camera Based Localization For Autonomous UAV Formation Flight," Zouhair Mahboubi, Zico Kolter, Tao Wang, and Geoffrey Bower, Stanford University.

Jefferson Goblet

AIAA 2007-2057, "Sensor Placement for Damage Detection in Nonlinear Systems Using System Augmentations," K. D'Souza and B. Epureanu, University of Michigan-Ann Arbor.

Lockheed Martin Student Paper Award In Structures

AIAA-2011-1716, "Aero-Servo-Viscoelastic Flutter And Torsional Divergence Alleviation For A Wing In Subsonic, Compressible Flow," Craig Merrett and Harry Hilton, University of Illinois, Urbana-Champaign.

CALL FOR NOMINATIONS

Nominations are now being accepted for the following awards, and must be received at AIAA Headquarters no later than **1 February**. A nomination form can be downloaded from **www.aiaa.org**. AIAA members may also submit nominations online after logging in with their user name and password.

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 honors 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 which have advanced the science of powered lift flight.

George M. Low Space Transportation Award honors the achievements in space transportation by Dr. George M. Low, who played a leading role in planning and executing all of the Apollo missions, and originated the plans for the first manned lunar orbital flight, Apollo 8. (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 is presented to recognize 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. *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 presented 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 is presented for 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 recognizes outstanding contributions in the management of a significant space or space-related program or project.

William Littlewood Memorial Lecture was renowned for the many significant contributions he made to the design of an operational requirement for civil transport aircraft. The topics for the lecture deal with a broad phase of civil air transportation considered of current interest and major importance. AIAA and SAE sponsor the lecture.

Answers to frequently asked questions or guidelines on submitting nominations for AIAA awards may be found at **www.aiaa.org/content.cfm?pageid=289**. For further information on AIAA's awards program, contact Carol Stewart, Manager, AIAA Honors and Awards, at 703.264.7623 or carols@aiaa.org.

How Far Can You See?

At AIAA, we see aerospace transforming the future ... How Far Can You See?

What is your hope for the future of aerospace? What discoveries and breakthroughs are on the way and what difference will they make? Share your vision at **www.aiaa.org/imagineit**.

I see the development of an immense space-based infrastructure dedicated to food production and addressing the dietary needs of our planet's population. It will rival the total production of terrestrial farming, leading to fundamental changes in agrarian cultures and global practices in land management.—**Gordon Lowrey, AIAA Associate Fellow**

7th AIAA Biennial National Forum on Weapon System Effectiveness

Achieving Capabilities-Based Weapons Effectiveness in the 21st Century

(SECRET/U.S. ONLY)

24–28 September 2012
Ft Walton Beach, FL

Abstract Deadline: 15 March 2012

General Chair
O. Nick Yakaboski
Chief, Modeling Simulation and Analysis
Air Armament Center, Capabilities Integration Directorate
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AIAA Weapon System Effectiveness Technical Committee Chair
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Synopsis

The AIAA National Forum on Weapon System Effectiveness is a biennial event dedicated to promoting and sharing knowledge about the complex nature of modern weapon systems. It provides a SECRET/U.S. ONLY forum for discussing entire weapon systems, design considerations, and the engineering decisions that must be made to acquire and produce effective and successful weapon systems.

The 7th AIAA Biennial National Forum on Weapon System Effectiveness is supported by the AIAA Weapon System Effectiveness Technical Committee. The forum will address the themes of major weapons, acquisition reforms, test and evaluation, performance analysis, and future systems. Topics for discussion include the technology, design, development, engineering, and operational considerations important to the successful employment of modern ground, sea, air, and space weapon systems and platforms. A capabilities-based approach requires a tooth-to-tail perspective of the weapon life cycle with a well-defined requirements process that better assures weapon effects will meet the combatant commander's intent. The forum is directed toward engineers, scientists, technical managers, program managers, and policymakers. There will be special opportunities for policymakers to discuss the role of weapon system effectiveness assessments and weapon acquisition and force structure. The implementation of the Weapons Systems Acquisition Reform Act (WSARA) and the role of Analysis of Alternatives in the early development planning of future weapon systems are examples of policy that explore the cost-effectiveness trade space to deliver warfighter capabilities during a time of constrained budgets. The program is being developed around a distinguished group of keynote speakers, government and industry panels, and classified and unclassified technical paper presentations.

Technical Topics

Technical paper abstracts are being solicited on the following topics:

- Major Service weapon systems
- Aircraft and maritime protection systems
- IED defeat
- Counter rockets, artillery, and mortars
- WMD threat and negation issues
- Ballistic missile defense
- Weapon system test, evaluation
- Weapon system modeling, and simulation
- Weaponeering and assessment standards
- New advances in weapon system technologies
- Novel target defeat approaches
- Advancements in weapon guidance, navigation, and control
- Sensors, target acquisition, and battle damage assessment
- Deep penetration weapons and hardened targets
- Long-range stand-off weapons
- High speed weapons applications
- Collateral damage control
- Tailoring weapon effects for irregular and asymmetric warfare
- Weapon system performance analysis and measures of system effectiveness
- Weapon effects analysis for Analysis of Alternatives (AoA)
- Non-lethal weapon systems
- Novel uses of kinetic and chemical energy weapon systems
- Advanced warhead technologies
- Robotic and unmanned weapon systems
- UAVs
- Directed energy weapons
- High power microwaves
- Lasers
- Network centric operations
- Other related weapon system effectiveness technical topics
- Space systems

Calls for **Papers**

Abstract Guidelines

All abstracts must be UNCLASSIFIED and cleared for public release with unlimited distribution. Please limit abstracts to 750 words.

Abstract Submittal Guidelines

Abstract submissions will be accepted electronically through the AIAA Web site at **www.aiaa.org/events/wse**. The Web site is now open for abstract submission. The deadline for receipt of abstracts via electronic submission is **15 March 2012**.

A "no paper, no podium" rule is in effect for this conference; any author failing to submit a written manuscript prior to his or her presentation will not be permitted to present the paper. Prospective authors should keep this rule in mind when submitting their abstracts. AIAA will not consider for presentation or publication any paper that has been or will be presented or published elsewhere. Authors will be required to sign a statement to this effect.

Questions pertaining to the full abstract or technical topics should be referred to Nick Yakaboski at Otmar.Yakaboski@eglin.af.mil or David Lyman at d.david.lyman@saic.com. Authors having trouble submitting abstracts electronically should contact Scholar One technical support. Letters of official acceptance and instructions for preparation of manuscripts will be e-mailed on or about **22 May 2012**.

Manuscript Guidelines

Detailed instructions and guidelines for submitting papers will be sent to authors of accepted papers. Authors must submit their final manuscripts, complete with any approval information, no later than **21 August 2012**. Security forms must be completed and submitted by **4 September 2012**.

Classified papers will be made available through the Defense Technical Information Center (DTIC).

Warning—Technology Transfer Considerations

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

Important Dates

Abstract Deadline: 15 March 2012
Author Notification: 22 May 2012
Final Manuscript Deadline: 21 August 2012

30th AIAA International Communications Satellite Systems Conference (ICSSC): Satellites for the Benefit of Humanity

18th Ka and Broadband Communications, Navigation and Earth Observation Conference

24–27 September 2012
The Westin Ottawa
Ottawa, Canada

Abstract Deadline: 31 March 2012
Final Manuscript Deadline: 30 June 2012

The 30th AIAA International Communications Satellite Systems Conference (ICSSC) and the 18th Ka and Broadband Communications, Navigation and Earth Observation Conference—the two most influential technical conferences on satellite systems—will be held jointly in Ottawa, Canada, 24–27 September 2012. As Canada's capital, the beautiful city of Ottawa is a hub of federal politics and culture. It is also a global high technology center, sometimes referred to as Silicon Valley North, supported by four universities and two colleges. At this period of the year, the nature in the Gatineau Hills offers breathtaking views of the fall foliage

The ICSSC 2012 theme is "Satellites for the Benefit of Humanity". Satellites play a vital role in everyone's life, every day. For some, it represents their main access to internet either directly or indirectly via backhaul services. For others, it is a source of entertainment and leisure from broadcast satellites or help them find their way using navigation satellites. In addition to individual reach, satellites provide key functions for governments' civil and military needs and for commercial enterprises. Security and public safety organizations rely on satellites for critical telecommunications, search and rescue operations, tracking of ships at sea, environmental sensing, and daily monitoring, more so during disaster events such as floods, earthquakes, forest fires, or tsunami to name a few. Our search for a better understanding of the universe and, in particular, of our galaxy calls for unprecedented communication capacity to be relayed to Earth from various sensors. Ka-band satellites offer broadband connectivity to meet these requirements, and, as the demand increases, new frequency bands (Q/V) will be explored to deliver ever-increasing capacity. Improving on the above capabilities and providing new ways to serve mankind are some of the challenges the satellite community must face. The conference will explore these challenges, and propose and discuss solutions.

The Ka and Broadband Conference will continue to highlight developments in Ka-band and broadband communications, in satellite-aided navigation and Earth observation systems and applications.

The joint conference will provide a forum for in-depth exploration of the economic, marketing, technical, and regulatory issues affecting these new and planned services.

Technical Topics

Papers are solicited for both conferences in the following areas:

- New mobile services
- New broadband services
- New navigation services
- Integration and interoperability of systems
- Communications protocols and networks
- Advances in satellite architecture
- Advances in satellite components
- Advances in Earth terminals
- Propagation and mitigation techniques
- Economic and marketing aspects
- Regulatory issues

In addition, papers are solicited for the ICSSC in the following areas:

- New broadcast services
- New fixed-satellite services
- New data relay services
- Integrated services for disaster relief
- Interactivity via satellite
- Domestic security applications and architectures
- Military applications and architectures
- Advances in payload subsystems
- User applications
- Navigation satellite systems and applications
- Search and rescue satellite systems and applications
- Low/medium/high Earth orbit systems
- Automatic identification systems

Organization

The Joint Conference, organized by FGM Events, LLC, will have a single registration fee that will provide access to both conferences and all joint plenary and social events. However, the technical programs of the ICSSC and the Ka and Broadband Conference will be separately organized. All papers will be published on the joint conference Web site accessible to registrants, and on a CD-ROM that will be provided to all registrants. In addition, papers submitted to the Ka and Broadband Conference will be published in the form of hard-copy proceedings that will be distributed to all registrants.

The working language of the joint conference will be English. For more details on the joint conference, visit the conference Web site: **http://www.kaconf.org**.

Author Instructions

Information on preparation and submission of abstracts, submissions of final papers and general author instructions are available on the joint conference Web site: **http://www.kaconf.org**.

For More Information

Inquiries relating to the ICSSC technical program should be directed to the Conference Technical Program Co-Chairs at **icssc2012_tpc@crc.gc.ca**.

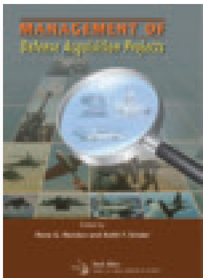
Inquiries relating to the Ka and Broadband Conference technical program should be directed to the Conference Technical Program Co-Chair:

Frank Gargione
E-mail: frankgargione3@msn.com

General inquiries about the conference organization should be directed to:

Clotilde Canepa Fertini
FGM Events, LLC
E-mail: clotilde.fertini@kaconf.org

New and Best-Selling Books from AIAA



"An excellent way to get a solid grounding in the complex and challenging acquisition process."
—**Jacques S. Gansler**, Ph.D., University of Maryland, and former Under Secretary of Defense for Acquisition, Technology and Logistics

Management of Defense Acquisition Projects

Rene G. Rendon and Keith F. Snider
Naval Postgraduate School
2008, 292 pages, Hardback, ISBN: 978-1-56347-950-2
List Price $64.95
AIAA Member Price: $49.95

A History of Two CIA Projects. *Based on interviews, memoirs, and oral histories of the scientists and engineers involved, as well as recently declassified CIA documents, and photographs, reports, and technical drawings from Lockheed and Convair, this is a technical history of the evolution of the Lockheed A-12 Blackbird.*

From RAINBOW to GUSTO: Stealth and the Design of the Lockheed Blackbird

Paul A. Suhler
2009, 300 pages, Paperback, 1SBN: 978-1-60086-712-5
List Price $39.95
AIAA Member Price $29.95

While the focus of this book is on ground combat system vulnerability, many of the principles, methodologies, and tools discussed are also applicable to the air and sea system communities.

Fundamentals of Ground Combat System Ballistic Vulnerability/Lethality

Paul H. Deitz, Harry L. Reed Jr., J. Terrence Klopcic, and James N. Walbert
Progress in Astronautics and Aeronautics, Vol. 230
2009, 384 pages, Hardback, ISBN: 978-1-60086-015-7
List Price $119.95
AIAA Member Price: $89.95

"I urge all who are serious about understanding the development of the national security space arena to read it."
—**Roger D. Launius**
Smithsonian Institution

Shades of Gray: National Security and the Evolution of Space Reconnaissance

L. Parker Temple III
2005, 554 pages, Hardback, ISBN: 978-1-56347-723-2
List Price $29.95
AIAA Member Price: $24.95

Also From AIAA

Weaponeering: Conventional Weapon System Effectiveness
Morris Driels, Naval Postgraduate School
2004, 466 pages, Hardback, ISBN: 978-1-56347-665-5
List Price: $99.95
AIAA Member Price: $74.95

The Fundamentals of Aircraft Combat Survivability Analysis and Design, Second Edition
Robert E. Ball, Naval Postgraduate School
2003, 889 pages, Hardback, ISBN: 978-1-56347-582-5
List Price: $104.95
AIAA Member Price: $79.95

Mathematical Methods in Defense Analyses, Third Edition
J. S. Przemieniecki, Air Force Institute of Technology
AIAA Education Series
2000, 421 pages, Hardback, ISBN: 978-1-56347-397-5
List Price: $104.95
AIAA Member Price: $79.95

The Missile Defense Equation: Factors for Decision Making
Peter J. Mantle, Mantle & Associates, LLC
2004, 525 pages, Hardback, ISBN: 978-1-56347-609-9
List Price: $99.95
AIAA Member Price: $74.95

Effective Risk Management: Some Keys to Success, Second Edition
Edmund H. Conrow, CMC, CPCM, PMP
2003, 554 pages, Hardback, ISBN: 978-1-56347-581-8
List Price: $84.95
AIAA Member Price: $64.95

Approximate Methods for Weapon Aerodynamics
Frank G. Moore, Naval Surface Warfare Center
Progress in Astronautics and Aeronautics, Vol. 186
2000, 464 pages, Hardback, ISBN: 978-1-56347-399-9
List Price: $119.95
AIAA Member Price: $89.95

Order online at www.aiaa.org/books

AIAA

09-0682

Upcoming AIAA Professional Development Courses

7–8 January 2012
The following Continuing Education classes are being held at the 50th AIAA Aerospace Sciences Meeting in Nashville, Tennessee. Registration includes course and course notes; conference, Wednesday awards luncheon, Wednesday evening reception, Thursday evening reception, and single-user access to the online conference proceedings.

ASM COURSE AND CONFERENCE REGISTRATION FEES

To register, go to **www.aiaa.org/events/asm.**

	Early Bird by 12 Dec 2011	*Standard (13 Dec–5 Jan)*	*Onsite (6–8 Jan 2012)*
AIAA Member	$1265	$1365	$1465
Nonmember	$1343	$1493	$1643

CFD for Combustion Modeling (Instructors: Heinz Pitsch, RWTH Aachen University, Aachen Germany and Suresh Menon, School of Aerospace Engineering, Atlanta, GA)
The objective of the course is to provide the interested combustion engineer or researcher with the fundamentals of combustion modeling to assess a combustion problem and to decide on the adequate models to be used in numerical simulations. The course is designed also to provide the knowledge to implement certain models into CFD codes. The course starts with fundamentals of combustion chemistry and includes a hands-on introduction to a 0D/1D combustion code. This is followed by a brief introduction to statistical models and turbulence modeling. A comparative overview of the most commonly used combustion models will be given next. Implementation issues and application examples will be discussed. Special topics include combustion instabilities, combustion in aircraft engines, augmenters, and high-speed combustion.

Concepts in the Modern Design of Experiments (Instructor: Richard DeLoach, NASA, Hampton, VA)
Aerospace researchers with considerable subject-matter expertise who have had relatively little formal training in the design of experiments are often unaware that research quality and productivity can be substantially improved through the specific design of an experiment. Reductions in cycle time by factors of two or more, with quality improvements of that same order, have occurred when the fundamental precepts of experiment design covered in this course have been applied in real-world aerospace research. Examples drawn from specific studies will quantitatively illustrate resource savings, quality improvements, and enhanced insights that well-designed experiments have delivered at NASA Langley. Computer software CDs included with the course (Design Expert) will be demonstrated.

Fluid Structure Interaction (Instructor: Rainald Löhner, George Mason University, Fairfax, VA)
The course will give an overview of the phenomena that govern fluid-structure interaction, as well as numerical methods that can be used to predict them. A wide range of phenomena, ranging from aeroelasticity to weapon fragmentation, will be covered.

Sustainable (Green) Aviation (Instructor: Ramesh K. Agarwal, Washington University, St. Louis, MI)
The titles "Sustainable Aviation" or "Green Aviation" are recently being used with increasing frequency to address the technological and socioeconomic issues facing the aviation industry to meet the environmental challenges of the twenty-first century. Air travel continues to experience the fastest growth among all modes of transportation, especially because of the tremendous increase in demand in major developing nations and emerging economies of Asia and Africa. It is forecasted that by 2025, 27,200 new airplanes worth $2.7 trillion would be needed. As a result of threefold increase in air travel by 2025, it is estimated that the total CO2 emission due to commercial aviation may reach between 1.2 billion tonnes to 1.5 billion tonnes annually by 2025 from its current level of 670 million tonnes. The amount of nitrogen oxides around airports, generated by aircraft engines, may rise from 2.5 million tonnes in 2000 to 6.1 million tonnes by 2025. The number of people who may be seriously affected by aircraft noise may rise from 24 million in 2000 to 30.5 million by 2025. Therefore, there is urgency to address the problems of emissions and noise abatement through technological innovations in design and operations of the commercial aircraft. The environmental issues such as noise, emissions, and fuel consumption, for both airplane and airport operations, have become important for energy and environmental sustainability.

This short course provides an overview of issues related to air transportation and its impact on environment, followed by topics dealing with emissions and noise mitigation by technological solutions including new aircraft and engine designs/technologies, alternative fuels and materials, and operational improvements/changes. The ground infrastructure for sustainable aviation, including the concept of "Sustainable Green Airport Design" is also covered. The integrated Aircraft/Engine/Operations analysis tools for Environmental Performance Studies of various aircrafts are also presented. Finally, the topics related to climate policy for civil aviation, including the economic analysis models with environmental, are covered.

Systems Requirements Engineering (Instructor: John C Hsu, CA State University, The University of CA at Irvine, Queens University and The Boeing Company, Cypress, CA)
Requirements analysis and specification development are the most important contribution at the onset of a program/project. It will set a corrective direction to guide the program/project preventing the later-on redesign and rework. This course will help you familiarize with an effective method for defining a set of requirements of a system. The focus is on the initial problem space definition, defining user needs, concept of operations, systems, segment, subsystem requirements, and architecture. Gain an understanding of the following requirements engineering activities: elicitation of requirements, system requirements analysis, requirements integration, interface requirements and control, functional analysis and architecture, requirements management, and verification and validation of requirements. Learn about the principles and characteristics of organizing a well-written requirements and specifications.

Modeling Flight Dynamics with Tensors (Instructor: Peter H Zipfel, University of Florida, Shalimar, FL)
Establishing a new trend in flight dynamics, this two-day course introduces you to the modeling of flight dynamics with tensors. Instead of using the classical "vector mechanics" technique, the kinematics and dynamics of aerospace vehicles are formulated by Cartesian tensors that are invariant under time-dependent coordinate transformations.

This course builds on your general understanding of flight mechanics, but requires no prior knowledge of tensors. It introduces Cartesian tensors, reviews coordinate systems, formulates tensorial kinematics, and applies Newton's and Euler's laws to build the general six-degrees-of-freedom equations of motion. For stability and control applications, the perturbation equations are derived with their linear and nonlinear aerodynamic derivatives. After taking the course, you will have an appreciation of the powerful new "tensor flight dynamics," and you should be able to model the dynamics of your own aerospace vehicle.

Best Practices in Wind Tunnel Testing (Instructors: David M. Cahill, Aerospace Testing Alliance, Arnold AFB, TN; Mark Melanson, Lockheed Martin Aeronautics, Fort Worth, TX; and E. Allen Arrington, NASA Glenn Research Center, Cleveland, OH)
This course provides an overview of important concepts that are used in many wind tunnel test projects. The course is based largely on AIAA standards documents that focus on ground testing concepts. In particular, the course will address project management aspects of executing a testing project, the use and calibration of strain gage balances, the use of measurement uncertainty in ground testing, and the calibration of wind tunnels.

22–23 January 2012
The following Continuing Education class is being held at the AIAA Strategic and Tactical Missile Systems Conference and AIAA Missile Sciences Conference in Monterey, California. Registration includes course and course notes; sessions (with approved security clearance form); Tuesday, Wednesday, and Thursday luncheons; and Tuesday and Wednesday receptions.

STRAT TAC COURSE AND CONFERENCE REGISTRATION FEES

To register, go to **www.aiaa.org/events/strattac** or **www.aiaa.org/events/missilesciences**

	Early Bird by 19 Dec 2011	*Standard (20 Dec–21 Jan)*	*Onsite*
AIAA Member	$1188	$1338	$1488
Nonmember	$1265	$1415	$1565

***Note**: A Security Clearance Certification Form is also required for this event (by **19 December 2011**). The Security Clearance Certification Form is separate from conference registration. Submitting a Security Clearance Certification Form does not register you for the conference. You must also register with AIAA.*

Missile Design and System Engineering (Instructor: Gene Fleeman, International Lecturer, Lilburn, GA)
This short course provides the fundamentals of missile design, development, and system engineering. A system-level, integrated method is provided for missile configuration design and analysis. It addresses the broad range of alternatives in satisfying missile performance, cost, and risk requirements. Methods are generally simple closed-form analytical expressions that are physics-based, to provide insight into the primary driving parameters. Configuration-sizing examples are presented for rocket, turbojet, and ramjet-powered missiles. Systems engineering considerations include launch platform integration constraints. Typical values of missile parameters and the characteristics of current operational missiles are discussed as well as the enabling subsystems and technologies for missiles. Sixty-six videos illustrate missile development activities and performance. Attendees will vote on the relative emphasis of types of targets, types of launch platforms, technical topics, and roundtable discussion.

Publications

New and Forthcoming Titles

Boundary Layer Analysis, Second Edition
Joseph A. Schetz and Rodney D. Bowersox

AIAA Education Series
2011, 760 pages, Hardback
ISBN: 978-1-60086-823-8
AIAA Member Price: $84.95
List Price: $114.95

Introduction to Flight Testing and Applied Aerodynamics
Barnes W. McCormick

AIAA Education Series
2011, 150 pages, Hardback
ISBN: 978-1-60086-827-6
AIAA Member Price: $49.95
List Price: $64.95

Space Operations: Exploration, Scientific Utilization, and Technology Development
Craig A. Cruzen, Johanna M. Gunn, and Patrice J. Amadieu

Progress in Astronautics and Aeronautics Series, 236
2011, 672 pages, Hardback
ISBN: 978-1-60086-817-7
AIAA Member Price: $89.95
List Price: $119.95

Spacecraft Charging
Shu T. Lai

Progress in Astronautics and Aeronautics Series, 237
2011, 208 pages, Hardback
ISBN: 978-1-60086-836-8
AIAA Member Price: $64.95
List Price: $84.95

Exergy Analysis and Design Optimization for Aerospace Vehicles and Systems
Jose Camberos and David Moorhouse

Progress in Astronautics and Aeronautics Series, 238
2011, 600 pages, Hardback
ISBN: 978-1-60086-839-9
AIAA Member Price: $89.95
List Price: $119.95

Engineering Computations and Modeling in MATLAB/Simulink
Oleg Yakimenko

AIAA Education Series
2011, 800 pages, Hardback
ISBN: 978-1-60086-781-1
AIAA Member Price: $79.95
List Price: $104.95

Introduction to Theoretical Aerodynamics and Hydrodynamics
William Sears

AIAA Education Series
2011, 150 pages, Hardback
ISBN: 978-1-60086-773-6
AIAA Member Price: $54.95
List Price: $69.95

Eleven Seconds into the Unknown: A History of the Hyper-X Program
Curtis Peebles

Library of Flight
2011, 330 pages, Paperback
ISBN: 978-1-60086-776-7
AIAA Member Price: $29.95
List Price: $39.95

Basic Helicopter Aerodynamics, Third Edition
John M. Seddon and Simon Newman

AIAA Education Series
Published by John Wiley & Sons, 2011, 3rd Edition, 264 pages, Hardback
ISBN: 9-781-60086-861-0
AIAA Member Price: $49.95
List Price: $74.95

Gas Turbine Propulsion Systems
Bernie MacIsaac and Roy Langton

AIAA Education Series
Published by John Wiley & Sons, 2011, 368 pages, Hardback
ISBN: 9-781-60086-846-7
AIAA Member Price: $84.95
List Price: $119.95

Encyclopedia of Aerospace Engineering: 9-Volume Set
Richard Blockley and Wei Shyy, University of Michigan

2010, 5500 pages, Hardback
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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.