May 2013

AEROSPACE AMERICA

Acquisition reform: Real solutions

Shifting fortunes for commercial X-band
A conversation with Eddy Pieniazek

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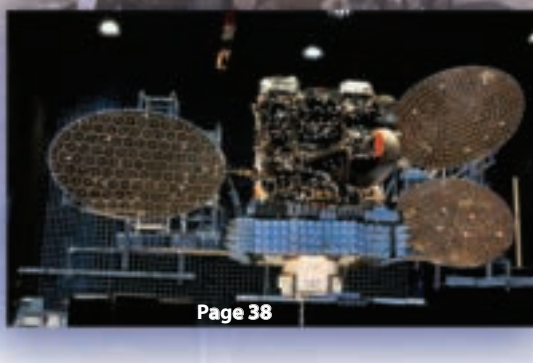

COVER
Meaningful defense acquisition reform can only take place with the active involvement of legislators, the Pentagon, and industry. See the story beginning on page 28. Cover by Fitzgerald Art & Design.

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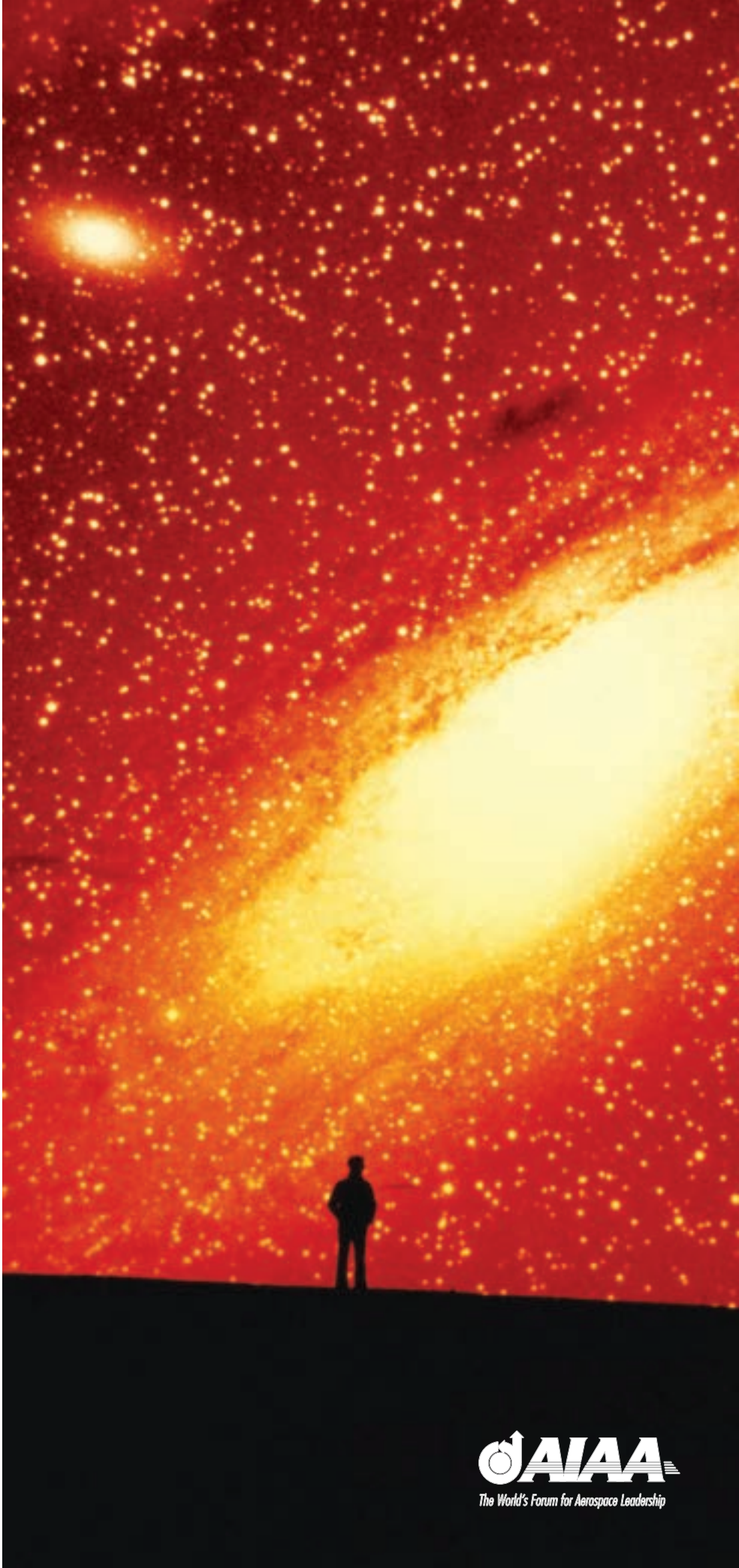

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Commentary

Our own worst enemy

The current restrictions imposed on U.S. government employees, preventing them from participation in scientific and technical activities, set the stage for undermining decades of progress and the credibility of our technical enterprises. We must correct the misconception that government travels are junkets without productive outcome, and protect attendance at technical convocations close enough that travel is not a consideration. These new regulations sometimes even extend to participation independent of government affiliation and at one's own expense, lest the appearance of government support be inferred. These issues are concentrated in the space and defense sectors, where the impact is immediate and lasting.

Everyone in our profession should realize the strong political and subjective influences in play, and deal with two facts: Most of the country does not understand what we do. And we are a very small constituency with insignificant political influence. Most of the people who benefit from our work do not even realize that it is ours.

So, what can we do?

First, our most senior leaders must resist amplifying the damage. To be sure, they are political appointees. But having accepted the posts, their principal responsibility should be to the missions of their agencies, not to political correctness. Might they be replaced by totally political agents? Of course, but then we would know where they were coming from and could deal better knowing that logic was a forlorn hope.

Second, those whose contributions are not affected by misguided policy should take up the slack, representing the interests of the nation at least as vigorously as their personal or corporate interests. This suggests that government employees be more forthcoming with regard to the needs of their organizations and their missions. Industry and, to an extent, academia must become the avatars for the common good.

Third, the aerospace community must support its professional societies much more than it has. The only voices for our careers and productivity are gasping for air. Conferences are their major revenue source. Many are now losing money on irrevocable commitments compromised by the restrictions. Some respond with fewer but more expansive conferences, which may be self-defeating, since each of the fewer conferences will attract more attendees than the individual ones would have, amplifying agencies' reluctance to send many employees to the same event. Conference organizers should also pull back on social events and locations that invite criticism.

Sequestration demands hard decisions from our legislators, and it is tempting to focus on what appear to be easy targets. But it is vital to look beyond that. Although participation in the technical community is but one among many victims, it is one with wide-reaching ramifications. This community is the heart of our national defense and the lifeblood of our commerce. A few dollars might be saved, but at what cost?

Dave Finkleman
Academician, International
Academy of Astronautics

The latest aerospace power faces tough choices

TURKEY WILL BE ONE OF THE 10 BIGgest economies in the world by 2030 if the government's current economic growth plans are successful. Prime Minister Recep Tayyip Erdogan's 'Vision 2030' aims to increase the nation's gross domestic product to $2 trillion from $775 billion in 2012 and raise per capita income to $25,000 from $10,524 over the same period.

Ambitions are one thing, but what is remarkable about Turkey is that, despite the dire economic situation in the rest of Europe and political turmoil along its borders, the country is almost on course to achieve this ambition. Although most of Europe is struggling with economic stagnation, Turkey is likely to see its economy grow at least 4% in 2013 over 2012—down from the 8.5% growth rate in 2011 over 2010, but heading toward the 6% growth figure next year that the government has targeted as the annual minimum increase needed in the short and medium term to achieve the 2030 target. According to the European Bank for Reconstruction and Development, Turkey should average an annual growth rate of 6.7% between 2011 and 2017.

Aviation: A key driver

Aviation and aerospace are key growth sectors for the economy. Turkish Airlines is now the world's fastest growing international airline. In March 2013 the airline detailed plans to order up to 117 Airbus single-aisle aircraft to take its fleet to 375 aircraft, including freighters. Business aviation is growing, too, in a European market that is currently declining. According to business aviation market specialists Avinode, year-on-year business jet traffic in Turkey grew around 4.8% during 2012 over 2011.

The country has also recently announced plans to build a third airport, costing $9.3 billion, for Istanbul, a city of 15 million. It will be built near the Black Sea coast, 37 miles northwest of the city center, with an initial capacity of 90 million passengers a year, rising eventually to 150 million.

Turkish Airlines has become the world's fastest growing international airline.

Turkey, in other words, is taking on the gulf states in the competition to become the key global connecting point between the Far East, Middle East, Europe, and North America.

But there are three key differences between Turkey and the gulf states. The first is that Turkey is no greenfield aviation market, where sudden spikes in demand look spectacular because the baseline of activity is so low. Turkey is already a mature aviation market, hosting the seventh busiest airport in Europe—and the only one to record significant growth last year—and three of the top 10 busiest city-pair routes in the continent.

The second major difference is that these increases are taking place at a time of considerable political and economic unrest along its borders, with civil war to the south in Syria and economic collapse in Greece to the West. With a return to peace and economic stability these growth rates are likely to increase rapidly.

Finally, Turkey's civil aviation ambitions are matched equally by its military ambitions—not just to buy but to develop an indigenous capability with the help of key Western companies.

Aerospace and defense rate high

According to a recent U.S. Dept. of Commerce report, Turkey is a $12-billion annual market for aerospace products and services and a $4-billion market for defense-related goods and services. "In 2011, U.S. exports to Turkey increased by 38% over 2010 and reached nearly $15 billion, and bilateral trade is up 35%, to nearly $20 billion. With a population over 75 million people, Turkey has the world's sixth largest army with 720,000 soldiers, the second largest army in NATO after the United States, and the Turkish air force is the world's third largest operator of F-16s, after the USA and Israel," says the report.

In a recent study, "Revenue Opportunity and Stakeholder Mapping—Turkey Defense Market," Frost & Sullivan reports that the defense market

Evolving Turkish Aerospace Industries

TAI is one of the world's fastest growing aerospace companies, rapidly evolving from a major licensed assembler of fourth-generation fighters to a designer and manufacturer of new generations of advanced trainers and rotorcraft. Its aircraft division produces the HÜRKU basic trainer and is engaged in a wide range of modernization programs for aircraft as varied as the country's Boeing 737 Airborne Early Warning and Control aircraft and the ATR-72 Meltem 3 anti-submarine-warfare platform. The aerostructures business makes ailerons for the Airbus A350 XWB, section 18 structures for the Airbus A320, and the forward and rear fuselage shells for the Airbus Military A400M. Other structural parts are supplied to Boeing 737 and Boeing 777 programs and the Bombardier CSeries. In May 2012 the SSM issued a request for proposal from TAI's helicopter division for an 'Indigenous Helicopter' program. The same division is developing the Turkish Utility Helicopter T-70, based on Sikorsky's S-70 platform, and is building 59 T-129 attack helicopters based on the AgustaWestland A129 airframe, with upgraded engines, transmission, and rotor blades. Other TAI divisions are involved in developing satellites and logistics services.

generated revenues of $18.76 billion in 2012, a figure which will reach $24.70 billion in 2021.

"Turkey's bilateral position as a North Atlantic Treaty Organization (NATO) member with significant West Asian associations is being leveraged to drive growth in its domestic defense market," says research analyst Yasha Izadpanah, one of the authors of the study. "Investment in domestic manufacturing infrastructure is the principal trend in the Turkish defense market at present. This will continue, buoyed by Turkey's steady economy and political intent to establish a self-reliant defense industry."

Major Western companies have set up operations in the country for some time. The first F-16 assembly line was established by Turkish Aerospace Industries (TAI) under license to Lockheed Martin in 1984. Since then it has built over 270 F-16s for the Turkish air force as well as building other F-16s and providing modernization services for F-16s in service in Egypt, Pakistan, and Jordan.

More recently Sikorsky has teamed with TAI on the $3.5-billion contract to deliver 109 Black Hawk utility helicopters to the Turkish military. To meet the requirement, Sikorsky has expanded its components manufacturing business of Alp Aviation, which is 50% owned by Sikorsky, to offer support, including the sale of Turkish assembled aircraft, to future Sikorsky international customers; that, together with the Turkish order, could reach 600 helicopters. Sikorsky is also teamed with Turkish avionics supplier Aselan to provide a new digital cockpit for the helicopter.

Airbus Military has set up a joint venture with TAI to provide in-service support for the A400M aircraft ordered by Turkey, with the potential to provide services to other A400M users in the future. Pratt & Whitney and Goodrich have both signed joint venture agreements with Turkish Technic to provide maintenance, repair, and overhaul services to airlines in the region.

The normal method of procuring Western aerospace assets and expertise is for Turkey's main procurement agency, the Undersecretariat of Defence (SSM), to encourage U.S. and European companies to establish coproduction joint ventures with Turkish defense industry companies, paving the way for the joint venture to sell Turkish-built platforms to other states in the region.

TAI and Sikorsky will deliver 109 Black Hawks to the Turkish military.

Thanks in large part to this policy over the last five years, Turkey's domestic aerospace manufacturing capabilities have become increasingly mature—especially in areas such as avionics and control systems—and are now seeking, and finding, customers for indigenously developed products such as the ANKA medium-altitude long endurance remotely piloted air system. TAI has been the major beneficiary of this investment, but there are still capabilities that cannot be met by domestic suppliers; in March 2013 a $3 billion-$4 billion competition for a long-range defensive missile program was being competed by U.S., European, Russian, and Chinese firms.

"C4ISR and air platforms make up 66% of military imports as a result of Turkey's lack of infrastructure. However, the time to build this cooperation is now, as the opportunities for partnership will diminish as indigenous technical capability continues to grow in Turkey," says Koray Ozkal of Frost & Sullivan. "Turkey will potentially become a major exporter to Gulf Cooperation Council and Association of Southeast Asia Nations countries."

EUROPEAN AIRPORT ACTIVITY 2012

Rank	Airport	Average daily departures	Growth on 2011
1	Paris, C. De Gaulle	680	-3.4%
2	Frankfurt, Main	659	-1.3%
3	London/Heathrow	649	-1.5%
4	Amsterdam, Schiphol	593	0.3%
5	Munich 2	540	-3.2%
6	Madrid Barajas	510	-13.3%
7	Istanbul-Ataturk	482	12.2%
8	Rome Fiumicino	429	-4.7%
9	Barcelona	396	-4.6%
10	Zurich	357	-2.8%

Source: Eurocontrol.

What's next?

But it is what happens next that is interesting, because Turkey is at a crossroads, both economically and strategically. The next several years will determine whether the nation realizes its goal of becoming a major global economic superpower with an indigenous defense capability to match.

Despite the close industrial relations with European and U.S. companies, strategically the government has shifted its foreign policy direction away from seeking closer ties with Western allies to pursue a more independent foreign policy agenda. Turkey did not support the U.S. invasion of Iraq in 2003, and its bid to seek closer ties with Europe through joining the European Union has been partially rebuffed by some EU member states. However, given the economic problems now assailing southern EU states, this may, for the moment at least, be to the country's best interest.

So in seeking to deal with political and economic instability among most neighbors—it is surrounded by Iran to the south, the Balkans to the west, and the Caucasus states to the northeast—Turkey has chosen to increasingly develop its own military capabil-

(Continued on page 23)

Budget realities hit home

On March 27, President Barack Obama signed a continuing resolution (CR) that enables the federal government to continue operations until September 30, the end of the current fiscal year. The Senate and House of Representatives had approved the CR days earlier, on March 24.

The CR locks in across-the-board spending cuts mandated by the process known as sequestration, with a few exceptions. White House spokesman Jay Carney told reporters that the president's approval of the CR does not make Obama a supporter of sequestration. Carney said Obama wants to negotiate with members of his own Democratic party and with Republican leaders to find a longer term debt and deficit solution that will focus on priorities rather than inflicting cuts equally to all agencies.

The alternative to the CR would have been for the government to shut down, and no one in either party wanted that, so the CR really does not change much. Washington anticipates a bruising battle over the budget for FY14, which begins October 1, and leaders in the executive and legislative branches are mustering their arguments for that.

Meanwhile, some Democrats are unhappy with the president for signing the CR because they do not like the indiscriminate form of austerity that comes with sequestration. Some Republicans are unhappy because even with sequestration, big government will see only a small reduction in its size and influence. If the sequester were to remain in effect for several years, it would reduce total government spending by about 4% in an era when the feds are borrowing fully 40% of all the money they spend.

"We're still running government by lurching from one uncertain flashpoint to the next," said one Army civilian employee in Virginia. "No one expects Washington to suddenly return to the traditional budget process, and no one is uttering the word 'compromise.'" This lurching is "the new normal," according to a different Dept. of Defense civilian, "and we'll just need to learn to work with it." No one is certain whether a major debate over the nation's debt ceiling will take place this summer, long before the FY14 budget battle.

In March, earlier than usual, the Senate and House passed competing versions of an FY14 budget. They did so in advance of the White House's budget proposal, which was expected in early April. In the traditional budget process, the White House makes its proposal before Congress acts.

Women to watch

The view from the White House is a little different now for Obama, who does not need to think about reelection and has settled into his second term. His revamped cabinet team is mostly in place and includes Secretary of State John Kerry, Secretary of Defense Chuck Hagel, and CIA director John Brennan.

Brennan will soon have to decide whether to keep the acting head of the CIA's National Clandestine Service.

Secret Service Director Julia A. Pierson

She may well be the most politically popular person in Washington whose name no one knows. Described by the *Washington Post* as a "veteran officer with broad support inside the agency," she remains under cover after being placed on an acting basis in the top spy position just before Brennan was sworn in as CIA boss.

The very existence of this smart, savvy officer poses a dilemma for Brennan. She was a pivotal figure in the CIA's post-September 11, 2001, program of secret prisons and interrogation overseas, in which Brennan also had a role. The program is now defunct, and Brennan and the administration would like to distance themselves from it. If Brennan does not assign the officer to the clandestine leadership job on a permanent basis, he is likely to draw criticism for acting in his self-interest as well as for undermining diversity in an administration already under fire for having few women in key spots. If he does assign her, he may draw flak for appearing to abide the detention and interrogation program.

The advice and consent of the Senate is not needed for Brennan's decision on the CIA officer and was not required when Obama named a new Secret Service director. Julia A. Pierson was sworn in as Secret Service boss on March 27. Pierson is a 30-year veteran agent who knows the 3,500-member service. She is expected to continue a cultural cleanup begun by outgoing director Mark Sullivan in the wake of a scandal that ensnared agents visiting Colombia last spring. Obama said Pierson is "breaking the mold" as the first woman to lead the male-dominated agency.

FAA, sequester, and the 787

The FAA is responding to the nation's ongoing fiscal uncertainty by planning to close 149 control towers at U.S. air-

ports in 38 states that conduct fewer than 150,000 flight operations a year. This will mean furloughs for 20,000 FAA employees. Originally scheduled to begin in April, the closures have been postponed until June 15, as legal challenges are sorted out.

Local officials and congressional delegations are objecting. At facilities such as Arizona's Phoenix-Goodyear Airport, one argument against the closings is that they will hurt local economies. At the Arizona location, a major flight school that conducts 85% of the airport's operations is threatening to move away, taking from the community 80 jobs, 200 people, and most of the airport's reason for being.

"Tales of turmoil at some of the nation's busiest airports are beginning to surface," wrote Andrew Stiles in the *National Review*, "causing some to wonder whether public perceptions of sequestration may soon begin to favor the administration. The FAA has insisted these cutbacks are unavoidable, but the administration has a clear political interest in maximizing the public's outrage, so critics aren't buying it."

Sen. John Thune (R-S.D.) and Rep. Bill Shuster (R-Pa.) wrote to outgoing Transportation Secretary Ray LaHood, whose department overseas the FAA, calling for "a detailed justification and explanation for how the FAA determined each contract tower would be closed." They pointed out that all of the towers involved were operational in 2009, when the FAA received less funding than it will get this year. At press time, the administration had not named a replacement for LaHood, who is scheduled to leave government in June.

Both the FAA and Japan's Civil Aviation Bureau are keeping the Boeing 787 Dreamliner grounded until questions about the jetliner's batteries are resolved. At a press event in Tokyo on March 15, Boeing unveiled a new version of the battery system, designed to overcome problems that caused two much-publicized earlier mishaps, including one serious fire. The Japanese authorities say preparations have not been finished to permit even a test flight of the grounded 787.

Boeing made the first test flight with the new battery systems on March 25 using a 787 with LOT livery.

In another development, the FAA is allowing 787 test flights on a limited basis, to evaluate improvements of the battery installation. Boeing made the first such flight at Paine Field, Washington, on March 25 using a 787 with LOT Polish Airlines markings. A flight for the purpose of gaining formal FAA certification of the new battery design, and hence the aircraft, was expected to take place in early April. At press time, 787 proponents were saying revenue airline flights might resume by the end of April.

Reuters reported that the FAA might certify the Dreamliner for operations over land only. According to the new service, even temporarily limiting extended operations (ETOPS) in this way would cost the company and airlines. An unnamed FAA spokesperson said, "It's really premature to talk about what ETOPS certification we would give them right now....We'll be in a better position to answer questions like that after we get through all this battery testing."

[In March, we wrote that other nations "followed the FAA's lead" in grounding all 50 787s worldwide because of incidents caused by battery problems. One reader pointed out that Japanese authorities grounded the 787 two days before the FAA did. That is incorrect. To clarify: Japanese airlines using the 787 grounded the aircraft before the FAA action, but Japan's civil aviation authority acted only after the FAA did.]


The FAA is facing closing control towers at many lesser-used airports.

Aerial shows and air exercises

Aerial performances for the public, and the air shows where they occur, are among the victims of Washington's budget uncertainty. At least 25 air shows scheduled at locations around the country, including 10 at Air Force bases, have been canceled. The Air Force's Thunderbirds flight demonstration team and the Army's Golden Knights parachute team have canceled scheduled performances from April 1 until September 30, when the fiscal year ends. The Navy's Blue Angels team has not officially canceled its season program, but eight of its performances scheduled for this summer will not take place because organizers chose to cancel the air shows for lack of a guarantee that the Blue Angels—

Uncertainties about the availability of the Blue Angels have resulted in the cancellation of several air shows.

called the 'Rolling Stones of the air show industry' by one observer—would not be forced to back out at the last minute.

On a more serious note, the Air Force canceled the Red Flag-Alaska 13-2 exercise slated for April because of budget uncertainty. Red Flag Alaska is a mock conflict that simulates war in Asia and brings together U.S. combat units from around the Pacific region, as well as British and Canadian forces, to play out a hyperrealistic warfighting scenario. Held periodically, the exercise is credited with sharpening readiness to deal with threats from North Korea, China, and elsewhere.

More serious yet, officials say the current budget situation threatens the Air Force's capability to maintain a bolstered presence on the scene in response to tensions on the Korean peninsula. They say they are uncertain whether funding will continue for a Theater Security Package, or TSP—a bulked-out fighter squadron serving as temporary reinforcement at Kunsan Air Base in South Korea.

F-16 Fighting Falcon pilots, maintainers, and support troops of the 4th Expeditionary Fighter Squadron from Hill AFB, Utah, were completing a six-month TSP deployment at press time. The 4th EFS is a mixed unit consisting of active duty and Reserve airmen, with 12 aircraft, 18 pilots, and 230 troops. During its temporary stay at Kunsan, the squadron functioned as a part of the base's 8th Fighter Wing, the 'Wolfpack.'

Lt. Col. Jay 'Fang' Sabia, squadron commander, said in a March 14 telephone interview that he cannot predict what will happen in Korea but that "we stay ready flying the full spectrum of realistic training missions, some with live ordnance." Col. John W. 'Yoda' Pearse, the Wolfpack wing commander, says that having the additional TSP squadron is "a big help" but adds, "it's disappointing that [the North Koreans] are ratcheting up their rhetoric."

North Korea detonated its third nuclear device on February 12 and issued a statement on March 11 declaring the Korean armistice invalid. North Korea also severed a 'hot line' between Pyongyang and Seoul, at least temporarily.

The USAF maintains four fighter squadrons permanently on the Korean peninsula—one with F-16s and one with A-10C Thunderbolt IIs at Osan Air Base, and two with F-16s at Kunsan. The ongoing presence of a deployed TSP at Kunsan provides a fifth squadron. All the U.S.-operated F-16 fighters are F-16CM Block 40 models that have been modernized in the Common Configuration Implementation Program (CCIP). The update includes the HTS (HARM targeting system), which enables Block 40 F-16s to use AGM-88 HARM (high-speed anti-radiation missiles), designed to home in on enemy radar emissions. The Republic of Korea air force operates

Lt. Gen. Stanley Clarke

An F-16CM Fighting Falcon takes off from Kunsan Air Base, Korea, in March, while serving as part of a Theater Security Package on the Korean peninsula. Courtesy: USAF.

newer KF-16C Block 52 Fighting Falcons that received the CCIP, HTS, and Link 16 improvements while on the production line.

The 4th EFS was slated to rotate home in April. Pearse, Sabia, and others say they do not know whether plans for a replacement TSP will survive ongoing defense cuts. Sabia says that spending six months in Korea has been "an especially good experience for our younger pilots" but adds, "Whether a future squadron will fill in behind us is still to be determined."

Changing of the guard

On March 22, Lt. Gen. Stanley Clarke III became director of the Air National Guard in a ceremony at Joint Base Andrews, Maryland. Clarke replaces Lt. Gen. Harry M. 'Bud' Wyatt III as the nation's top Air Guardsman. (Wyatt was also the last pilot in uniform to have flown the F-106 Delta Dart interceptor of the 1960s.)

The changeover happens when tensions are rife between the Guard and the active duty Air Force, with many in Congress looking for ways to halt Guard aircraft retirements that were planned by the active duty Air Staff. "I've arrived in a time of budget turmoil and uncertainty," Clarke says, "but I view this as a time of opportunity as well."

Clarke is a command pilot with over 4,000 hours, including more than 100 combat hours, in A-10 Thunderbolt IIs and F-16s.

Clarke told a congressional over-

sight panel that one of his priorities is to minimize the "dramatic toll" that budget cutbacks are taking on the Air Guard's readiness and people. At future hearings, he can expect to be grilled about Pentagon plans to retire or cancel 38 C-27J Spartan tactical airlifters and numerous other aircraft once slated to equip half a dozen Guard units. Lawmakers are upset that manned flying missions are being replaced by missions involving UAVs—often flights that do not involve having aircraft at home base. Clarke has acknowledged the concern and promised to keep at least one manned flying mission in every state.

Army Gen. Lloyd Austin, who previously served as Army vice chief of staff, assumed command of U.S. Central Command from Marine Corps Gen. Jim Mattis in a ceremony at MacDill AFB, Florida, on March 22. Defense Secretary Chuck Hagel presided over the event. Mattis, who is retiring from the military after 41 years of service, had led CENTCOM since August 2010, overseeing the U.S. military's activities in Afghanistan, Iraq, Central Asia, and the Middle East.


Gen. Lloyd Austin

"Jim Mattis really is one of a kind. He's a visionary," said Gen. Martin Dempsey, Chairman of the Joint Chiefs of Staff, during the ceremony. Dempsey added, "I've never met a marine who has served with Jim Mattis who has anything but the highest regard for his leadership." Dempsey noted that Austin also has done some "heavy lifting" downrange, having overseen the conclusion of the U.S. mission in Iraq.

Austin said he was honored to lead CENTCOM and thanked the members of command for their service. "I'm reminded of the courage, determination, and professionalism of the soldiers, sailors, airmen, marines, and coast guardsmen and their families," said Austin. He added, "They are without question the reason why ours remains the finest and most capable military in the world."

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Robert F. Dorr's latest book is Mission to Tokyo.

Fundamentals of Aircraft and Airship Design

Volume 2—Airship Design and Case Studies

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Fundamentals of Aircraft and Airship Design, Volume 2 —Airship Design and Case Studies examines a modern conceptual design of both airships and hybrids and features nine behind-the-scenes case studies. It will benefit graduate and upper-level undergraduate students as well as practicing engineers.

The authors address the conceptual design phase comprehensively, for both civil and military airships, from initial consideration of user needs, material selection, and structural arrangement to the decision to iterate the design one more time. The book is the only available source of design instruction on single-lobe airships, multiple-lobe hybrid airships, and balloon configurations; on solar- and gasoline-powered airship systems, human-powered aircraft, and no-power aircraft; and on estimates of airship/hybrid aerodynamics, performance, propeller selection, S&C, and empty weight.

The book features numerous examples, including designs for airships, hybrid airships, and a high-altitude balloon; nine case studies, including SR-71, X-35B, B-777, HondaJet, Hybrid Airship, Daedalus, Cessna 172, T-46A, and hang gliders; and full-color photographs of many airships and aircraft.

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Eddy Pieniazek

What is the state of the civil aviation market today?

In 2012 we saw passenger traffic grow ahead of capacity growth, and that is always a good thing to see. The real growth areas have been, in terms of percentages, the Middle East, Latin America, and Africa, while Asia Pacific is still growing annually at about 6% in terms of passenger numbers. Europe is a little more anemic, towards the 5% mark, and North American growth is very low, about 1%.

We will probably see something a little bit better than this in 2013. Global gross domestic product [GDP] figures are forecast to increase about 2.6% this year and 3.5% next year. So it looks as though we are coming off the bottom of this particular downturn in the market. It also looks as though some of the economic and financial crises that we have recently seen are starting to ease, even if they are not quite over yet.

There is no growth in the Eurozone, but at least it's stabilizing, notwithstanding problems in certain countries. Political risk is ever-present, and there is always something going on somewhere in the world that can trip up the industry. If there are any clouds out there they are probably on the political side.

The International Air Transport Association [IATA] is forecasting GDP growth of 2.3% over 2013, which would translate into passenger growth of about 4.5%. Yields are down a little, and I think cargo traffic is probably quite a concern, so maybe we are seeing some fundamental shifts there. Oil prices seem to be moderating, and again we are not expecting to see any major uplifts. Airlines are looking to generate close to a $600-billion turnover and profits of around $8 billion to $9 billion—which is a 1.3% margin. These are not stellar figures, but certainly an improvement on where we thought we might be and with some good indicators going forward.

"People talk about this being 'a lost decade' for Europe, and I can quite buy into that."

European aircraft operator trade associations seem to be convinced that we're not in the usual cycle of growth and decline but that there's a new economic aviation dynamic with no clear path for growth. Some believe that even in 2017 they won't hit 2008 traffic levels. Are they wrong?

No, I think in terms of Europe they're probably right. People talk about this being 'a lost decade' for Europe and I can quite buy into that. We're not seeing growth in Europe but stabilization, and you've still got some of the bigger, heritage airlines shedding numbers and making big losses and still trying to adapt their model to what's required going forward. The upstarts, the low-cost carriers are making waves and making things happen.

But the biggest potential for passenger growth is in Asia and the emerging markets, and certainly for the next few decades growth in demand is going to be driven by those markets. If we have more stable oil prices—they might still be high but at least if they are stable—carriers can plan around this, and they are managing their capacity much better than they have done before.

Previously they would just chase market share at any cost. Now they are much more disciplined, and I think the U.S. is leading the way here, growing capacity very minimally and just trying to get better yields and better margins, making their businesses more sustainable. It's similar to what we saw in the early 1990s with some airline consolidation, a weak economy, and uncertainty over U.S. fiscal policies. We managed to work our way out of that and in fact the upturn came not by surprise but by stealth. You can almost see that sort of thing happening again.

How does that translate to aircraft orders and deliveries?

The order and delivery boom is driven primarily, I suspect, by fuel price. The biggest shock we've had in the past decade has come from fuel-price increases. It has shown how efficient today's generation of aircraft is compared to previous generations. If you think back to the 1990s, you could fly an Airbus A320 against a Boeing 727 and you could make both of them work; the reason was because oil was

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Interview by Philip Butterworth-Hayes

$10 a barrel and the fuel equation was a much smaller part of the overall costs. But once you hit $100 a barrel, today's aircraft suddenly are recognized for being so much more economic. So we've had this wave of older equipment that's beginning to be replaced.

For airlines what this means is that even if oil prices come down they still have to deal with the uncertainty of future prices, so they simply need to have the most efficient aircraft in their fleets, to cope with whatever happens to oil prices.

What we have seen in the last few years is airlines competing to get hold of delivery slots, getting hold of new aircraft. A lot of orders have come from the low-cost carriers, and part of the lesson that they have learned is to have a homogenous fleet and to buy in bulk. So, yes, we have a big backlog of close to 10,000 aircraft. In terms of the available slots I believe most of the slots for 2013, 2014, and 2015 have gone now—though there might be a few regional jet slots available, based on aircraft production rates published by the manufacturers. Some recent orders have specified deliveries in 2026; these are long lead times.

Is there any sign of Airbus and Boeing adding production capacity to meet short-term demand, or are they still being fairly conservative about how they manage their production?

There are two camps here. I think manufacturers would say they are being very conservative, but others believe they are overbuilding. Manufacturers say they are only building aircraft that people have ordered, but others, who have already or recently invested in aircraft, don't want to see too many aircraft being built and a glut forming, which could drive down prices.

Airbus and Boeing have both got slots to fill prior to introducing new models—the Boeing 737MAX and the Airbus A320neo families—and they don't want to start decreasing production and then increasing it again. So they're trying to sell off remaining availability, and I guess some of these Lion Air, Ryanair, and Turkish Airlines orders are soaking up some of that. The leasing companies are also looking at taking up some of the remaining near-term production availability as well.

I'm quite surprised that the values of the current Airbus A320 and Boeing 737 families don't seem to have been badly affected by the launch of the neo and MAX variants. Have these new types had any impact on the secondhand value of the current fleet?

They haven't. Values have stayed relatively flat for a long time, and you can buy a new A320 or a new 737 for between $40 million and $45 million—the same cost as 10 or 20 years ago. There's effectively been a cap on new-delivery pricing for these models; it's gone up a little recently as labor and materials have gone up, but a lot of that's just had to be absorbed. So yes, they have been relatively stable and we think they'll stay stable.

In the past we've seen new aircraft come along and the value of the older models depreciated much more rapidly. That might happen a little but it won't be as dramatic as it has been in the past, probably because there's such a large population of A320 and 737 aircraft and you're not just going to replace them all in one fell swoop. It's going to take 10 or 15 years to make a material impact.

Maybe in the next downturn or the downturn after that we will start to see values probably fall away, but that's when much of the current Airbus A320 and Boeing 737 fleets will be 20 years old, and you'd expect to see that happen anyway.

In terms of funding new aircraft, what are the big issues for 2013?

The biggest headline event in aviation finance for 2013 is the fact that this will be the first year that we will see more than $100-billion worth of deliveries occurring. It's a big number that covers both commercial jets and regional jets. Last year the total was about $85 billion, and we think this year it is going to be about $102 billion. We think this will grow by perhaps around $10 billion a year for the next few years because we're getting a large wave of widebody deliveries and of course they're more expensive.

For the last five or six years the market has been worried whether there will be enough sources out there to finance all these aircraft. But by the end of each year the last aircraft was delivered and the money was found. There are lots of new sources now. The export credit agencies in the U.S. and Europe have done a sterling job supporting these sales and have accounted for perhaps 30% to 35% of financing deliveries, by providing guarantees that have in turn allowed some of the banks to also carry on providing commercial debt into other aspects of the business. Leasing companies are coming to the fore as well.

"The biggest headline event in aviation finance for 2013 is the fact that this will be the first year that we will see more than $100-billion worth of deliveries occurring."

Many banks and investors are happier lending to leasing companies now because these companies know how to manage aircraft—they know how to place them into airlines, they know how to take them out, they

know how to manage the process to move them to the next operator, and that gives investors confidence. So we expect to see them play a bigger part going forward.

Many airlines are still funding their deliveries with cash from their own cash-flows, and once they take delivery they'll sell and lease them back as a refinancing deal—they therefore have their own pool of money that keeps circulating. There are some regulatory changes happening that could make financing in some respects a little bit more expensive, but I believe that's something the market will absorb.

What are these changes?

They are changes in terms of the way funding occurs, making funding a little more expensive for airlines to manage, so interest rates will be higher. It's all to do with protecting the banks going forward and their ability to repossess aircraft and take them back should things go wrong. It's something that the market has been aware of for a few years and is being implemented this year.

Are you less optimistic about the cargo market?

Yes. If you look at all the signals from the cargo market it's been struggling and continues to struggle for a number of reasons. Because of the economic downturn, with China slowing down a little as well, that means there is effectively less traffic and more competition to air traffic. One of the things we've noticed is that the reliance on just-in-time production is not as important as it used to be. There are goods that are still important and need to be delivered quickly, like perishables, but computers and iPads and iPhones now tend to go by ship because it's more affordable and not as sensitive on a time basis.

I think the run-down in terms of military support in places like Iraq and Afghanistan has also released a lot of aircraft back into the general cargo market, so you have an oversupply there. We also have deliveries of new freighters like the Boeing 747 and the Boeing 777s, so you have an immediate overcapacity of aircraft.

It's going to require some really strong economic growth and industry replenishing inventories to kick-start this market again, and I don't see that improving near term; but aircraft will continue to be delivered and they will be very fuel-efficient. I think in terms of Boeing 747 conversions, we don't expect to see many more of these because the older Boeing 747 may have had its day in this particular market.

Traditionally aircraft stay in service 25 years and are then scrapped—are there any changes to the lifespan of airliners?

This is very topical at the moment. Some analysts believe lifespans haven't changed, others say they are increasing and others say they are getting shorter. I suppose the question is whether this is a structural issue or simply part of a cycle.

What we are seeing at the moment is that there are more aircraft retiring at a younger age, though it's a marginal change. If you look from 2000 onward, the average age of economic retirement—when they leave service and don't return—was probably hovering around the 27- to 28-year mark. We are now down to about 25. And if you look at the overall average age of retirement—including a period in store after retirement—that's come down from around 30 to 26 years.

This is still a very young industry relatively speaking, and there just isn't a track record to give any long-term clarity. We are, however, seeing aircraft that are being broken up today at a very early age. We're seeing Boeing 777s being broken up at 10 or 15 years; we're seeing Bombardier CRJs broken up at five years, and we've seen a Boeing 747 freighter broken up four years after it was converted. Airbus A318s, A319s, and A320s as well as Boeing 737s are being broken up relatively early.

Much of this is because there is an opportunity to recover more value from the parts than there is from the aircraft as a going concern. So you might be able to sell an older A320 for $6 million-$8 million as a going concern, but if you dispose of the parts you might recover $10 million-$12 million. There are opportunities there, windows that appear every now and then, and if you've got the right aircraft type with the right engine variant you can make a better return by breaking it up.

Do you think Boeing and Airbus face real competition on their single-aisle fleets from new entrants in China, Russia, and elsewhere?

The competition's real enough, but I think you just have to look at production rates to see how big an impact these new aircraft might have. If you consider the Boeing and Airbus narrow-body production rates and wind that clock forward to 2020 and look at what's going to be delivered between now and then, even if the newcomers build to their full production rates Airbus and Boeing will by then account for 90% to 95% of the narrow-body market. So I would say Airbus and Boeing are fairly relaxed about it; they are in a very strong position now, and it's going to take more than a decade for any competitor to really start eating into that market.

The COMAC C919 and Irkut MS-21 are pretty much complementary designs to what's already out there in terms of size, shape, and performance, and they hasve got the same kind of engines. So they're just adding to the mix and creating more of a choice. They have domestic markets that will probably help them, and the indicators are that COMAC is very serious, and we expect the company to build a decent aircraft.

But looking at Airbus and its original A300 and A310 launch models, it wasn't until Airbus delivered the A320 that they actually started to hit a rich seam. It could be that when COMAC enters the widebody market, that's when they will start to make bigger inroads. COMAC and the Russians have

"If you look at all the signals from the cargo market, it's been struggling and continues to struggle for a number of reasons."

both said they are looking at the wide-body space, but we are probably looking at 2025 or beyond for those new aircraft to materialize.

The Bombardier CSeries is a little more disruptive, because it's placed between two particular markets and it has more potential to be a game-changer here. If it can deliver what has been promised it will probably have a very good future. Again, even if the company builds to its full production rate it still won't make that big an impact on the overall market. But it can at least start to capture a share of the business and be a success.

In the regional sector I think everyone's stepping up a gear, and the Embraer E-Jet is showing the way in terms of new seat capacity. There will be great opportunities here, especially as new "Scope clause" rules, which have tended to limit the size of aircraft that U.S. regional airlines have been able to use on their feeder routes, are now opening up the market.

The turboprop end is an interesting market because we've seen some submarkets, like the 30-seater sector, disappear from production. There is nothing in production there at the moment and yet there are fleets of aircraft of this size out there. In fact, there are hundreds of 30-seat aircraft still operating. They will require replacing, and there's an opportunity there for somebody to step in and build a new 30/35-seater. It's not a massive market, but there's got to be room for somebody to capture that.

The 19-seat market is also interesting, and at the other end—the 70-, 80-, 90-seat turboprop market—I know there's talk of even growing beyond that. The turboprop's had a pretty good renaissance at the larger end of the market because of fuel prices. Now that fuel has become the biggest cost component—it's 50% or thereabouts of the overall costs for some aircraft operators—you live and die by that, and so you've got to learn to adapt to it.

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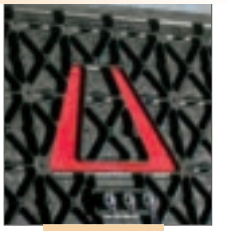


Deep space 2023: The art of the possible

"The object of your mission is to explore the Missouri River, and such principal streams of it, as, by its course and communication with the waters of the Pacific Ocean…may offer the most direct and practicable water-communication across the continent, for the purposes of commerce."

—Thomas Jefferson to Meriwether Lewis, 1803.

President Jefferson's order to Meriwether Lewis inaugurating the Lewis and Clark expedition offers the nation a model for guiding its explorations of Earth-Moon space. The U.S. should make deep space not only an arena of scientific exploration, but also a fertile economic frontier where private enterprise and industry can thrive. The guiding mission for the U.S and NASA in the coming decade should be to explore Earth-Moon space and tap the resources found there—*for the purposes of commerce.*

"NASA's Strategic Direction," a National Research Council report issued in December, stated that the agency's progress toward achieving its long-term priorities is hampered by a lack of national consensus on its strategic goals and objectives. Another serious obstacle is the mismatch between its directed goals and the congressionally allocated budget. Because current law restricts NASA from reorganizing its personnel and infrastructure more efficiently, the agency cannot use its limited resources more wisely in pursuit of long-term goals. The panel suggested that the White House take the lead in developing a national consensus on space policy goals and provide a budget better suited to the directives it gives NASA.

Far from boosting NASA's resources, the Congress passed a budget in March cutting about a billion dollars through the rest of this fiscal year. Whatever the funding details for 2013 and 2014, neither the White House nor the Congress will make any major shifts in the agency's overall goals. A change in NASA fortunes requires a change in strategic direction.

The SpaceX Dragon was captured and berthed at the ISS by Expedition 34 using Canadarm II on March 3. Future commercial vehicles will be essential in supplying propellant and hardware to exploration outposts in Earth-Moon space.

How far in a decade?

On the current course, by 2023 NASA astronauts will still be working aboard the ISS, an outpost heading into its twilight years. Commercial transport firms will be handling resupply, and NASA will be leasing private spacecraft for the launch and return of its space station crews. ISS lifeboat services also will have gone commercial, shifting that duty to the U.S. for the first time since Russia's Soyuz assumed the role in 2000. NASA will announce a stream of interesting scientific discoveries from the ISS, but no scientific or technological breakthroughs will have reached the marketplace. In public perception, the ISS and its mission will still have a very low profile.

By 2023, NASA's Orion will have launched just three times, and only once with crew aboard. The heavy-lift Space Launch System (SLS) might have two missions under its belt, perhaps propelling the first Orion crew around the Moon in 2021. But these milestones assume flawless performance for Orion and SLS in their initial shakedowns. Budget projections for the 2020s envision NASA flying the SLS/Orion only once every couple of years. With progress and momentum so slow, and without the ability to equal even Apollo achievements, a future president and Congress could easily decide to end NASA's entire human space exploration enterprise.

NASA hopes its announced deep space goal, an expedition beyond the Moon to a near-Earth asteroid (NEA) by 2025, will finally revive its fortunes. However, progress toward that goal has been elusive: Orion and SLS are hardly on a fast track, and the agency's ideal targets for such expeditions have yet to be discovered.

NASA has not even allotted funds to conduct the half-billion-dollar survey mission, critical to finding a target for the administration's 2025 asteroid goal. As NASA's own Small Bodies Assessment Group reported in January, "Funding a NEO survey mission has the collateral benefits of identifying potential NEO targets for ISRU [in-situ resource utilization] and robotic science missions, as well as Potentially Hazardous Objects for planetary defense." Yet no funds to commence the needed space-based search (0.3% of the NASA budget over 10 years) can be found.

Neither the scientific discoveries to be made in deep space nor the prospect of losing leadership to China in that arena seem to energize U.S. policymakers. If science and foreign policy are insufficient prods, perhaps we should turn to another incentive, one that has sustained U.S. progress for more than two centuries: entrepreneurial commercial development.

Reviving a mission

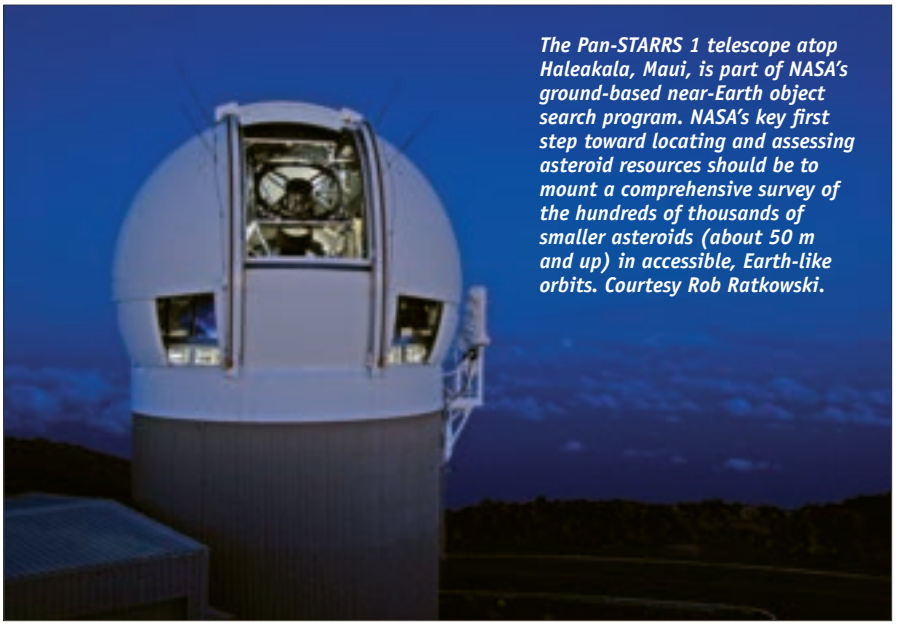
Fortunately for NASA and the nation, the agency is already empowered to help open up the deep space economic frontier. Congress, in the National Aeronautics and Space Act (as amended in 2010), declares: "*…the general welfare of the United States requires that the Administration seek and encourage, to the maximum extent possible, the fullest commercial use of space.*"

The Moon and nearby asteroids offer abundant raw materials, and the Sun provides nearly limitless energy to power industrial activity in space. The president, then, should direct NASA to expand the $300-billion global space sector by using its deep space programs to actively open the resources of Earth-Moon space to economic development.

The millions of NEAs are cosmic leftovers from the formation of the solar system, constantly streaming through Earth-Moon space. Asteroid 2012 DA14, for example, passed within Earth's geosynchronous satellite ring on February 15; at 45 m in diameter, its mass is about 130,000 metric tons. The NEA population harbors more than half a million objects as large as or larger than DA14, many on orbits accessible to NASA and private spacecraft. To date, we have discovered just 10,000, barely 1% of the total population.

A deep-space mission to a near-Earth asteroid may reignite NASA's fortunes.

Two asteroid mining companies, Planetary Resources and Deep Space Industries, have already announced their intentions to go after these natural sources of water, metals, and volatile organic compounds. They plan to find asteroidal water first and sell it to space agencies, later using NEA metals, organic compounds, and rare elements as feedstock for construction and industrial processes. The initial benefit derived from the asteroids (as from the Moon) is water for use as propellant, to replace hydrogen and oxygen launched at greater cost



The Pan-STARRS 1 telescope atop Haleakala, Maui, is part of NASA's ground-based near-Earth object search program. NASA's key first step toward locating and assessing asteroid resources should be to mount a comprehensive survey of the hundreds of thousands of smaller asteroids (about 50 m and up) in accessible, Earth-like orbits. Courtesy Rob Ratkowski.

NASA astronauts Kevin Ford (foreground), Expedition 34 commander, and Tom Marshburn, flight engineer, worked with the combustion integrated rack multiuser droplet combustion apparatus in the ISS Destiny laboratory on January 9. The ISS can host commercial/NASA tests of equipment and processors needed to exploit resources on the low-gravity surfaces of near-Earth asteroids.

from Earth. Even a 500-ton asteroid (about 7 m across) could harbor 100 tons of water, worth about $5 billion at today's launch prices.

Space resources, step by step

Both companies expect to take at least a decade to bootstrap their way to prospecting missions on distant asteroids. NASA can speed this progress appreciably.

As a matter of policy, the agency should put industrial use of space resources on a par with its science and technology goals as it plans to send astronauts to lunar distance and beyond. By fast-tracking physical access to in-space resources on both NEAs and the Moon, NASA can make these materials available not only to astronauts, but also to commercial industry.

Specifically, this means accelerating the search for water ice at the lunar poles, and returning samples and bulk asteroidal material for industrial assessment and testing. It's not enough just to invite industry to help NASA in these efforts; the agency should use its launch systems, or harness commercial partners to put companies in direct contact with space raw materials.

First, NASA can announce its intention to spur prospecting for space resources by starting a focused search for small asteroids using existing and off-the-shelf ground-based systems, such as the ATLAS search telescope just funded by the agency. It can evaluate this year and next the practicality of a robotic asteroid capture and return mission (see "Delivering on a promise to Columbia's explorers," March, page 14). NASA should initiate a low-cost mission to prospect for ice on the Moon using a commercially built rover and launcher.

In parallel, NASA should push ISS experiments testing asteroid surface systems and commercial resource processors aimed at exploiting water-bearing NEA regolith when available. Within five years, NASA should launch commercially built asteroid probes toward promising NEA targets, with the results guiding development of appropriate resource processors.

The shift to including commercial space activity as a NASA exploration goal, equal to science and exploration technology development, can happen quickly in a series of small but high-profile steps.

One of the ambitious elements in this sequence is a robotic capture mission to 'bring an asteroid to us.' That enterprise will be far less expensive than a human mission to an asteroid (now sliding inexorably toward 2030).

Steps to integrate commercial activities in NASA's deep-space planning

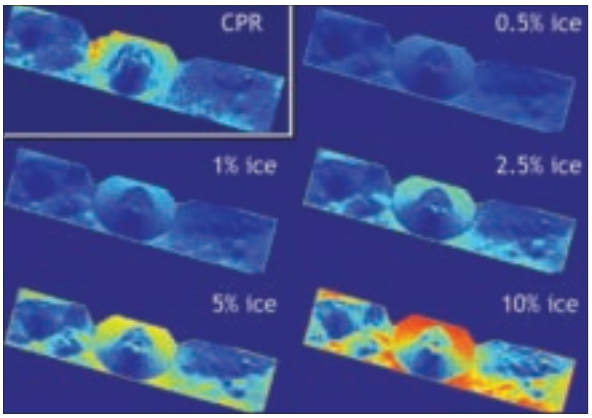
•A search for small, accessible NEA targets using ground-based systems.
•ISS tests of NEA regolith collection and sampling, using simulated asteroid material.
•Launch of an infrared NEA discovery telescope to heliocentric orbit.
•Commercial ISS demonstration of water extraction from meteorite materials.
•NASA-commercial water ice robotic prospecting on the Moon.
•NASA launch of commercial probes to nearby asteroids.
•Launch of a NASA robotic mission to capture and return a roughly 7-m NEA to high lunar orbit.
•Solar electric propulsion delivers a small habitat to the Earth-Moon L2 Lagrange point.
•Using SLS, Orion visits the L2 habitat on the first crewed, deep-space mission.
•Commercial launch services deliver cargo and propellant to restock the L2 habitat.
•International outfitting of the L2 outpost for remote sensing of lunar resources.
•The first in-situ water production from lunar ice.
•The first lunar water samples boosted to L2 for return to Earth by Orion crews.
•A captured NEA placed in stable lunar orbit.
•L2 crews visit a captured NEA for sampling and processing demonstrations.
•International and commercial access (via telerobotics) to a 500-ton captured NEA.
•The first use of lunar-derived propellant in a launch from the Moon.
•The first commercial-scale extraction of asteroidal water in high lunar orbit.
•Competitive choice of space-derived water for propellant production: from the Moon or an NEA.
•Space-fueled lunar surface sorties.
•Space-fueled NEA expeditions.
•Use of lunar or NEA materials for industrial processes in Earth-Moon space.

With a small asteroid in a stable lunar orbit, astronauts in the 2020s will have access to 500 tons of raw material, and with far less cost and complexity than putting humans on the Moon.

In fact, the U.S. should do both, but no one at NASA is proposing astronaut sorties to the Moon. That leaves small asteroid retrieval as the only means of giving robotic and human explorers access to bulk quantities of raw materials. A bonus is that asteroidal material avoids the considerable delta-V expended in getting into and out of the lunar gravity well.

These overlapping activities would begin in 2015 and culminate in deep-space asteroid expeditions in about 2030. Multiple robotic initiatives would be followed by astronaut involvement, with international and commercial participation providing telerobotic hardware, human habitats, life-support consumables, and processing machinery on the Moon and at a small captured asteroid. The payoff in the 2020s is a breakout from the 'only governments in deep space' model, where commercial firms develop the capability to supply in-space propellants and lower the overall cost of future exploration. Industry can determine what space products best match markets on or off the planet.

NASA should invite its ISS international partners to participate in this commercial push, too. In exchange for hardware and transportation services, the partners would gain physical access to lunar and asteroidal materials for assessment and process demonstration. Collectively, they can contribute launch services, habitats, propulsion modules, logistics flights, robotic rovers, and regolith samplers and processors. What happens after that is a matter of self-interest and competition: Those who contribute to the effort will get to pursue follow-on partnerships in pursuit of these resources (there are plenty of asteroids to go around).



Radar data indicates that the walls of Shackleton crater may hold ice. Actual observations (CPR) by LRO's mini-RF instrument are compared to calculated radar values for 0.5% to 10% ice. Credit: NASA.

Opening an economic frontier

The addition of a commercial element to NASA's deep space plans is well out of NASA's comfort zone. Jumpstarting a space-supplied industrial frontier isn't a straightforward engineering challenge, like Apollo. But the shift is firmly based on the NASA charter, and a willing president and Congress can pivot to commercial exploration with the expectation of widespread support.

The alternative would be a continuation of the budget-constrained, sluggish pace toward a few astronaut deep-space sorties in the 2020s. Results will be meager, with nearby asteroids still out of reach, the Martian surface more so. Budgets will keep shrinking. A move to gain access to space resources will draw commercial innovation, public buy-in, private investment, and a rush to find methods of exploiting the raw materials and energy NASA first makes available.

The president's budget appeared after this column went to press, but it is unlikely that he issued new orders to NASA: No Orion sorties to EM L2, no outpost stationed above the far side of the Moon, no fast-paced, space-based search for accessible asteroid targets. Our exploration outlook for 2023 is stagnant, with a significant likelihood that we will abandon deep space to more energetic competitors. Could a goal of discovering material and industrial wealth in space turn those prospects around? We won't know until we try, as Jefferson and Lewis did.

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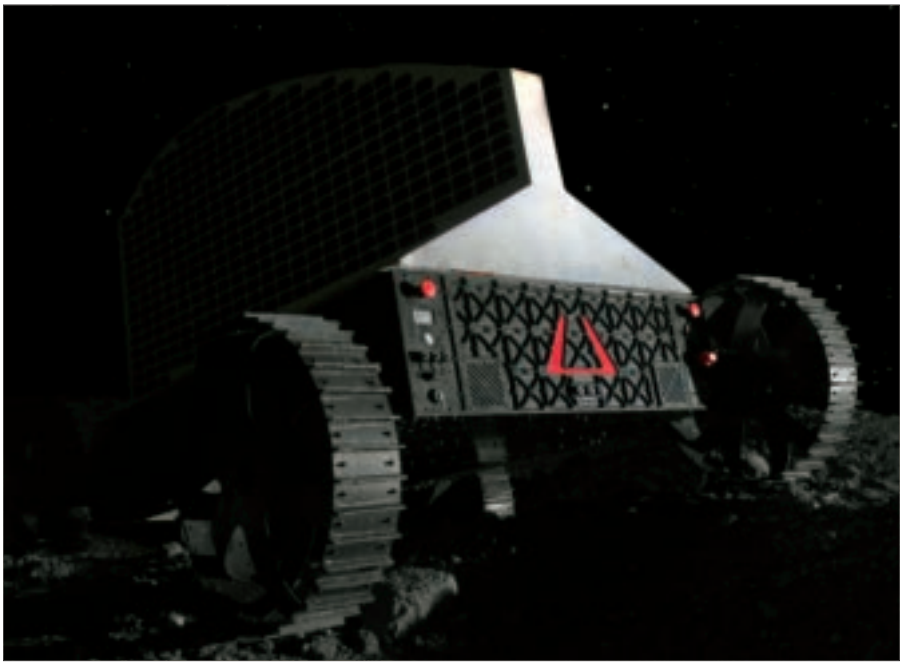

Commercially designed lunar ice prospectors, like this Polaris robotic rover from Astrobotic Technology, a spinoff of Carnegie Mellon University, can help NASA accelerate the search for valuable resources in Earth-Moon space. Courtesy Astrobotic Technology.

Hopes rise for U.S. UAV sales to Middle East

The United Arab Emirates' (UAE) decision to purchase the Predator XP signals a breakthrough in U.S. industry efforts to break into the Middle East UAV market. The $197-million sale is the largest to date for U.S. UAVs in the Middle East and, of equal importance, the first U.S. sale of a medium-altitude, long-endurance UAV in the region. The deal was signed in February.

The XP is an export version of the Predator A, known as the MQ-1 in U.S. service. The XP has built-in safeguards to prevent any tampering with its technology and to ensure that it cannot carry weapons. It was designed to be compliant with the Missile Technology and Control Regime (MTCR). U.S. industry executives were concerned that the UAE and other Persian Gulf states would insist on either buying the Predator B or nothing at all from the U.S. When the UAE purchased its version of the F-16, the Block 60, it bought a version that is more modern than those flown by the U.S. Air Force.

The contest in the UAE was hard fought. It pitted U.S.-based General Atomics Aeronautical Systems' modified Predator against BAE Systems' Mantis. Chinese industry also got involved by offering a medium-altitude, long-endurance UAV.

Addressing MTCR's disadvantages

In offering its next-generation Mantis, BAE Systems was hoping to gain UAV R&D funding for the cash-strapped program, according to industry sources. That concerned U.S. industry, which saw transfer of the Mantis technology as potentially noncompliant with the MTCR, putting U.S. firms at a comparative disadvantage.

There are serious issues for U.S. UAV manufacturers and sensor makers in addressing the export market in general and the Middle East specifically. Because of Israel's proximity, getting authorization to sell systems to other countries in the region is very difficult. In addition, Middle Eastern nations often want systems used by the military that are considered MTCR Category I systems (with a presumption of denial of exports according to the MTCR's rules).

Predator XP

The MTCR was a voluntary agreement established to limit the proliferation of delivery systems for weapons of mass destruction, including missiles and UAVs. It created categories intended to restrict the export of such systems. Category I is for systems that would deliver a 500-kg payload at least 300 km. For this category, which includes Predator/Reaper and Global Hawk, there is to be a presumption of denial for exports.

The U.S., as a signatory of the MTCR, is particularly stringent about enforcing the MTCR rule because it wants no loopholes under which other countries could export missile systems to Iran. However, U.S. industry executives complain that competitors in other countries are often not held to the same standards by their own governments.

In its effort to address the Middle East market, General Atomics unveiled a version of its Predator that takes it out of the MTCR Category I with its presumption of denial. This export version, the XP, is being offered to the UAE and Saudi Arabia, among other Middle Eastern countries. The aircraft includes antitamper devices to protect its technology and carries a lesser payload to ensure its MTCR compliance.

The UAE sale may assuage concerns among other oil-rich Arab states about buying the Predator XP as well as other U.S. UAVs. In particular, Saudi Arabia has repeatedly considered the XP purchase without moving ahead.

Illusory growth

Expectations that U.S. UAVs would dominate the market both in the Middle East and worldwide have never been realized, despite the systems' effectiveness in the wars in Iraq and Afghanistan.

U.S. industry's serious competitive advantages over exporting rivals in Israel, Europe, and China have not yet resulted in export strength. The U.S. market will spend 62% of the $28.5 billion spent on R&D over the period from 2012 to 2021, according to projections prepared by the Teal Group. The U.S. market will represent 55% of the $60.6-billion procurement market over the same period. That figure means that U.S. industry will have

clear advantages both in its ability to fund research and in having the economies of scale that should make it the world's leader in sales.

Of all areas in the emerging world, it is the Middle East that offers the U.S. the greatest advantages. The U.S. is the dominant arms supplier in the area. Between 2008 and 2011, the U.S. provided 54% of the arms deliveries to the region, according to figures compiled by the Congressional Research Service (CRS) in its annual report on arms transfers worldwide. Of Saudi Arabia's $33.7 billion of arms transfer agreements in 2011, fully 99.9% were with the U.S.

The Middle East is a critical region for any arms exporting country because of the size of its market. Of the 10 largest recipients of arms in the developing world during 2011, seven were Middle Eastern or North African nations.

In a leading indicator of future arms deliveries, the Middle East led the world in arms transfer agreements in 2011. Saudi Arabia ranked first in the value of arms transfer agreements among all developing nations that are weapons buyers, concluding $33.7 billion in such agreements, according to CRS. India came in second, with $6.9 billion in such agreements. The UAE ranked third with $4.5 billion.

Israeli industry, which has established itself as a UAV export powerhouse to Europe, Asia, and Latin America, is unable to compete in the Arab countries of the Middle East. That adds another potential advantage for the U.S. in that region.

U.S. defense companies also have the needed relationships with Middle Eastern countries. Yet expectations of U.S. dominance in this market have proved illusory. So far, U.S. sales in this UAV market have been limited to small numbers of smaller, lower cost systems. In May 2012, the U.S. agreed to sell the Iraqi navy 12 ScanEagle UAVs to help the nation keep watch over its offshore oil facilities.

Kuwait also has shown interest in the ScanEagle, which offers the country several advantages. The Kuwaiti military is familiar with the system because U.S. troops have operated it there and because the small tactical UAV can be operated off ships as well as from land.


Mantis

Boeing Insitu has established a partnership with UAE-based Abu Dhabi Autonomous Systems Investments to promote sales in the UAE and to provide support for Insitu's products there and in the rest of the region.

There have also been small sales of AeroVironment's inexpensive mini-UAVs. The 4-lb, hand-launched Raven is operated in small numbers by Saudi Arabia, Lebanon, Yemen, and Iraq.

The U.S. Army's tactical workhorse, the RQ-7 Shadow, was exhibited in the November 2011 Dubai Air Show, but it has not been purchased by any Middle Eastern nations despite its extensive use during the Iraq and Afghanistan conflicts. Expected interest by U.S. Middle Eastern allies did not develop.

Rising competition

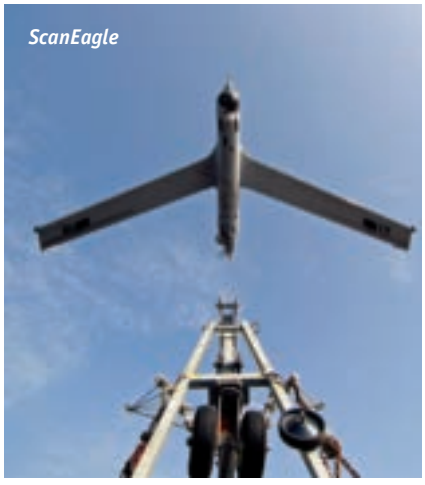
U.S. industry has been active in arguing that the country has been squandering its leadership in UAVs in the Middle East and elsewhere. "Today, the U.S. is struggling to sell unmanned aircraft to our allies while other nations prepare to jump into the marketplace with both feet," Wes Bush, Northrop Grumman's CEO, warned last year in a speech at the Washington Aero Club.

Tough export restrictions threaten to undercut the advantage U.S. manufacturers currently enjoy in the UAV market just as earlier restrictions undermined the U.S. position in the satellite export market. "Before the controls were applied, we held 75% of the satellite market. That percentage dropped to as low as 25%, with significant revenue and job losses," Bush warned. It is important that the precedent not be followed, he said.

Middle Eastern nations frequently have gone to other countries in Europe, Asia, and South Africa for their UAV imports.

The UAE, which has been the most active in the Arab world in developing a UAV capability, already has large inventories of European models and is interested in developing its own local UAV industry. The country already has mini, fixed-wing tactical, and rotary-wing UAS in its inventories, making it the largest UAS user in the Arab world. In making these acquisitions, the UAE has shown a willingness to buy from a number of countries. It placed an order with Schiebel for 60 S-100 helicopter UAVs in 2006, with options for 20 more. The purchases of the Camcopters mean the UAE now has one of the world's largest fleets of these small helicopter UAVs, if not the largest. The UAE also operates the South African Denel Seeker II and deployed at least three to Afghanistan in 2010.

Saudi Arabia, the world's largest arms importer, has not yet bought many UAVs. It purchased Italian Falco tactical UAVs several years ago. Fin-


ScanEagle

meccanica executives have said they are hopeful that the kingdom will make a second purchase. It is worth noting that the Italian Ministry of Defense awarded a $64-million contract to Textron's AAI to purchase four Shadow 200 tactical UAV systems in 2010 in preference to buying the Falco. It appears that for Saudi Arabia the difficulties of purchasing a U.S. system may tilt the competitive advantages toward alternative suppliers in other nations.

Jordan has turned to two of the same suppliers as UAE and Saudi Arabia. Under a November 2009 agreement, Finmeccanica's Selex Galileo division agreed to work with Jordan's King Abdullah Design and Development Bureau on joint UAV technologies and electrooptical sensors for use by Jordanian special operations forces. Work will be based on the Falco UAV. Schiebel delivered two Camcopter

Camcopter

S-100 systems to Jordan in February 2011 for the Jordanian Armed Forces Reconnaissance Squadron.

To obtain UAVs, the Egyptians have turned to emerging suppliers, namely China and Turkey. Egypt's Arab Organization for Industrialization is building 12 Chinese ASN-209 tactical UAVs under license. The 320-kg airplane carries a 50-kg payload for up to 10 hr. The organization said it completed the first six last year. In November, Turkey and Egypt signed a number of cooperation agreements, some of which covered defense industrial collaboration. Egypt might acquire 10 Anka medium-altitude long-endurance UAVs now under development in Turkey under the agreement.

✈✈✈

Middle Eastern nations' evaluations of their own UAV requirements are being spurred on by Iran's aggressive acquisition of unmanned systems. In February Iran revealed that it is building its own version of ScanEagle after claiming to have captured one of the UAVs in its waters. The country claims that its own development of this industry is sufficiently advanced that it has exported UAVs and UAV technology to Syria and Venezuela.

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(Continued from page 5)

BUSIEST AIRPORT PAIRS PER NUMBER OF DAILY FLIGHTS

Rank	Departure Airport	Avg. Daily Arrival Airport	Growth Movements	on 2011
1	Barcelona	Madrid Barajas	62	-19.1%
2	Istanbul-Ataturk	Izmir-Adnan-Menderes	59	12.5%
3	Toulouse Blagnac	Paris Orly	51	0.6%
4	Trondheim/Vaernes	Oslo/Gardermoen	49	4.3%
5	Milan Linate	Rome Fiumicino	48	1.9%
6	Oslo/Gardermoen	Bergen/Flesland	48	-2.2%
7	Paris Orly	Nice	46	1.6%
8	Istanbul-Ataturk	Antalya	44	6.4%
9	Oslo/Gardermoen	Stavanger/Sola	44	2.0%
10	Istanbul-Ataturk	Ankara-Esenboga	42	4.3%

Source: Eurocontrol.

ities rather than look for help from abroad. While its indigenous aerospace industry has probably achieved a technical superiority to most of the defense systems within neighboring states, in the future its industry will be more focused on finding new clients in the global marketplace.

Turkey's defense sector currently exports $1.1 billion of materiel—exports in 2011 were 29% higher than in 2010—which the SSM plans to increase to $2 billion by 2016, initially by increasing exports to the Gulf, Africa, Latin America, and Southeast Asia. According to government figures Turkey's defense industry currently supplies 54% of the country's equipment needs and employs just over 24,000 workers. The SSM is investing $2 billion in Teknopark Istanbul, a major new industrial technology research park at Sabiha Gokcen Airport, east of Istanbul, and accommodating more than 30,000 people. The target is to generate more than $10 billion in defense and civil business annually as a result of the investment.

Earlier investments in defense are starting to pay dividends—in November 2012 Egypt announced it would buy 10 indigenously developed ANKA RPAS units which were due to enter production at the start of the year. Another major program to enter series production this year is the T-129 attack helicopter; TAI is the prime contractor with Aselsan and AgustaWestland NV as the main subcontractors.

Although Turkey has plans to buy up to 100 F-35s and TAI is an industrial partner in the program, at the start of 2013 the SSM announced it would be delaying an order for the first two by a year, citing technical factors and a 'high cost yield.' At the same time, the SSM is pushing ahead with plans to develop a Turkish advanced trainer/fighter; TAI began initial work on the project in September 2011. A detailed technical and cost evaluation on the project is due to be submitted to the SSM and the Turkish air force in September.

This is already a crowded market. But the success of the country's rapidly developing aerospace programs is giving Turkey's government renewed confidence that, perhaps, their nation will not be requiring the same amount of technology help from the U. S. and Europe as it has relied on in the past to meet its capability requirements.

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Events Calendar

MAY 13-16
Reinventing Space. Los Angeles, California.
Contact: www.ReinventingSpace.org

MAY 15-17
Seventh Argentine Congress on Space Technology. Mendoza, Argentina.
Contact: Pablo de Leon, 701/777-2369; Deleon@aate.org

MAY 27-29
Nineteenth AIAA/CEAS Aeroacoustics Conference (34th AIAA Aeroacoustics Conference). Berlin, Germany.
Contact: 703/264-7500.

MAY 27-29
Twentieth St. Petersburg International Conference on Integrated Navigation Systems. St. Petersburg, Russia.
Contact: Prof. V. Peshekhonov, +7 812 238 8210; icns@eprib.ru

MAY 29-31
Requirements for UTC and Civil Timekeeping on Earth: A Colloquium Addressing a Continuous Time Standard. Charlottesville, Virginia.
Contact: Rob Seaman, 520/318-8248; info@futureofutc.org

JUNE 6
Aerospace Today…and Tomorrow: Disruptive Innovation, A Value Proposition. Williamsburg, Virginia.
Contact: Merrie Scott, merries@aiaa.org

JUNE 12-14
Sixth International Conference on Recent Advances in Space Technologies. Istanbul, Turkey.
Contact: Suleyman Basturk, rast2013@rast.org.tr

JUNE 17-19
2013 American Control Conference. Washington, D.C.
Contact: Santosh Devasia, devasia@u.washington.edu

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Comfortable in your own exoskeleton

On the outside, NASA's X1 exoskeleton looks like a set of high-tech leg braces with a harness running up the back and over the shoulders. A computer inside a pouch tells the device's motorized joints how much resistance to apply as the wearer moves his or her legs. Sophisticated algorithms match the complexity of human locomotion.

Engineers at NASA Johnson and the Florida Institute of Human and Machine Cognition designed and built the $1.3-million X1 to catch the eye of their colleagues in NASA's Space Life Sciences Directorate, which last August was renamed the Human Health and Performance Directorate.

A flight version of the device could become a new workout tool for astronauts aboard the space station or on the long trip to Mars and back. At least, this is what the development team hopes.

At 57 lb, the X1 is small and lightweight compared to the 1,500-lb squat machine used by astronauts on the space station for working out and to mitigate loss of strength and muscle mass during long stays in space.

Project engineer Roger Rovekamp demonstrates the X1 robotic exoskeleton for resistive exercise, rehabilitation, and mobility augmentation in the Advanced Robotics Development Lab. Image credit: Robert Markowitz

Not doing squat?

Could something like the X1 complement or even replace the squat machine? There is no consensus yet, even among the designers. Finding out exactly what the X1 can and cannot do is one of the team's top priorities for the coming months.

"Our goal right now is to understand what we are getting [in terms of exercise] and what we are not getting," says NASA's Roger Rovekamp, mechanical engineer for the project.

Rovekamp's software engineering partner, Chris Beck, chimes in: "The first priority is to compare our device to what's currently out there and basically try to prove that we can [make] what they have. After we prove that, then we can hopefully try to show them what we also have that they don't currently have."

The bottom line is that after six or so more months of ground tests and design revisions, the team hopes to earn a thumbs-up from NASA to build a flight version for testing aboard the space station.

Spinoff applications

Beyond NASA's walls, the field of wearable robotics is taking off. Assisted walking devices offer new hope of mobility for those recovering from strokes or suffering from spinal cord injuries, with commercial prices expected to range from $80,000 to $150,000. Exactly what a space-qualified exercise version would cost is not certain, but the team predicts that unit costs will be lower than the $1.3 million provided so far for X1 under NASA's Game Changing Technology initiative.

The team has work to do to convince NASA management to send a version of the X1 into orbit. Job one in the Human Health and Performance Directorate is to make sure astronauts get equipment that will benefit them. It must not put them at unacceptable risk of injury in orbit, where there are limited medical supplies and a long to-do list for each astronaut.

NASA needs to be sure the device will not overextend the crew's joints, tendons, or muscles. The agency is conservative on matters of safety; even in the Johnson lab, not just anyone is permitted to don the X1.

"There is a core group of people who are checked out to wear the device and evaluate it," Rovekamp says. "Some people are checked out to operate powered; some are checked out to operate it passively."

For the most part, the testers are project engineers, although "we have had one crewmember in it," he adds.

Safety first

X1 engineers can hardly complete a sentence without uttering the word safety. They considered it from the very start of the design and development work last April.

The device has, for example, built-in mechanical hard stops to make it impossible for the computer to overextend the wearer's joints.

Engineers had two starting points for their design work. One was an assisted walking device called Mina, built by the Pensacola Institute. The Mina software has been adapted to perform the high-level control and integration of data from the different joints. The other starting point was Robonaut 2, a humanoid robot whose torso and arms were delivered to the space station in February 2011 by the crew of Discovery. R2 firmware governs the lower level control algorithms that monitor and run each individual joint.

Robonaut looks nothing like a wearable computer, but it's what's inside that matters.

"The spaceflight-proven software and firmware [for Robonaut] are the same stuff that's on our device," says NASA's Beck, a software expert and biomedical engineer.

Capitalizing on Robonaut let the team save valuable development time. It also created opportunities for brainstorming. The Robonaut team is working on legs for the torso in the same room where the X1 team works.

"We're always talking and understanding what they're doing," expalins Rovekamp.

The X1 team finished the device in December and continues refining it. The big challenge was to make a device whose primary purpose would be just the opposite of Mina's—to provide resistance instead of assistance. Engineers also had to consider how astronauts move in space.

"We're trying to think about things like, what's going to happen in zero *g*? What's the body orientation going to be like? How are you going to react to loads?" says Rovekamp. "If we can remain free floating while using the device, then we can avoid imparting vibration disturbances into the ISS structure," he adds.

Working with the Pensacola group and the Robonaut team was helpful, but only to a point: "There's really not a precedent to what they've done in the past," says Rovekamp. "It's a very radical concept."

Even in space, the X1 will need stronger motors than those of walking devices to provide the extra torque required for an exercise machine.

Maintaining strength

Flip a switch and the X1 also can become an assisted walking device to give to spacesuit-clad astronauts after they land on Mars. "Now it's helping them walk around if they're a little bit weak after the long space flight," Beck explains.

Exercise remains the top near-term goal, however. The device is programmable, so NASA can adjust an astronaut's exercise routine, and it will be able to stream back dynamometer readings telling doctors how fast the wearer's legs are moving.

Project engineer Shelley Rea demonstrates the X1. Image courtesy Robert Markowitz.

"The doctors can say, 'Okay, your hamstrings are not being exercised properly. We need to change your exercise protocol a little bit," Beck says.

That would be a big improvement over the way things are done now. Before missions, astronauts learn how they will need to exercise to minimize loss of muscle. Dynamometer readings are taken to make sure the exercises are rigorous enough. The astronauts go to space with a prescribed exercise protocol telling them how much they need to work out on various devices, including the squat machine (officially known as the advanced resistive exercise device).

Once the astronauts are in orbit, doctors cannot gauge their performance, but can only wonder, "What was your effort in that squat? Was it a really good squat or are you cheating somehow?" Rovekamp says.

The X1 would improve that process by streaming back dynamometer readings.

None of that can happen without a safe, comfortable, wearable robot. The X1 team started its work by making a quick structural mockup. "One of the challenging things with a device is, where do you pivot?" says Rovekamp. "We put all of the bearings in the position we thought they would be in. A lot of times our initial assumptions were not correct, and it was more comfortable another way."

The result was a design with 10 joints: motorized joints on the hips and knees, plus six passive joints for stepping sideways, turning, and flexing the foot. Adjustment points make the X1 adaptable for different wearers. Mechanical hard stops prevent the wearer from exceeding his or her range of motion.

Sensing and control

The control software is key. The process starts with readings from position sensors at each joint. "We can determine from that what the person's joint angle is," Beck says. "The software is intelligently written so that it can basically manage all the joints at once. It knows where all of them are, and what the person's left knee is doing and what the person's left hip is doing—everything."

The Pensacola group's algorithms were critical. The engineers combined them with the flight-proven Robonaut software: "It has gone through several iterations of safety reviews to make sure it's safe for use on orbit," Rovekamp points out.

That strategy, the team hopes, will lead to quicker approval for a flight version of the X1. Even as they work on it, engineers have the future in mind. The rig might be a game changer, but it still is more bulky than the engineers would like.

"The ideal exoskeleton is like a pair of pants. You're comfortable in them. It's natural," says Rovekamp. "We would like to get even smaller and lower profile."

If the engineers can do that, astronauts could someday wear an exoskeleton for an hour or two and get a workout while doing chores aboard the station or on the way to Mars.

"It has to be extremely comfortable. It has to be low profile so they can zip throughout the space station. We have a lot of different ideas for how this could continue to evolve into a device that has extreme payoff to the crew long term," Rovekamp says.

But first things first: Earning approval to make a spaceflight version of the X1.

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Acquisition reform
REAL SOLUTIONS

Repeated attempts to reform the nation's defense acquisition process have had surprisingly little impact. Technical complexity, ever-increasing costs, and cumbersome management structures are just a few of the difficulties inherent in this vast and complicated system. Political considerations further distort a picture already clouded by unrealistic promises and expectations. True reform will be achievable only if some vital—and missing—ingredients are brought into the mix.

USAF Maj. Fred A. Kimler *is currently a division chief for the Air Force Operational Test and Evaluation Center. He holds a master's degree in aeronautical engineering and has experience in test and evaluation, depot maintenance, structural design, and aircraft propulsion.*

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The Dept. of Defense acquisition system was first codified on July 13, 1971 (in DOD Directive 5000.1). The system has evolved since then, following numerous attempts at reform. Yet despite these changes, many major defense acquisition programs still encounter significant problems in meeting their cost, schedule, and performance requirements. Unfortunately, DOD has seen acquisition cost overruns continue to grow.

With cost growth now exceeding 30%, DOD must begin making better acquisition decisions or the number of program investments will have to be reduced significantly. This becomes especially true given the drawdown of forces in Afghanistan and the pending effects of sequestration. Further compounding problems, the average program delay in FY12 was 23 months, 32% beyond original estimate. This means that DOD programs not only cost more, they also deliver much later, and often with reduced capabilities.

A CLOSER LOOK

Even though the overall number of major defense acquisition programs has remained reasonably steady since FY05, program costs have continued to grow. ***To put it bluntly, DOD's return on investment has been very poor and continues to get worse.***

This is certainly not a new problem. "Our review of the efforts of the military departments to correctly estimate initial delivery dates for about 50 weapon systems indicates that, on the average, the weapon systems experienced 33% schedule slippage. Average cost growth of these systems was approximately 30%." That statement, from a report of the General Accounting Office (GAO, now the Government Accountability Office), appeared in 1971.

Quotes from two other reports are also significant in this regard:

"In the last several months, the Office of the Secretary of Defense and the military services have been engaged in a substantial effort to resolve problems identified as adversely affecting the acquisition of major weapon systems. These problems include compromised performance, delayed availability, and increased costs," says one.

"Since 1997, there have been 74 Nunn-McCurdy breaches involving 47 major defense acquisition programs. [Nunn-McCurdy is an amendment regarding cost overruns.] Of the 47 programs that breached, 18 programs breached more than one time," says the other report.

These two quotes say essentially the same thing: Programs cost too much, are delivered late, and do not meet performance objectives. The first quote is from a 1971 GAO report. The second is from a GAO report issued 40 years later, in 2011.

More worrisome is that there have been numerous efforts to reform the acquisitions process during that period. Since 1994 there have been six acts of Congress passed explicitly for acquisitions reform. This is in addition to the numerous panels and boards, with their subsequent studies and reports, convened to explore ways to improve the process (27 major studies from 1960 to 2009, and a host of smaller ones).

J. Ronald Fox, a Harvard Business School professor, puts it most appropriately: "Despite the many studies and the similarity of their findings, major defense programs still require more than 15 years to deliver less capability than planned, often at two to three times the initial cost."

REASONS FOR POOR PERFORMANCE

The real question is, as Fox suggests, if all of these studies find essentially the same issues and make the same recommendations, why haven't acquisitions gotten significantly better?

One of the reasons was well stated by

Early on, the F-16 had some significant technical issues but has become very successful after several block upgrades. Credit: MSgt. Andy Dunaway/USAF.

the Institute for Defense Analyses in its comments on the 1986 recommendations of the Packard Commission: "The first four of these recommendations [for clear command channels, stability, limited reporting requirements, and small, high-quality staffs] have generally been implemented cosmetically and in a way that does not support recommendation five [communications with users]. Consequently, we believe the substance and intent of these recommendations has not been implemented."

Another reason is the implementation of additional oversight of the process because of continuing poor performance.

Finally, the GAO offered yet another insight: "One of the most troublesome features of the present program management structure is difficulty in obtaining decisions. It seems to us the most likely cause of this problem is that decision-making layering is not commensurate with organizational layering.…Most of the decisions that the project manager does not make himself are made at the highest levels of the service or by OSD.

"Between the project manager and top management are a large group of organizational units whose commanders attempt to keep themselves informed about a particular weapon system and study and deliberate on pending programs to recommend some course of action. As a rule, they have no direct approval powers. They can delay or stop a project but cannot make decisions to proceed, change direction, provide money, or take other positive action."

This was a very astute observation, and the situation has not changed very much since 1971, when the report was issued. DOD, since the advent of Microsoft PowerPoint, has become exceptionally fond of briefings. Staffing time alone for a normal program can take as long as 180 days. For a joint or international program, it can take nearly a year.

WHAT HAS WORKED?

In 1983, the President's Private Sector Survey on Cost Control, the Grace Commission, released its report recommending the streamlining of the acquisitions chain of command. This was further amplified in the 1986 Packard Commission report. Both reports led to the creation of new undersecretary-level positions within DOD and brought the management of programs directly under the purview of the secretary of defense. Although the need to produce a seemingly endless number of briefings to organizations outside the direct acquisitions chain persists, for the first time the reporting chain was actually fully defined.

Another area of reform progress has been the professional development of the acquisitions corps. For anyone assigned in a coded acquisitions position, certification standards and identified training are now required. Most of the training is managed through the Defense Acquisition University, which maintains and defines the courses required for certification in numerous specialized acquisitions areas. Training evolves continually based on new trends, policies, and lessons learned.

Finally, there have been some improvements in the contracting laws and policies governing defense acquisition. Contracting vehicles, such as the Simplified Acquisitions Procedures for small purchases, have brought some degree of sanity back into the overall process. It can certainly be argued, however, that more reform is needed in this area.

WHAT HAS NOT WORKED?

Almost every acquisitions reform report or study mentions the need for changes in the program manager (PM) position. Most emphasize the need to keep the PM in the position for a significant length of time. In some cases, this has been carried out to good effect; often, however, the PM is a military officer and must be reassigned after a few years. The reason usually cited is the need to keep the officer competitive for promotion against others in the peer group. This is potentially one of the biggest shortcomings in the acquisitions system—it takes time to bring a new person up to speed on a complex program, so it would seem most beneficial to leave the PM in the position for as long as is practical.

Obviously, reality stands in the way in most cases, and PMs must be replaced for their own professional benefit. Further reforms could make the position a fixed term for military as well as civilian PMs. (Usually a civilian PM is required to sign an agreement to stay for four to five years.) There

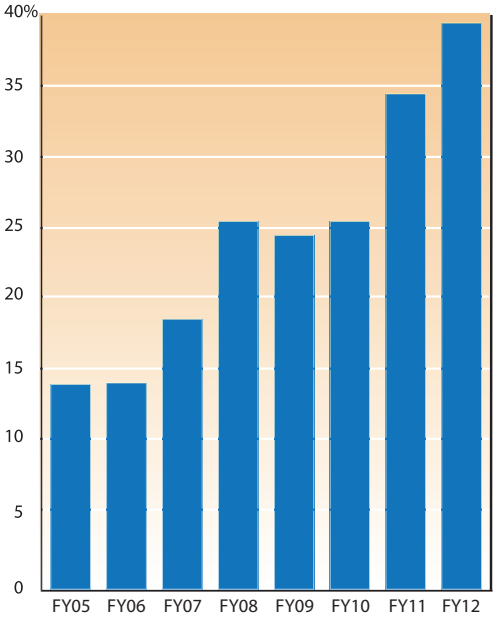
really is no reason that military personnel could not also be required to stay for longer terms, as long as the individual services recognize the status of the position or make it a competitive assignment.

The individual services should consider putting their acquisitions personnel in a separate promotion category, as in the case of medical or legal personnel (nonline officers). They should also ensure that these acquisitions officers are placed into senior positions. Such actions would help to strengthen the PM position.

Another frequently voiced concern regarding PMs involves accountability. Ideally, a PM is recognized for good performance through awards or promotion (while still maintaining the position after a promotion). Likewise, poor performance by a PM would result in dismissal; however, this rarely occurs, because the effects of a PM's decisions may not be known for many years, when the program enters full development or production. PMs should occupy their positions long enough for these effects to become apparent.

In the case of a grossly underperforming program, the PM should be removed immediately, especially if he or she has failed to suggest the program's cancellation. It also should be implicitly understood that some programs are going to fail—there is no guarantee that the analysis of alternatives process chose the correct option. In these cases, there should not be any negative repercussions for the PM.

PERCENTAGE INCREASE
MDAP Current Budget over Initial Budget Estimate



Major Defense Acquisitions Programs (MADP)

THE PM'S EXPERIENCE

Another issue that most reports have not discussed very thoroughly is the PM's experience. The services prefer the PM to be someone who has operated similar systems. This, however, is a potential mistake. The complexity of the acquisitions process itself requires that the PM be someone who is familiar with its functioning and procedures. Most programs are highly technical and entail complex decisions involving tradeoffs of cost, schedule, and performance. There is no real shortage of operators who can be called on to provide the needed expertise on these issues and on important operational considerations. In addition, having an operator in charge sometimes leads to 'gold-plating' of the system being acquired (paying for capabilities above what is actually required), further increasing program risk.

DOD must use incremental development strategies more effectively. Often, the first increment of a system contains many new technologies that not only must be simultaneously developed (usually independently) but also must be integrated together. Unfortunately, integration is the most difficult part of the process.

A more successful approach probably would be to use existing subsystems, rather than newer ones, on the first increment. Once the newer subsystems have matured, they can then be integrated onto the system as a follow-on increment. For example, the first increment develops the new airframe, while using existing radars, antennas, seats, and avionics. The second increment integrates the new radar and antennas. New avionics would be part of the third increment, and so forth. There seems to be much less risk in such an approach.

Another area that needs improvement is defense contracting. One of the biggest issues is that in many cases the contract vehicle is not consistent with the program under development. There has often been a preferred contract vehicle, such as cost plus award fee or firm fixed price. Attempts to use this preferred approach on everything, even when it is not appropriate,

The development of the Bradley tank was so troublesome that a comedy was made about it.

have been the result. Using a firm fixed-price contract to develop something from scratch will likely result in cost and schedule overruns and poor performance. Conversely, using a cost plus incentive fee to purchase a readily available item could result in DOD paying too much.

Most defense contractors would say contracting laws, policies, and procedures are too complicated. Many contracting officers probably would agree. There could certainly be more progress in this area; however, this is largely because of the requirements for insight into a program's performance and the need to ensure compliance with other public law, such as the Buy American Act or Small and Disadvantaged Businesses Act.

Requirements for a system must be realistic at the very beginning. Once defined, they must remain stable during development. Not only must the PM be able to enforce them, but the contractor also must be forthcoming when they need to be adjusted or waived. Both the PM and the contractor are responsible for informing users of how a requirements change will affect the system being developed. If the requirement can be altered or waived, the program may continue. If the requirement cannot be changed, the PM must be able to decide on the value of continuing the program.

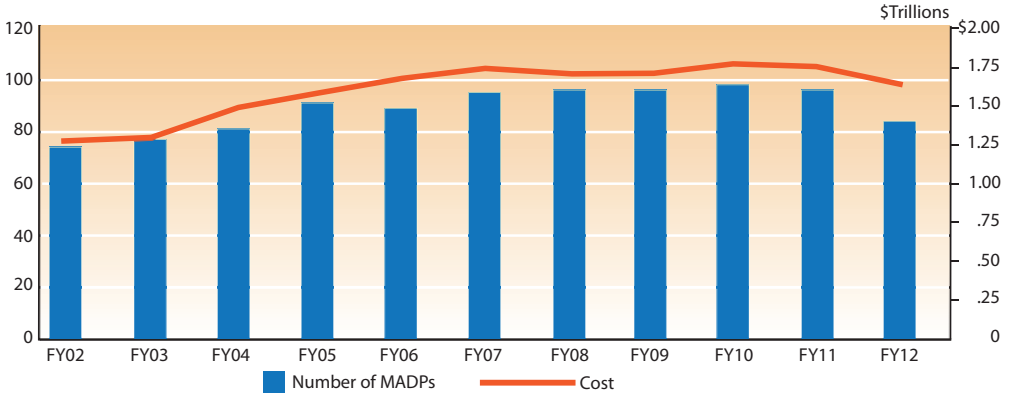
MILITARY-INDUSTRIAL-POLITICAL COMPLEX

No discussion of defense acquisition reform would be complete without addressing the military-industrial-political complex. Although the original phrase omitted the word 'political,' it was added in later years because there was growing recognition of how this sector contributes to acquisitions instability. The political realm is also the area with the most potential for reform, given the continuing decline in acquisitions program performance.

Most of the literature on acquisitions reform focuses on the military, obviously because it is the military service that creates the program and purchases the resulting system. However, there is still a need for reforms in this sector's interactions with the other two.

The foremost of these is that DOD must become more willing to cancel underperforming programs. All too often the PM has spent a great deal of time selling a program in order to get it approved and funded. Canceling it then seems much less desirable; so the program continues and is continually restructured. In the end, the services are stuck with a system that requires the start of new upgrade programs to get it to full operational capability (or even, in some cases, to make it usable). In addition, industry brings in political forces to garner more support for the program, making cancellation extremely difficult.

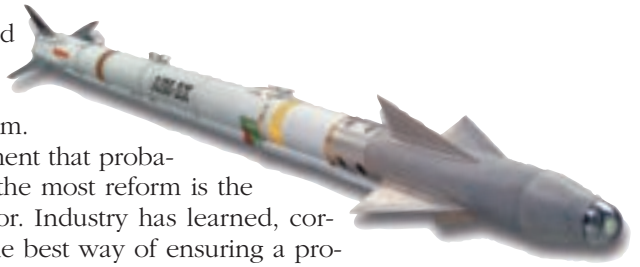
NUMBER OF MAJOR DEFENSE ACQUISITIONS PROGRAMS (MADP) AND TOTAL COST



The PM must be empowered and willing to be an honest broker concerning the program's status. DOD in turn must be willing to cut those programs that cannot meet their requirements. This is all the more important in light of declining budgets.

Industry also needs some reform. Companies must be more honest and up front about their actual capabilities to develop and produce a particular system. DOD could encourage this more effectively by not advertising the cost ceiling for a program. This would, to some degree, allow the contractor to provide a bid at a much more accurate cost instead of the lowest cost possible. This in turn could make it far more likely to meet the requirements of the contract. All too often the contractor must make overly optimistic assumptions in order to be competitive. More historical or empirical data should be used to provide more realistic projected program performance.

In addition, DOD must make its budget submissions more accurate by doing a better job of estimating program costs. Finally, there also should be more emphasis placed on each bidder's past performance and the risk it could bring to the program.



The AIM-9X is one of the few modern weapons programs to meet its acquisitions baseline cost, schedule, and performance.

The element that probably requires the most reform is the political sector. Industry has learned, correctly, that the best way of ensuring a program survives is to split up its subcontractors into as many different states as possible to gain the maximum number of congressional constituencies. As a result, some programs that should be canceled continue, because of earmarks (congressional additions to the budget). Members of Congress must understand the impacts of their decisions, particularly in terms of added costs to the government.

There is potential for some reduction in congressional oversight requirements (generally additional reporting). This, however, would be difficult to accomplish, because many of these requirements have come about directly because of poor performance on previous programs. Until DOD and industry prove they can execute several large programs successfully, this situation is likely to continue.

TWO FUNDAMENTAL QUESTIONS

Twelve years as an acquisitions officer have led this author to formulate two fundamental questions:

Is the success of a weapon system an indication that the acquisition program execution was a success?

On its face, this answer would appear to be an obvious 'yes,' but looking deeper into the question leads to the opposite conclusion. In some ways this is a Machiavellian question; the system is the end, the program is the means. In other arenas, the ends do not always justify the means, and the same should be true of an acquisitions program. There is little doubt that any system can be made highly effective given infinite, or at least substantial, resources. But DOD's resources are not infinite—in fact they will be far less substantial in the coming years. The result must be that programs are scored on their current merit, not on what the future may promise.

Is the acquisition system broken, or is the execution of the system broken? The system itself has not changed fundamentally since its introduction in 1971; thus the inevitable conclusion is that its execution is the true, underlying issue. The PM must be more of a decision-maker and less of a briefer and program advocate. The users must allow the PM to make the appropriate programmatic decisions.

Overall, there must be more honesty throughout the process and from all parties. Without this, much of the vaunted reform will not be effective. Recognizing the part each sector plays in the process will increase the chances for success in the execution of acquisitions programs.

If all three sectors of the military-industrial-political complex continue to operate as they have since the 1940s, the trend toward poorly performing programs will likely continue. In competing for programs, industry must provide more realistic, executable bids. DOD must cancel programs that have little chance of meeting their requirements within the cost and schedule parameters. Congress must understand the effects of continuing programs that should be canceled. No individual program that is significantly underperforming should be continued at the expense of other more promising ones.

Russia's robotic space renaissance

by Leonard David
Contributing writer

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The demise of the Soviet Union left its much-vaunted space program underfunded and in disarray. Technical, monetary, and management problems have continued to plague Russia's efforts during the difficult transition to a new era. Several high-visibility undertakings, such as the Phobos-Grunt Mars mission of 2011, have ended in failure. Nonetheless, recent activities indicate that ambitious plans are in the offing for the country's robotic lunar and planetary exploration efforts.

A revamping of Russia's robotic space exploration program appears to be under way, perhaps even a rebirth for the country's interplanetary endeavors. To some extent this 21st-century revival mirrors the former Soviet Union's missions to a variety of destinations beyond LEO.

First on the agenda of Roscosmos, the Russian Federal Space Agency, are lunar missions. Longer range plans include the design of an aggressive Venus mission, an attempt at the first landing on Mercury, and a rekindling of Mars exploration. Add to this a reported Russian Jupiter research project that would place a lander on the Jovian moon Ganymede by 2023.

But are these grand plans on solid footing, given Russia's spotty track record over the years, underscored by the botched Phobos-Grunt mission to Mars? That aggressive undertaking, launched in November 2011, ended when the probe plunged back to Earth in an uncontrolled reentry some two months later—felled by the tug of gravity, yes, but also by technical and management slip-ups.

Years earlier, the country's ambitious Mars 96 mission suffered a similar fate, crash landing just one day after liftoff, possibly in South America. The jam-packed probe carried a Mars orbiter, surface stations, and surface penetrators.

Nonetheless, history shows that the Soviet space program, fueled by Cold War rivalries, scored significant achievements at the Moon, Venus, and Mars.

But today, the situation is different.

Notably absent

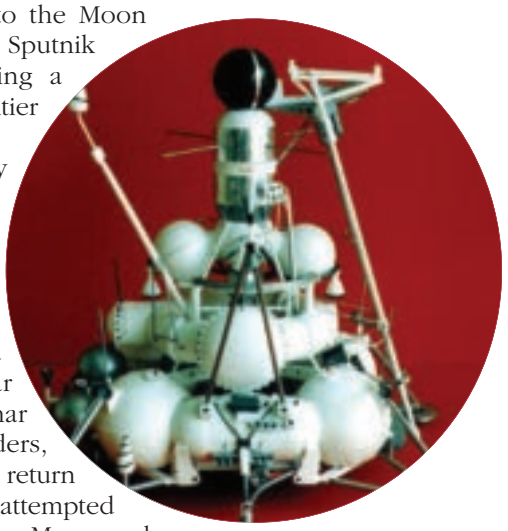
"I personally am very excited to see the Russians building on their outstanding success of the past and returning to earlier destinations where they were major innovators in science and technology," says Stephen Mackwell, director of the Lunar and Planetary Institute in Houston, Texas.

Mackwell notes that the Soviet Union was a key player in the early age of robotic and human solar system exploration. One might argue, he says, that the U.S. would never have sent astronauts to the Moon had the Soviets not launched Sputnik and set the course for taking a strategic lead in the new frontier of space.

"While the Soviets' early lead in space was clearly surpassed by the United States with the phenomenal Gemini and Apollo programs, Russia was a major early driver for lunar exploration with its Luna and Zond programs of lunar impactors, flybys, circumlunar spacecraft, orbiters, landers, rovers, and, ultimately, sample return missions. In total, the Soviets attempted over 45 robotic missions to the Moon and had considerable successes, including the only robotic sample return from the lunar surface," says Mackwell.

"Unfortunately, the Soviet lunar program ceased in 1976, a few years after the United States abandoned its lunar missions. While the scientific community never lost interest in the Moon, and vibrant studies of lunar samples continued...it was only in the 1990s that we saw a resurgence of interest in lunar missions.

"This time, however, the broader international community had started to become involved. First the Japanese, and then the Europeans, Chinese, and Indians sent missions to the Moon. The United States too flew a series of missions that made major advances in our understanding of the



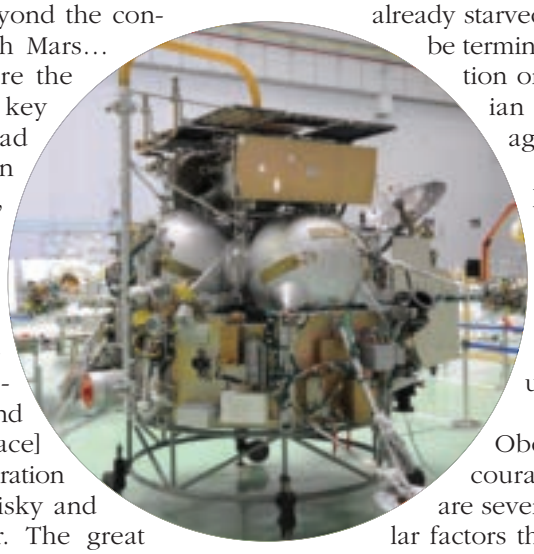
Luna 24 was the last of three successful Soviet lunar sample return missions. The mission returned 170.1 g of lunar samples to the Earth on August 22, 1976.

Moon, the Earth-Moon system, and the evolution of the early solar system," he says.

More recent missions, he observes, also set the stage for an ultimate human return to the Moon, involving longer term plans for habitation and resource utilization. The Russians, however, have been notably absent from these activities.

Resurgence of interest

"Now we are beginning to see a resurgence of interest in both robotic and human exploration of the Moon and other bodies in the solar system, beyond the continued activities with Mars… notably Venus, where the Soviet Union was a key innovator and had great robotic mission success with orbiters, landers, and balloons," says Mackwell. "I am also excited to see Russian interest in participating in human exploration activities beyond [the international space] station. Human exploration has always been a risky and expensive endeavor. The great success of Apollo was driven by national security issues, where major investment was regarded as justified by the international political climate of the time."



Plans for a Russian return to the Moon include the Luna Glob probe. Credit: Lavochkin Association.

But Mackwell views this new century as one in which collaboration, rather than competition, seems to be the best way forward. "Few nations have the fiscal capability or the political will to reach out into space with humans. However, there is great support from the general public for exploration, and capturing the technological capabilities of the Russians and engaging with them in human exploration makes a lot of sense if we are to truly expand our horizons in space."

While the United States is developing new launch vehicles and space transportation systems, Mackwell says, a key missing piece is the ability to land on any object in the solar system with any appreciable gravity. "International partnerships, especially with the Russians, may help significantly with redevelopment of that capability. It would be such a great thing, 50 years after the first Apollo landing, to see Russians and Americans return to the lunar surface together," he concludes.

'Hothouse orchid' theory

James Oberg is a long-time historian and expert on Soviet/Russian space matters. For Russia, he says, the key to acquiring the 21st-century technologies crucial for future spaceflight activities is in efforts led by Sergey Zhukov, a trained but unflown cosmonaut who is pushing well-financed technology development projects.

"Available space funding just isn't enough to maintain, much less modernize, the broad base of Soviet-era space capabilities," Oberg observes. "Many projects have already starved, and still more need to be terminated, to allow concentration on key areas where Russian space efforts may yet again shine."

There are others, however, who view Russia's space program as a 'hothouse orchid,' a flower that needs pampering because it is not hardy enough to grow under natural conditions. This theory, which Oberg does not find encouraging, also holds there are several independent, particular factors that must all appear concurrently for the space program to succeed. These include not just intentional pampering, but other incidental and unintentional factors that also turn out to be critically important to enabling success.

"In this view, the spectacular Soviet-era space successes required the conflation of several highly specific conditions that together created a world-leading capability which has long since faded, and probably can never be rebuilt. Aside from financial largesse, those years saw the best and brightest Soviet engineers and managers flocking to the space effort, because of the historical challenges as well as unique perks—special stores, schools, hospitals, travel—that ordinary Soviet citizens had no hope of otherwise seeing. The entire country was mobilized to provide them with the best materials, minds, and methods," says Oberg. "That's all gone now and will never return. A scaled-back, modest program with respectable specializations is the best they can hope for," he concludes.

Rubles for deep space rocketry

Asif Siddiqi, associate professor in the Dept. of History at Fordham University in New

York, is a scholarly specialist in Soviet Union/Russian space endeavors. Although the Russians have never lacked ambitious plans, he tells *Aerospace America*, over the past two decades "the payoff has not been significant." Siddiqi does note some small signals, such as cooperation with ESA and India, that suggest Russia is exploring other avenues. However, he does not see any fundamental shift having occurred to change the current paradigm.

Clearly, he says, the Phobos-Grunt disaster was a huge letdown after all the time and effort spent preparing the mission. The Russian space industry in general has been plagued by a range of problems, from quality control issues to brain drain to corruption, as well as the tightening of rubles available for deep space rocketry. That combination creates a very high-risk situation, he says. The upcoming Luna Glob and Luna Resurs missions are being closely watched by the Russian space community, and their outcome will be telling.

"Every couple of years there's discussion within Russia's space media, a sort of handwringing about the average age of engineers in their space program, which is pretty high now. If you are a smart young person in Russia, space is not on the top of your list…not a priority. You would probably be going into software or something like that," says Siddiqi. "Young people see space as a good thing, but it's in the past."

One development to keep an eye on, Siddiqi believes, is the Skolkovo high-tech project—a plan to mimic Silicon Valley and its innovative research and production. Space technology is a major focus of the effort, he notes, "and the whole point of that is basically to feed very smart people back into the space program."

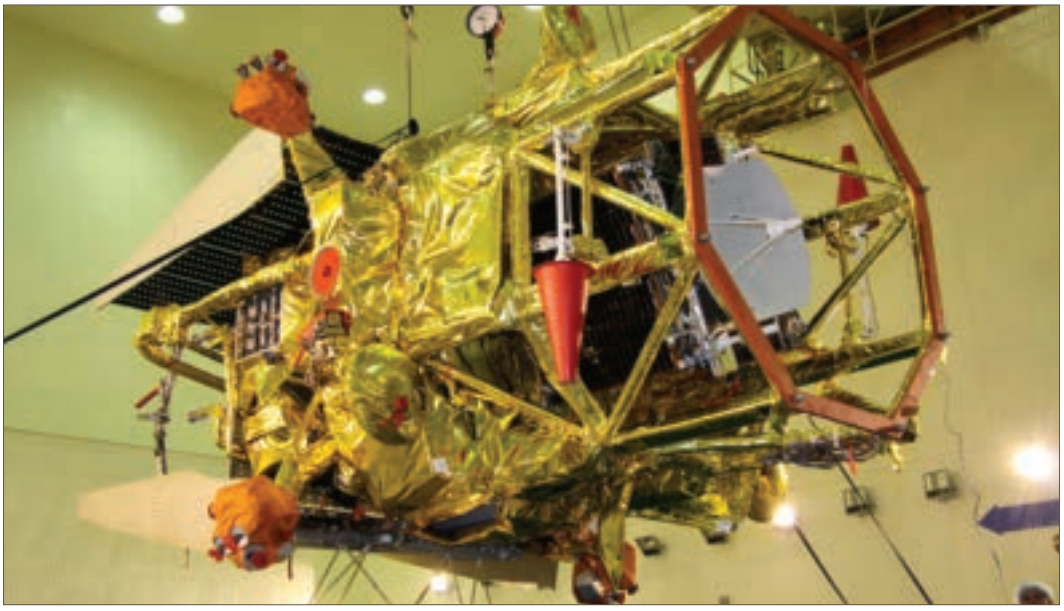
Author and Russian space watcher David Harland offers some similar views. "Although the Russians can employ their Soyuz rocket to send a small payload to Mars—as they did for Mars Express on behalf of the Europeans—they always build heavy 'Christmas tree' probes that require the more capable Proton rocket because they are festooned with instruments, capsules, and landers. Yet, remarkably for this day and age, both Mars 96 and Phobos-Grunt were stranded in Earth orbit by their upper stages. One has to wonder what complexity they have built into their design, by either commission or omission, that makes it so susceptible to failure at this point in the mission…because an escape burn is no longer rocket science!"

Optimism grows

From inside Russia looking outward, several experts have offered their perspective on the history and future of Russia's robotic lunar and planetary exploration program.

Mikhail Marov is a professor and academician of the Russian Academy of Sciences. Paraphrasing Mark Twain, he calls rumors of the program's demise "exaggerated" and adds that "the situation right now is much more optimistic."

Speaking last October at an Arlington, Virginia, symposium on the 50th anniversary of planetary exploration, Marov noted that the disintegration of the former Soviet



The failed Phobos-Grunt spacecraft did not perform its scheduled burn to begin a trajectory to Mars, later tumbling to Earth in an uncontrolled reentry. Courtesy: National Space Science Data Center.

Russia's Luna Resurs mission is on the books as part of that country's reconnection with lunar exploration. Credit: Lavochkin Association.

Union, followed by social and economic turmoil, had a dramatic impact on Russia's space program, specifically solar system exploration. He emphasized that the country's space budget was drastically reduced, the lion's share going for orbital station operations, support for the Mir space station program, Mir-shuttle dockings, and later, participation in the ISS program.

"Space facilities were partly destroyed, cooperative links broken, and many skilled personnel in space science and technology lost," Marov told attendees of the symposium. In reviewing the launch, subsequent breakdown, and fiery Earth reentry of the Mars-bound Phobos-Grunt mission, he said the failure basically was caused by these destructive factors of the 1990s whose consequences "have not been yet overcome… though lessons were learned."

Speaking at the same symposium was Wesley Huntress, director emeritus at the Geophysical Laboratory of the Carnegie Institution for Science in Washington, D.C. Huntress underscored the "tragic loss of vision, enterprise, and expertise" of the Soviet Union's robotic planetary effort, which had begun "in a spirit of bold adventure and technical genius."

An agreement signed by Roscosmos and ESA details their cooperation on ExoMars, ESA's 2016 and 2018 Mars missions. Roscosmos will provide major contributions, including the descent stage for the 2018 flight, scientific instruments for both missions, and the two Proton rockets that will launch them. Credit: ESA.

The two space scientists noted that the Soviet program was bold and innovative, achieving many firsts in space exploration, but was also riddled with flaws that caused numerous failures. Factors hampering the program included deficient electronics technology, poor system engineering management, insufficient ground systems testing, and a complex, entangled, heavy-handed national system of control and supply, said Huntress.

Robust missions, valuable science

While he cannot speak for the Russian space agency, Marov notes, he can share his understanding of its current situation.

"Yes, we are going to return to the Moon with the new robust and scientifically valuable missions Luna Glob in 2015 and Luna Resurs in 2017." Their federal program is committed to the missions, says Marov, adding, "I personally hope that they will manifest our recovery with [a] lunar-planetary program after [the] turmoil of the former two decades."

Marov says there are also ambitious plans for extended lunar study in future years. In addition, Roscosmos has signed an agreement with ESA about involvement in the European agency's ExoMars program. That agreement, signed last November, details cooperation by the two agencies on ESA's 2016 and 2018 missions to Mars. An orbiter and a stationary lander are planned for 2016. A Russian lander is to deliver the ExoMars rover, planned for 2018. Roscosmos will provide major contributions, including the descent stage for the 2018 flight, scientific instruments for both missions, and the two Proton launchers.

"As far as Venus is concerned," he says, current plans are "sound enough indeed" and are still targeted for the early 2020s.

Tight oversight

As the Russians move beyond the failure of the Phobos-Grunt mission, just how realistic and technologically sound are their plans for rebooting interplanetary probe programs?

"Keep in mind that Phobos-Grunt started as the only interplanetary mission in the program," says Igor Lissov, senior editor of the Russian journal *Novosti Kosmonavtiki* (Cosmonautics News). "They decided to choose a bold mission, and they tried to design it from scratch. They [made] several conceptual errors, which played out at the first possibility," Lissov explains.

Russia's current lunar exploration program involves three launches of increasing difficulty, notes Lissov, with designers having some leeway to err without ruining all: Luna Glob 1 (a test lander with very limited science payload), Luna Glob 2 (a science orbiter), and Luna Resurs (a polar lander with a sophisticated science payload). "This seems to be a good choice to reestablish our capabilities. Future projects are being listed and discussed, but their chances of full funding and development depend heavily on the success [of the preceding missions]," he says.

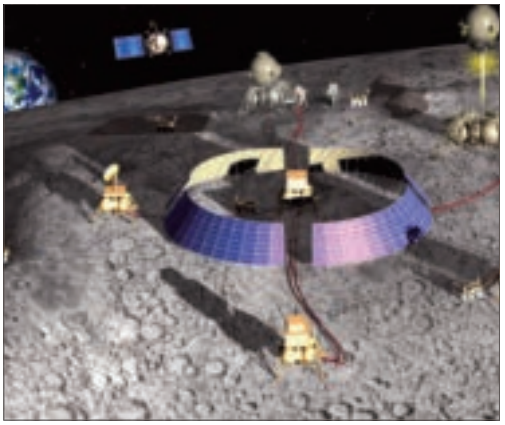
At Lavochkin Association, the group that also created Phobos-Grunt, different people are working on the Luna missions. As far as Lissov can tell, the key persons involved in the failed probe's design have left. "Oversight is tight, and the upper management is more competent," he says.

Funding has been available from the beginning, Lissov says, noting that this was not the case for Phobos-Grunt, which lingered 10 years in the paperwork stage. "So I believe the situation is much better from the budget, programmatic, and competence sides. Also, we are not bound by planetary windows now, and Lavochkin can test their spacecraft as long as needed….Of course this does not exclude design errors or component failures…but I have much more faith in the Luna Glob/Luna Resurs series than in Phobos-Grunt."

Lunar strategy

Also emphasizing Russia's robotic return to the Moon is James Head, a noted space scientist in the Dept. of Geological Sciences at Brown University. He points to the past track record of the Soviets: Successfully completing three robotic sample return missions (Luna 16, 20, and 24), two very well instrumented robotic lunar rovers, Lunokhod 1 (Luna 17) and Lunokhod 2 (Luna 21), and several orbiters—all undertaken more than 35 years ago. These basic accomplishments, he says, represent a remarkable robotic capability not duplicated by anyone, including the U.S.

"The Russians are building on the original clever and novel engineering designs for these missions, and thinking ahead with a focus on polar landers and on exploring for volatiles in the polar and near-polar regions," Head says. "Sample return missions are very likely to focus on the discoveries of the early polar Luna lander and rover missions, and to involve the return of volatile-containing samples using special devices for preservation and return."



Russia's re-rendezvous with Moon exploration also includes discussion of establishing an international lunar base. Courtesy: IKI.

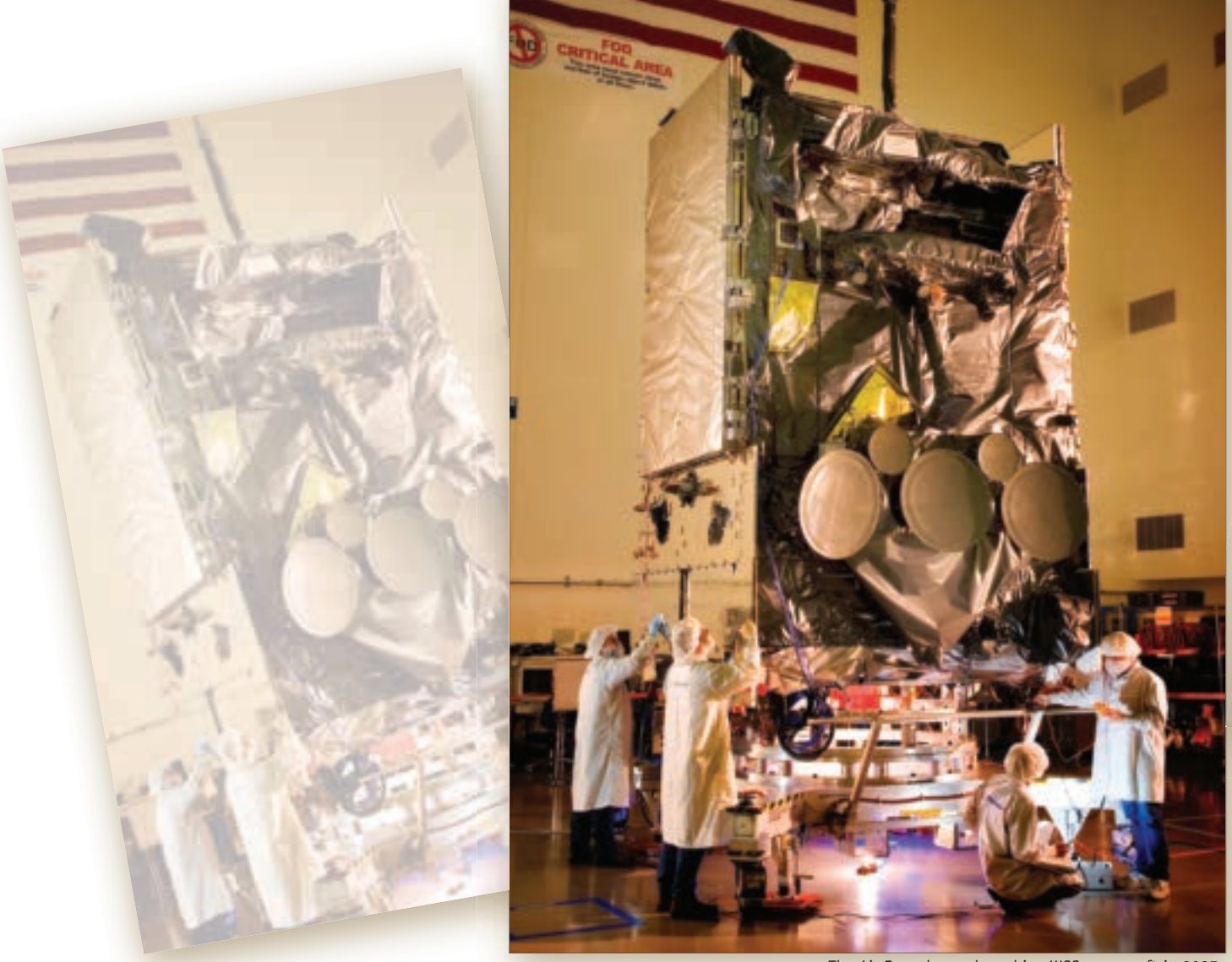
Head and his colleagues at Brown have been involved for years with their Russian colleagues from the Institute for Space Research and the Vernadsky Institute. Working together they have scoped out candidate landing sites for lunar spacecraft, and also possible destinations for future Lunokhods and sample return missions to the Moon. The lunar strategy is clearly working toward a set of larger Russian national goals, possibly to include a lunar base, Head adds.

Given the apparent abandonment of human and robotic lunar surface exploration by the U.S. for the near future, Head thinks the Russians see a major leadership opportunity as well as a technology driver and are therefore moving out vigorously on their strategy.

"Clearly the Russians have long demonstrated that they have the technological sophistication to engage in expansive space exploration activities," says Roger Launius, senior curator in the Division of Space History at the Smithsonian Institution's National Air and Space Museum. "If they redouble efforts, invest sufficient resources, and structure a realizable long-term strategy for robotic planetary exploration," says Launius, "there is no reason to believe they will not be successful."

However, he also notes that the box score on Soviet/Russian planetary exploration has been checkered, particularly regarding Mars. They have had much greater triumph with Venus and, especially, the Moon.

"What is past does not directly affect the future, of course," adds Launius. "But it will require a concerted effort to restart these activities and be successful with them. We'll see what happens."



The Air Force began launching WGS spacecraft in 2007.

Shifting fortunes for

The war in Afghanistan sparked a booming market for commercially provided satellite communications in the X-band range of 8-12 GHz. This frequency band is reserved exclusively for government use by the U.N.'s International Telecommunication Union. Commanders, troops, and intelligence analysts needed to share maps, detailed satellite images, and electrooptical and infrared videos of villages and roads. The U.S. government's satellites could not cover all of the demand.

But now the U.S. and its allies are planning to bring most troops home from Afghanistan by the end of 2014, and the U.S. is trying to shift more of its diplomatic and military partnership resources toward the Pacific region to meet a rising China. That pivot could spell business trouble for commercial X-band providers, because it is a region largely uncovered by them.

Those providers know they must adjust their plans if they are to sustain or grow their businesses, and there are signs that this is happening.

"We're very aware of the pivot to Asia that's talked about by the U.S. government," says Andrew Ruszkowski, vice president for global sales and marketing at XTAR in Herndon, Virginia. Founded in 2001, the company provides communications for the Spanish government, the U.S., NATO, and their allies.

by Ben Iannotta
Contributing writer

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COMMERCIAL X-BAND

In this corner, weighing 13,000 lb…

As they seek to adapt, XTAR and other X-band providers will be facing a familiar competitor: the Boeing-built Wideband Global Satcom (WGS) satellites. The Air Force began launching these in 2007 in the midst of the commercial X-band boom. A WGS spacecraft weighs 13,000 lb, almost twice as much as some X-band-equipped commercial satellites. Each operates in both X- and Ka-band, and can even convert signals arriving in one band to the other, so that recipients with different terminals can exchange information.

The Air Force has started launching upgraded Block II versions that are even more powerful. They have frequency bypass electronics that transmit Ka-band reconnaissance imagery at three times the data rate of the original satellites. By the service's calculation, a single WGS satellite provides more capacity than the entire Defense Satellite Communications System they are gradually replacing.

The U.N.'s International Telecommunication Union reserves the X-band frequency exclusively for government communications. During the war in Afghanistan, the need for sharing battlefield information was so great that U.S. government satellites could not keep up with it. As that war ends and the U.S. shifts its attention to other regions, commercial satellite companies face some significant challenges—including competition from U.S. government spacecraft.

XTAR-EUR and the XTAR-LANT payload coverage leave out most of the Pacific region.

The commercial providers nevertheless pushed back hard on the U.S. government's plans to buy more and more WGS satellites, arguing that shifting to commercial capacity would be cheaper at a time when governments need to spend less. In an April 2012 commentary in *Space News*, XTAR president and COO Philip Harlow said the U.S government was now a "front-line competitor" in the market: "Not only does the [WGS] program appear focused on replacing as much commercial capacity as possible, the government is becoming the de facto service provider to a host of high-value customers," he wrote.

Since then, XTAR has cooled its rhetoric about WGS. Only when pushed would Ruszkowski attribute XTAR's slow growth to the emergence of the WGS. "There was a lot of promise [for XTAR's profitability] early on, and then I guess I would say that maybe some policy issues particularly with the U.S. government slowed down the demand for XTAR capacity," he says.

These days, XTAR is adjusting its plans, rather than trying to get the U.S. government to adjust WGS. The U.S. shows no signs of backing off from WGS in the face of the industry's criticism. There are now four of these satellites in orbit; a fifth was scheduled for launch by the start of this month, and more are under construction. In fact, Boeing is now on contract to build a tenth, ensuring there will be satellites to sustain the constellation for years to come.

Fresh approaches

The commercial X-band satellites and hosted payloads have been produced mainly by Space Systems/Loral of Palo Alto, California, and its European rival, Astrium Satellites, based in Stevenage, U.K.

XTAR's reliance on SSL was not surprising. Loral helped form XTAR in 2001 and remains the majority owner. The minority partner is Madrid-based Hisdesat, the government services arm of the Hispasat telecommunications company.

If XTAR was once locked into SSL, it is not now. Last year, Loral sold its SSL unit to MacDonald, Dettwiler and Associates of Richmond, British Columbia, meaning Loral and by extension XTAR no longer have a stake in SSL's manufacturing.

"We enjoy a very good relationship with Space Systems/Loral," says Ruszkowski. "But we also have good relationships with other manufacturers, and we will do what's right with the XTAR business and by our customers and our users," he says.

XTAR was founded partly on the concept of the hosted payload—separate transponders installed on a satellite owned by another company or agency. XTAR operates an eight-transponder X-band payload called XTAR-LANT, which rides on Spainsat, a 7,500-lb Spanish military satellite. Spainsat was launched in March 2006 to a position high over the Atlantic at 30° W longitude, with an X-band communications footprint spanning west to Denver, south to Latin America, and east across Africa and into the Middle East.

SSL also built XTAR-EUR, an 8,000-lb satellite launched in February 2005. It is located at 29° East (over the Horn of Africa).

Taken together, XTAR-EUR and the XTAR-LANT payload provide coverage from Denver to Singapore, which of course leaves out most of the Pacific region.

XTAR wants to change that, and sees particular need for expanding coverage to Southeast Asia. The firm has not announced details of its strategy, but Ruszkowski hints that the solution could be a surprising one.

"We are XTAR, and today we are X-band, but if you recall, our mandate…is to support the government user with satellite communications. That, in our view, doesn't necessarily limit us to X-band. So while we might grow by offering more X-band capacity, we might also grow in other frequency bands, whether they be military Ka, commercial Ka, Ku," he says.

As for applications, Ruszkowski predicts the U.S. will need to tap commercial X-band services to move information off its large fleets of traditionally piloted intelligence, surveillance, and reconnaissance planes. The primary unmanned aircraft—Air

Force Predators and Reapers—are equipped to communicate in other frequencies and thus are not candidates for X-band. "There are some new UAV systems, including the Navy's BAMS system, which are going to come out with an X-band-capable antenna. But if we're talking the Predators and the Global Hawks that are out there today, those are typically Ka-band systems," Ruszkowski adds.

None of this is to say that XTAR is giving up on X-band. The company's strategists remain convinced that the U.S. and allied militaries are going to need additional capacity, and that XTAR can fill that role in many cases. Military X-band satellites "often have special features on them that make them maybe more survivable in the case of a nuclear attack or a little bit more resistant to offensive pursuit by an adversary," explains Ruszkowski.

XTAR's payloads are simpler and less costly because of that. "XTAR is kind of in this nexus between the technical features of a milsat resource—X-band specific—and the features that make for a value proposition by a commercial operator," he says. "We enjoy that position because we think we offer to the government user, to the military user, a unique value proposition that they don't get elsewhere in the commercial or government market of resources."

On top of that, Ruszkowski says XTAR knows the importance of adaptability to changing demand and customer requirements. In fact, such capability is engineered into XTAR-LANT and EUR through the advent of steerable spot beams.

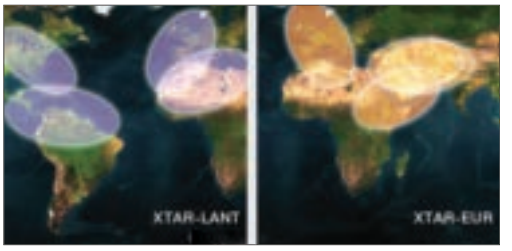
"It's not a Game Boy, but you do literally put in new coordinates to the ground-based system that flies the satellites and controls the payload," he says. "The antennas are actually moved, repositioned on the satellite to provide different pointing and different coverage of the Earth."

XTAR has done a lot of that in the past 18-24 months in reaction to changing geopolitical conditions. "Notably, we've moved a beam on the LANT payload to provide coverage of Latin America and the Caribbean," Ruszkowski points out. On XTAR-EUR, "we also repointed a beam from Europe…to the Horn of Africa to address obvious demand for military and diplomatic" communications, he adds.

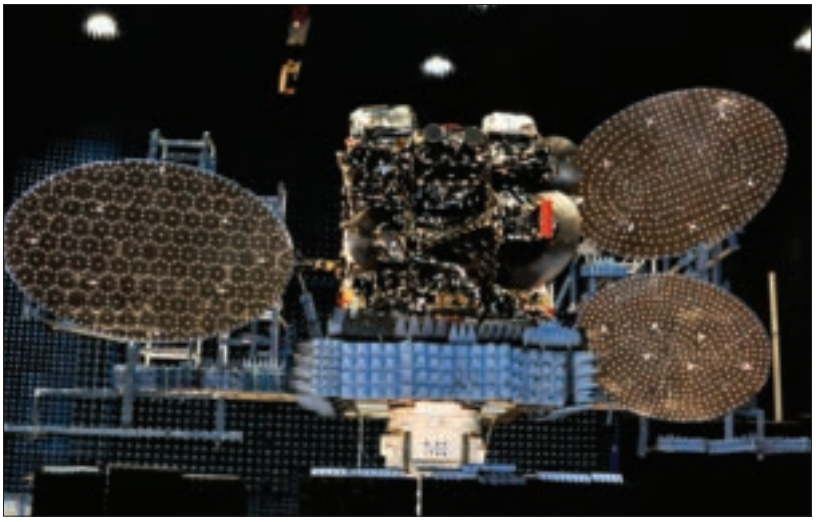
Pacific specific

There is another X-band-capable satellite on the way, a commercial spacecraft called Anik G1. Built by SSL for Canada's Telesat, it will be positioned over the Pacific Ocean west of Ecuador (107.3° West) in an orbit that will maximize coverage of the western Pacific. The satellite's main job will be to broadcast Ku-band television signals for Shaw Direct, a Canadian direct-to-home television service. If all goes as planned, it will simultaneously route X-band military and diplomatic communications in the Pacific region.

Air Force officials launch a ULAe Delta IV-Medium rocket carrying the fourth WGS satellite January 19, 2012, from Cape Canaveral AFS. (USAF photo/Patrick Corkery.)



Adaptability to changing demand and customer requirements is engineered into XTAR-LANT and EUR through the advent of steerable spot beams.



Anik G1 arrived at the Baikonur Cosmodrome on March 18 for launch on a Proton Breeze M.

Telesat is not the only X-band provider that is counting on Anik G1 to expand coverage in the Pacific region. U.K.-based Astrium Services Government Communications (formerly known as Paradigm) has leased X-band capacity on the satellite. Astrium wants to use the capacity to fill its coverage gap in the western Pacific.

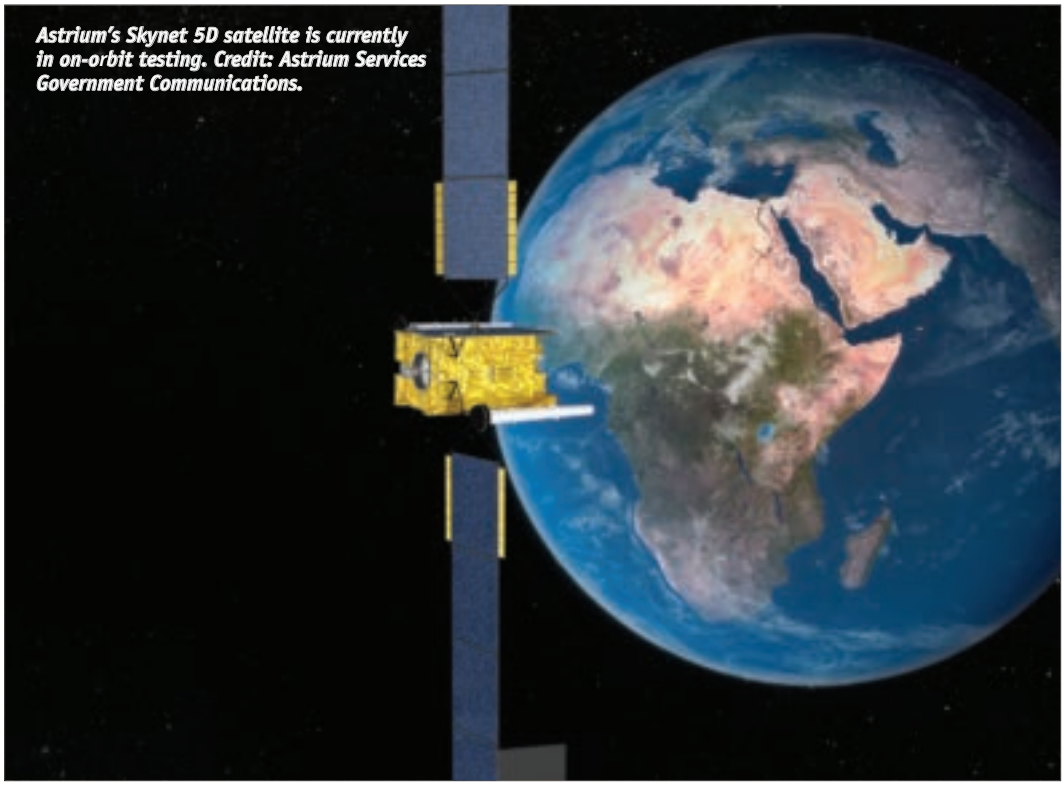
It is an unusual step for Astrium, whose role has been as operator of the U.K. military's Skynet fleet. The U.K. encourages Astrium to lease excess Skynet capacity to other governments, including the U.S., as a way to defray satellite costs.

Astrium has no choice but to look beyond Skynet if it wants to expand its Pacific reach. Skynet satellites are positioned over the equator from the Atlantic Ocean to Africa and the western Indian Ocean. The best they can do from those perches is reach eastward halfway across Australia. The newest of the satellites, the 11,000-lb Skynet 5D, will not change that. It was launched in December to a position over Africa (25° East) and is in on-orbit testing. It was built at facilities in the U.K. and assembled in Toulouse under supervision by the U.K. Ministry of Defence. "When the satellite was being constructed, it was obviously effectively part of the U.K. MOD with U.K. staff guarding it 24/7 to make sure nobody gets a close look at what's on it," says Astrium U.K. spokesman Jeremy Close.

For Astrium Services Government Communications, Anik G1 is a compromise that will fill geographic gap for the MOD. Ken Hadfield, the defense and security advisor at Astrium Services, says Anik G1 will give the company capability "virtually around the globe, except for a tiny portion."

Anik G1 is not a perfect solution when compared with Skynet 5 series, which was built to exacting U.K. military specifications. Skynet 5D, for example, is "antijam, antilaser, anti all sorts of other things," he says.

Anik G1 is more of a consumer satellite



Astrium's Skynet 5D satellite is currently in on-orbit testing. Credit: Astrium Services Government Communications.

than a military spacecraft, so it has less protection. Hadfield says that is also true for other services, such as XTAR's.

If Anik G1 shows the U.K.'s willingness to compromise, the Skynet 5 series shows its willingness to innovate. These satellites were born of a stark choice: "If you're doing warfighting operations against a sophisticated enemy, that means protected comms with survivability, resilience, and redundancy. That drives you toward a military-grade satellite that is nuclear hardened, antijam, capable of doing shaped beams, which is what a Skynet 5 is," Hadfield says.

But how to pay for all that?

"You either put a huge amount of money into research and development and a huge bow wave of expenditure up front, or what you do is partner with industry to smooth out that financial profile, and that's exactly what the United Kingdom has done with the Skynet 5, private-finance deal," Hadfield says.

The ministry put in some 'seed corn' during the concept definition phase of the Skynet 5 series, says Hadfield, then hired Astrium to build the satellites using loans. After that initial funding, Skynet 5D was built without any MOD funds at all, he says.

Bank loans will be repaid as Astrium leases the spare capacity that the U.K. MOD does not need. This capacity is leased as a service to include billing and troubleshooting. "The United Kingdom Ministry of Defence takes the view that it should help us to generate extra revenue, and we have commercial contracts with a number of nations, including the U.S. DOD," he says.

The agreement between Astrium and the U.K. runs through 2022; after that, satellites and ground equipment revert to the MOD. An extension would not be unprecedented, however. The agreement was extended once from 2018 to 2020, and then to 2022. Skynet 5D was added to the plan when a study by the MOD warned that the Skynet constellation would be out of capacity by 2016.

Hadfield, a retired officer who served in the British Army's Royal Corps of Signals, is anxious to see how a new communications study now under way comes out. The result could be one indicator of whether commercial X-band is here to stay.

Out of the

25 Years Ago, May 1988

May 13 The Collier Trophy, the top U.S. aerospace award, goes to NASA Lewis and the NASA/Industry Advanced Turboprop Team for pioneering work in developing a new generation of fuel-efficient turboprop propulsion systems. NASA, *Astronautics and Aeronautics, 1986-1990*, p. 172.

May 14 An unmanned Soviet spacecraft performs a rendezvous and docking with the Mir space station. This is a resupply mission providing food, fuel, mail, and equipment to cosmonauts Vladimir Titov and Musa Manarov, who have been on board since December. NASA, *Astronautics and Aeronautics, 1986-1990*, p. 172.

50 Years Ago, May 1963

May 1 Cuban Premier Fidel Castro is the honored guest at Moscow's May Day parade, which displays the latest in Soviet missile hardware. The annual event is always of great interest to Western military analysts, although this one has no major surprises. A solid-propellant Polaris-type ballistic missile with the NATO code name Snark is the 'newest' weapon, although it was displayed the previous November at the anniversary celebration of the Bolshevik Revolution. An almost identical new missile drawn by a Soviet T-54 tank is shown, however, along with the SA-2 and SA-3 Guideline antiaircraft missiles and the Shaddock, Shyster, and wire-guided Snapper missiles. *Aviation Week*, May 6, 1963, p. 36.

May 1 Famed aviatrix Jacqueline Cochran sets a new women's speed record of 1,203.7 mph over a 100-km course, flying a TF-104 Starfighter. D. Daso, *U.S. Air Force: A Complete History*, p. 431.

May 2 At Cuxhaven, Germany, Berthold Seliger's private company, Berthold Seliger Research and Development, reportedly launches an experimental three-stage solid-propellant sounding rocket. It attains a maximum altitude of 63 mi., with its last stage returned by parachute. This is claimed as the first major firing of a rocket in West Germany since the end of WW II. D. Baker, *Spaceflight and Rocketry*, p. 151.

May 6 JPL's Deep Space Instrumentation Facility at Goldstone, Calif., succeeds in bouncing radar signals off Mercury, 60.5 million mi. from Earth. Preliminary analysis of the echo patterns indicates that Mercury has a rougher surface than Venus or Mars. NASA, *Aeronautics and Astronautics, 1963*, p. 179.

May 7 Telstar 2 is launched by a Thor-Delta vehicle from Cape Canaveral. It is as successful as its famous predecessor, Telstar 1, launched on July 10, 1962, as the world's first active communications satellite. Telstar 2 is used to conduct several voice, TV, and other communications experiments. Essentially identical to Telstar 1, although heavier, it carries an additional experiment designed to measure the energetic proton and electron distribution in the Van Allen belts. The spacecraft continues to function until May 1965, when its transmitters are turned off. *Aviation Week*, May 13, 1963, p. 36; Telstar 2 file, NASM.

May 7 Theodore von Kármán, the famous Hungarian-born aerodynamicist, dies in Aachen, Germany, at 81. Especially noted for his work on supersonic and hypersonic airflow characterizations, he is regarded as the outstanding aerodynamic theoretician of the 20th century. Von Kármán received his doctorate in 1908 from the University of Göttingen and taught there for several years. In 1930 he emigrated to the U.S. to accept the directorship of the Guggenheim Aeronautical Laboratory at the California Institute of Technology. In 1936, with Frank Malina and others, he founded Aerojet, the second U.S. commercial rocket company (after Reaction Motors). Von Kármán also helped to found other organizations, including JPL in 1944 and, later, AGARD (the Advisory Group for Aerospace Research and Development). He received numerous honors for his many achievements. *New York Times*, May 8, 1963.

May 8 President John F. Kennedy approves the development of an antisatellite system based on the Thor missile and known as Program 437. A successor to the Saint project, it is a defensive system against potential Soviet orbital bombs. D. Baker, *Spaceflight and Rocketry*, p. 151.

May 9 An experimental Midas early warning satellite is launched by an Atlas-Agena B from Vandenberg AFB. Midas subsequently demonstrates the feasibility of missile detection and observation. It includes highly sensitive infrared detectors that sense hot exhausts of liquid-propellant rockets as well as cooler exhausts from solid-propellant types. D. Baker, *Spaceflight and Rocketry*, pp. 151-152.

Past

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

May 10 From Point Arguello, Calif., the Air Force lofts two 1.5-lb Tetrahedral Research Satellites (TRS), and its second 50-lb Project West Ford satellite, via an Atlas-Agena vehicle. They are launched piggyback aboard an unidentified satellite. The TRS measure solar cell radiation damage, while the West Ford places small copper needles in a belt around Earth for passive communications experiments. The needles are ejected from a special dispenser. The first West Ford experiment was attempted in October 1961 but failed following a mechanical malfunction of the dispenser. *Aviation Week*, May 20, 1963, p. 34.

May 15-16 Air Force Maj. Leroy Gordon Cooper Jr. successfully undertakes the sixth and final manned Project Mercury flight. In the capsule he named Faith, Cooper completes 22 "almost perfect" Earth orbits. This is the nation's fourth orbital flight. An automatic control system of his MA-9 capsule forces him to control the capsule manually during the reentry phase; nonetheless, he lands in the Pacific Ocean less than 4 mi. from the recovery ship, the aircraft carrier Kearsarge. C. Scarboro and S. Milner, *Cape Kennedy: America's Spaceport*, pp. 220-221; *Aviation Week*, May 20, 1963, pp. 26-30.

75 Years Ago, May 1938

May 13-15 The Koken long-distance-flight monoplane, designed by Tokyo Imperial University's Aeronautical Research Institute and built by the Tokyo Gas Denki Works, sets a new long-distance record for a closed circuit of 400 km. The plane stays airborne for 62 hr 29 min 49 sec for a total distance of 7,200 mi. Powering the low-wing monoplane is a liquid-cooled Kawasaki Special engine. *Aireview's The Fifty Years of Japanese Aviation 1910-1960*, p. 114.

May 13 French pilot Elizabeth Lion breaks Amelia Earhart's long-distance record for women (3,930 km), set in 1932. Flying her Caudron Aiglon, Lion covers the 4,300-km distance from Istres in southern France to Abadan, Iran, in 32 hr. *The Aeroplane*, May 25, 1938, p. 627.

May 16 Famed German aviatrix Hanna Reitsch breaks the world gliding record, flying the 156.25 mi. from Darmstadt to the Wasserkuppe mountains and back in 5 hr 30 min. *The Aeroplane*, June 8, 1938, p. 727.

May 24 The first of three high-speed three-engine Savoia-Marchetti S.M. 83 airliners is flown from Milan to Brussels for delivery to Sabena Belgian Airlines. After tests on Sabena's European network, the planes will be put into Belgium-Belgian Congo service. *Interavia*, May 28, 1938, pp. 8-9.

May 26 Robert H. Goddard launches one of his experimental liquid-fuel rockets, carrying a barograph, to an altitude of 140 ft. A gust of wind makes the rocket veer to the right, and it lands 500-600 ft from the launch tower. Three Army officers witness the flight. E. Goddard and G. Pendray, eds., *The Papers of Robert H. Goddard*, pp. 1666, 1173.

May 28 Empire Air Day, celebrated at 90 RAF and civil airports throughout Britain, features open-house static displays, air races, and demonstrations of RAF equipment and formation flying. There were to have been mass bomber flying formations, but the planes could not get through because of heavy downpours. *The Aeroplane*, June 1, 1938, pp. 653-654, 661-665.

And During May 1938

—The Navy's new blimp, the L-7, is delivered to Lakehurst, N.J., from the Goodyear factory in Akron, Ohio. Powering the new 123,000 ft^3 ship are two 145-hp engines. *Aviation*, June 1938, p. 61.

100 Years Ago, May 1913

May 13 The Sikorsky Bolshoi ('The Great'), the world's first multiengine large airplane, makes its maiden flight at St. Petersburg, Russia, piloted by its designer, Igor Sikorsky. Four Argus 100-hp engines power the aircraft, which spans 92.5 ft. The Bolshoi carries eight people and boasts a large cabin with four armchairs, a sofa, and dual controls for the pilot and copilot. C. Gibbs-Smith, *Aviation*, pp. 169-170.

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AIAA Bulletin

In March, during AIAA's 2nd Annual California Aerospace Week, which took place in Sacramento, CA, State Senator Steve Knight honored AIAA on the floor of the California State Senate for organizing California Aerospace Month, while presenting the Institute with a resolution honoring its commitment to promoting aerospace. A Resolution declaring March California Aerospace Month passed 32-0 in the California State Senate. Pictured, center, California State Senator Steve Knight, with AIAA staff members Duane Hyland, left, and Ross Bell, right.

MAY 2013

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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
2013				
8 May	**2013 Aerospace Spotlight Awards Gala**	Washington, DC		
13–16 May	**Reinventing Space Conference**	Los Angeles, CA (Contact James Wertz, jwertz@smad.com; www.reinventingspace.org)		
15–17 May†	**Seventh Argentine Congress on Space Technology**	Mendoza, Argentina (Contact: Pablo de Leon, 701.777.2369, Deleon@aate.org, www.aate.org)		
27–29 May	**19th AIAA/CEAS Aeroacoustics Conference (34th AIAA Aeroacoustics Conference)**	Berlin, Germany	*Jul/Aug 12*	**31 Oct 12**
27–29 May†	**20th St. Petersburg International Conference on Integrated Navigation Systems**	St. Petersburg, Russia (Contact: Prof. V. Peshekhonov, +7 812 238 8210, icins@eprib.ru, www.elektropribor.spb.ru)		
29–31 May†	**Requirements for UTC and Civil Timekeeping on Earth: A Colloquium Addressing a Continuous Time Standard**	Charlottesville, VA (Contact: Rob Seaman, 520.318.8248, info@futureofutc.org, http://futureofutc.org)		
6 Jun	**Aerospace Today ... and Tomorrow: Disruptive Innovation, A Value Proposition**	Williamsburg, VA (Contact: Merrie Scott: merries@aiaa.org)		
12–14 Jun†	**6th International Conference on Recent Advances in Space Technologies (RAST 2013)**	Istanbul, Turkey (Contact: Suleyman Basturk, rast2013@rast.org.tr, www.rast.org.tr)		
17–19 Jun†	**2013 American Control Conference**	Washington, DC (Contact: Santosh Devasia,devasia@u.washington.edu,http://a2c2.org/conferences/acc2013)		
24–27 Jun	**43rd AIAA Fluid Dynamics Conference and Exhibit** **44th AIAA Plasmadynamics and Lasers Conference** **44th AIAA Thermophysics Conference** **31st AIAA Applied Aerodynamics Conference** **21st AIAA Computational Fluid Dynamics Conference** **5th AIAA Atmospheric and Space Environments Conference** **AIAA Ground Testing Conference**	San Diego, CA	*Jun 12*	**20 Nov 12**
14–18 Jul	**43rd International Conference on Environmental Systems (ICES) (Mar)**	Vail, CO	*Jul/Aug 12*	**1 Nov 12**
15–17 Jul	**49th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit** **11th International Energy Conversion Engineering Conference (IECEC)**	San Jose, CA	*Jul/Aug 12*	**21 Nov 12**
11–15 Aug†	**AAS/AIAA Astrodynamics Specialist Conference**	Hilton Head Island, SC (Contact: Kathleen Howell, 765.494.5786, howell@purdue.edu, www.space-flight.org/docs/2013_astro/2013_astro.html)		
12–14 Aug	**AIAA Aviation 2013: Charting the Future of Flight** **Continuing the Legacy of the AIAA Aviation Technology, Integration, and Operations (ATIO) Conference and Featuring the 2013 International Powered Lift Conference (IPLC) and the 2013 Complex Aerospace Systems Exchange (CASE)**	Los Angeles, CA	*Oct 12*	**28 Feb 13**
16–18 Aug†	**DC-X First Flight 20th Anniversary**	Alamogordo, NM (Contact: Cathy Harper, 575.437.2840 x41153, cathy.harper@state.nm.us, http://dc-xspacequest.org)		
19–22 Aug	**AIAA Guidance, Navigation, and Control Conference** **AIAA Atmospheric Flight Mechanics Conference** **AIAA Modeling and Simulation Technologies Conference** **AIAA Infotech@Aerospace Conference**	Boston, MA	*Jul/Aug 12*	**31 Jan 13**
10–12 Sep	**AIAA SPACE 2013 Conference & Exposition**	San Diego, CA	*Sep 12*	**31 Jan 13**
23–27 Sep†	**64th International Astronautical Congress**	Beijing, China (Contact: http://www.iac2013.org)		
24–25 Sep†	**Atmospheric and Ground Effects on Aircraft Noise**	Sevilla, Spain (Contact: Nico van Oosten, nico@anotecc.com, www.win.tue.nl/ceas-asc)		
6–10 Oct†	**32nd Digital Avionics Systems Conference**	Syracuse, NY (Contact: Denise Ponchak, 216.433.3465, denise.s.ponchak@nasa.gov, www.dasconline.org)		
14–16 Oct	**31st AIAA International Communications Satellite Systems Conference (ICSSC) and 19th Ka and Broadband Communications, Navigation, and Earth Observations Conference**	Florence, Italy (Contact: www.icssc2013.org)	*Feb 12*	**31 Mar 13**
3–7 Nov†	**22nd International Congress of Mechanical Engineering – COBEM 2013**	Ribeirao Preto, Brazil (Contact: Joao Luiz F. Azevedo, joaoluiz.azevedo@gmail.com, www.abcm.org.br/cobem2013)		
5–7 Nov†	**8th International Conference Supply on the Wings**	Frankfurt, Germany (Contact: R. Degenhardt, +49 531 295 3059, Richard.degenhardt@dlr.de, www.airtec.aero)		

DATE	MEETING (Issue of *AIAA Bulletin* in which program appears)	LOCATION	CALL FOR PAPERS (*Bulletin* in which Call for Papers appears)	ABSTRACT DEADLINE
5–7 Nov†	**2013 Aircraft Survivability Symposium**	Monterey, CA (Contact: Laura Yuska, 703.247.2596, lyuska@ndia.org, www.ndia.org/meetings/4940)		

2014

13–17 Jan	**AIAA SciTech 2014 (AIAA Science and Technology Forum and Exposition 2014)**	National Harbor, MD		**5 Jun 13**

Featuring **22nd AIAA/ASME/AHS Adaptive Structures Conference · 2nd AIAA Aerospace Sciences Meeting · AIAA Atmospheric Flight Mechanics Conference · 15th AIAA Gossamer Systems Forum · AIAA Guidance, Navigation, and Control Conference · AIAA Modeling and Simulation Technologies Conference · 10th AIAA Multidisciplinary Design Optimization Specialist Conference · 16th AIAA Non-Deterministic Approaches Conference · 55th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference · 7th Symposium on Space Resource Utilization · 32nd ASME Wind Energy Symposium**

26–30 Jan†	**24th AAS/AIAA Space Flight Mechanics Meeting**	Santa Fe, NM	*Jun 13*	**2 Oct 13**
		Contact: http://www.space-flight.org/docs/2014_winter/2014_winter.html		
1–8 Mar†	**2014 IEEE Aerospace Conference**	Big Sky, MT (Contact: Erik Nilsen, 818.354.4441, erik.n.nilsen@jpl.nasa.gov, www.aeroconf.org)		
30 Apr	**2014 Aerospace Spotlight Awards Gala**	Washington, DC		
5–9 May	**SpaceOps 2014: 13th International Conference on Space Operations**	Pasadena, CA	*May 13*	**5 Aug 13**
26–28 May	**21st St. Petersburg International Conference on Integrated Navigation Systems**	St. Petersburg, Russia (Contact: Prof. V. Peshekhonov, +7 812 238 8210, icins@eprib.ru, www.elektropribor.spb.ru)		
16–20 Jun	**AVIATION 2014 (AIAA Aviation and Aeronautics Forum and Exposition)**	Atlanta, GA		**12 Nov 13**

Featuring **20th AIAA/CEAS Aeroacoustics Conference · 30th AIAA Aerodynamic Measurement Technology Conference · AIAA/3AF Aircraft Noise and Emissions Reduction Symposium · 32nd AIAA Applied Aerodynamics Conference · AIAA Atmospheric Flight Mechanics Conference · 6th AIAA Atmospheric and Space Environments Conference · 14th AIAA Aviation Technology, Integration, and Operations Conference · AIAA Balloon Systems Conference · 22nd AIAA Computational Fluid Dynamics Conference · AIAA Flight Testing Conference · 7th AIAA Flow Control Conference · 44th AIAA Fluid Dynamics Conference · AIAA Ground Testing Conference · 20th AIAA International Space Planes and Hypersonic Systems and Technologies Conference · 21st AIAA Lighter-Than-Air Systems Technology Conference · 15th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference · AIAA Modeling and Simulation Technologies Conference · 45th AIAA Plasmadynamics and Lasers Conference · 45th AIAA Thermophysics Conference**

15–18 Jul†	**ICNPAA 2014 – Mathematical Problems in Engineering, Aerospace and Sciences**	Narvik University, Norway (Contact: Seenith Sivasundaram, 386.761.9829, seenithi@aol.com, www.icnpaa.com)		
28–30 Jul	**Propulsion and Energy 2014 (AIAA Propulsion and Energy Forum and Exposition)**	Cleveland, OH		**Nov 13**

Featuring **50th AIAA/ASME/SAE/ASEE Joint Propulsion Conference · 12th International Energy Conversion Engineering Conference**

2–10 Aug†	**40th Scientific Assembly of the Committee on Space Research (COSPAR) and Associated Events**	Moscow, Russia http://www.cospar-assembly.org		
5–7 Aug	**SPACE 2014 (AIAA Space and Astronautics Forum and Exposition)**	San Diego, CA		**Feb 14**

Featuring **AIAA/AAS Astrodynamics Specialist Conference · AIAA Complex Aerospace Systems Exchange · 32nd AIAA International Communications Satellite Systems Conference · AIAA SPACE Conference**

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

†Meetings cosponsored by AIAA. Cosponsorship forms can be found at https://www.aiaa.org/Co-SponsorshipOpportunities/.

AIAA Courses and Training Program

DATE	COURSE	VENUE	LOCATION
2013			
21–24 May	**Inflight Icing and Its Effects on Aircraft Handling Characteristics**	The Ohio Aerospace Institute	Cleveland, OH
5 Jun	**Nuclear and Future Flight Propulsion: Advanced Concepts in Rocket Propulsion, Nuclear Systems, Advanced Physics, and High-Energy Density Propellants**	Webinar	
10–11 Jun	**Introduction to Spacecraft Design and Systems Engineering**	The Ohio Aerospace Institute	Cleveland, OH
10–11 Jun	**Aircraft and Rotorcraft System Identification: Engineering Methods and Hands-on Training Using CIFER®**	The Ohio Aerospace Institute	Cleveland, OH
22–23 Jun	**Verification and Validation in Scientific Computing**	Fluids Conferences	San Diego, CA
18–19 Jul	**Liquid Propulsion Systems—Evolution and Advancements**	Joint Propulsion Conference	San Jose, CA
18–19 Jul	**A Practical Introduction to Preliminary Design of Air Breathing Engines**	Joint Propulsion Conference	San Jose, CA
18–19 Jul	**Missile Propulsion Design and System Engineering**	Joint Propulsion Conference	San Jose, CA
29–30 Jul	**Introduction to Space Systems**	National Aerospace Institute	Hampton, VA
29–30 Jul	**Phased Array Beamforming for Aeroacoustics**	National Aerospace Institute	Hampton, VA
29–30 Jul	**Turbulence Modeling for CFD**	National Aerospace Institute	Hampton, VA
10–11 Aug	**Guidance of Unmanned Aerial Vehicles**	AVIATION 2013	Los Angeles, CA
10–11 Aug	**Systems Engineering Verification and Validation**	AVIATION 2013	Los Angeles, CA
17–18 Aug	**Emerging Principles in Fast Trajectory Optimization**	GNC 2013 Conferences	Boston, MA
17–18 Aug	**Recent Advances in Adaptive Control: Theory and Applications**	GNC 2013 Conferences	Boston, MA
10–12 Sep	**Human Engineering Principles for Flight Deck Evaluations**	Univ. of Tennessee Space Institute	Tullahoma, TN
11 Sep	**Missile Defense: Past, Present, and Future**	Webinar	
23–24 Sep	**Gossamer Systems: Analysis and Design**	The AERO Institute	Palmdale, 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 or www.aiaa.org/SharpenYourSkills.

ACHIEVE MORE

THE AIAA CAREER CENTER – With thousands of job postings, it's your best source for finding the ideal job. And now, with its expanded services, it's also your best source for career advice and development. This AIAA member benefit includes professional development tools to help you in your career.

CAREER TIPS – Free access to articles on job hunting, interview and negotiation techniques, networking, work-life balance, and other career-related topics.

PROFESSIONAL RESUME WRITING – Hire a professional writer to critique, create, or enhance your resume and cover letter.

CAREER COACHING – Work with an experienced and certified career coach to plan, develop, and manage your career goals.

SOCIAL NETWORKING/PROFILE DEVELOPMENT – Ensure your professional presence on LinkedIn, Plaxo, and Twitter.

REFERENCE CHECKING/EMPLOYMENT VERIFICATION – Identify questionable references before they speak with prospective employers.

DISCOUNT TEST PREP SERVICES/PRINCETON REVIEW TEST PREP COURSES – Work with the industry leader to prepare for the SAT, ACT, MCAT, LSAT, GRE, or GMAT.

Achieve more with this valuable member benefit today!
www.aiaa.org/careers

From the **Corner** Office

OUTREACH? FOR TECHNICAL PROFESSIONALS? YOU BET!

Klaus Dannenberg, AIAA Deputy Executive Director

We have recently initiated a series of notes in this column that highlight the changes within AIAA. Taken one at a time, they are not surprising at all. But taken together, there is really a remarkable transformation going on as the Institute changes with the times—to be more relevant, to be more cost effective, to take advantage of new technologies, to expand into new mission areas, and always to try to better meet the needs of all of our members, whether individuals or corporations; government, industry, or academia; or professional, student, or retiree. Each group has different needs and desires and different ideas of how a professional society should address those needs. At heart, our core products and services of broad based events and technical publications still serve the same essential needs—to inform our members on topics of interest and to provide networking opportunities to meet peers and mentors, thereby stimulating cross functional exchanges and their resulting innovation. Where else can our technical constituencies in dozens of niche areas find communities of people sharing their interests in specialty technologies or in platform or mission design and integration areas?

This core of activities remains AIAA's strength. For sure, the delivery mechanisms are changing to include updated information distribution technologies and the content we provide is expanding beyond our current areas of interest. Those are natural results of applying our problem-solving abilities to a broader and more complex set of challenges.

In hindsight, the change that surprises me the most is the outreach that the Institute is conducting and for which it is being sought out. Technical professionals are not usually viewed as marketing and sales people (nor do they want to be seen that way). From the time that I began my career until after the Cold War, there was not a lot of sentiment within the Institute's membership for public policy, public relations, advocacy, or other outreach-oriented activities. The perceived role for AIAA and our sister professional societies was to focus on technical issues, usually to the exclusion of outreach efforts. That role has changed dramatically and will, I think, make AIAA a better place. In surveys and focus group studies conducted in the recent past, our members of all ages, but especially our younger members, all want AIAA to take a stronger role in advocating for our profession and for our problem-solving capabilities. It is now becoming increasingly apparent that our membership sees ways in which we can make the world a better place through application of new technologies for new missions not historically perceived as aerospace related. But we get frustrated when others don't see it or understand it. So we have an increasing desire and need to help others understand how we can contribute.

Fortunately, the timing is excellent! Just as our membership is recognizing the need to communicate the value of aerospace products, capabilities, and talents to those outside our community, there is increasing interest and a growing number of opportunities to do just that. These opportunities stem from a desire by both federal and state governments to assure policies that stimulate and nurture aerospace successes. This desire is combined with observation of aerospace success stories like GPS and Unmanned System applications, both originally developed for military usage but quickly becoming ubiquitous for countless applications in the civil and commercial arena.

AIAA (like other societies) has had Congressional Visits Days in the spring for many years. But in the past few years, the participation by our individual members has grown substantially. That forum has helped establish relationships with Capitol Hill that have served us, and the nation, very well as we try to have a positive influence on upcoming legislation and its implementation. Because of our deliberate objectivity, our opinions and suggestions are often sought out and frequently implemented.

More recently, partially due to the legislative impasse and stalemate on Capitol Hill, the Institute has been sought out to educate and stimulate discussions at the state level. With a highly successful Unmanned System Forum in California and additional Aerospace Days events held in California, Georgia, and Virginia, AIAA is rapidly becoming the "Go To" organization to provide insight and understanding to state policy and decision makers wanting to invest in our areas of expertise for the long-term health of their local economies. While we are unsure how much activity we can support at the state level, it is also an emphasis that we cannot and will not ignore. Other areas of broad-ranging interest at the state level as well as the federal level include Earth observation and cyber threats.

As these and other areas have a direct economic impact, even at the state level, new opportunities arise for AIAA to reach out to the world beyond our legacy technical sphere of interest. This outreach has and will continue to provide new opportunities for our members to engage at the local level and to have a direct impact. As you become aware of similar opportunities and have an interest in engaging, feel free to contact me at klausd@aiaa.org. We'd love to explore these new emerging opportunities with you.

2013 BOARD OF DIRECTORS ELECTION RESULTS

AIAA proudly announces the results of the 2013 Board of Directors election. The newly elected officers and directors are:

President-Elect—Jim Albaugh, The Boeing Company (retired)

VP-Elect, Technical Activities—David Riley, The Boeing Company

VP-Elect, Member Services—Annalisa Weigel, Massachusetts Institute of Technology

Director–At-Large—Neal Barlow, United States Air Force Academy

Director–At-Large, International—Shamim Rahman, NASA Johnson Space Center

Director–Technical, Information Systems Group—Sanjay Garg, NASA Glenn Research Center

Director–Technical, Propulsion and Energy Group—Jeff Hamstra, Lockheed Martin Corporation

Director–Region 4—Jayant Ramakrishnan, Bastion Technologies

Director–Region 5—Laura Richard, United Launch Alliance

Director–Region 7—Luisella Giulicchi, European Space Agency

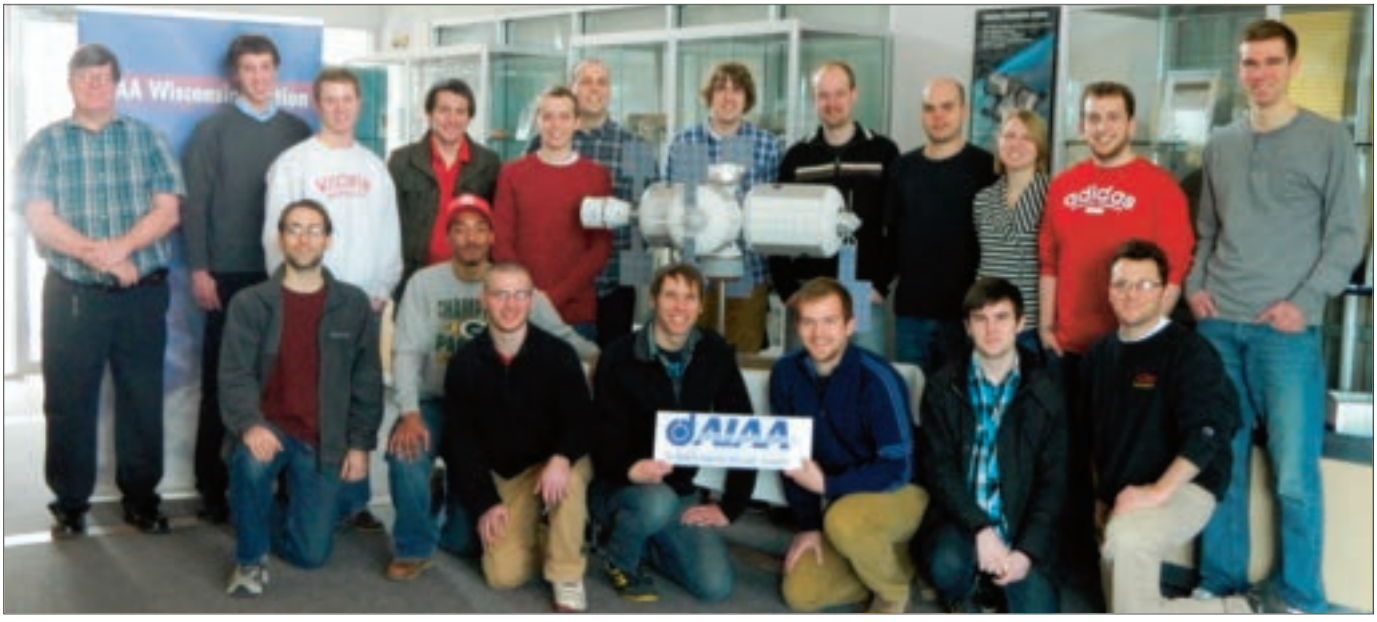
In addition, AIAA will appoint two new Board liaisons: Cheryl Blomberg from the University of Colorado, Boulder as Student liaison and Ryan Rudy from The Boeing Company as Young Professional liaison. The newly elected board members will begin their term of office on **9 May 2013**.

2013 AIAA CONGRESSIONAL VISITS DAY

Duane Hyland

The 16th annual Congressional Visits Day program took place 19–20 March, drawing 167 AIAA members from 44 AIAA sections, representing 35 states and the District of Columbia, to Washington, DC, to meet with their elected representatives and discuss matters of vital importance to the U.S. aerospace community. Through over 300 meetings with congressional decision makers, AIAA members discussed a number of topics, including: Promoting and incentivizing public–private partnerships for tech transfer and research; enabling sustained deep space exploration; completing public/private human Earth–orbit programs; developing a world-class aerospace workforce; supporting STEM K–12 education; assuring the viability of the U.S. aerospace and defense industrial base; lessening the impact of export controls on aerospace; accelerating the integration of UAV/UAS into the National Air Space, and ensuring that a robust and integrated cybersecurity policy is one of our top national security priorities.

When asked about the value of CVD to AIAA, and why she feels members should attend, Carol Cash, Vice President of Public Policy, and chair of the Public Policy Committee said, "This year's Congressional Visits Day program gave AIAA members their first chance to engage the newly elected Congress, in an effort to educate them on the importance of aerospace to our nation's prosperity and security. I am happy that 170 members from 44 sections took the chance to do so. Congressional Visits Day serves a vital link between our members and Congressional decision makers who formulate the policy and regulations which can either stifle or free our industry. Engaging Congress is vital to ensure that American aerospace keeps moving in an upward trajectory, and to ensure that we remain the world leaders in aerospace. If you haven't yet participated in the CVD program, I invite you to join us in 2014—without your voice, change is impossible!"



(Front L-R) Jon McCabe, Aaron Olson, Chris Vandamme, Harvey Elliott, Joe Jaeckels, Patrick Zubrickas, Todd Treichel, (Back L-R) Dr. Bob Morrow, Brandt Dietry, Ben Butler, Steve Wishau, Aaron Riedel, Sean Kelly, Matt Dhennin, Erik Fischer, Alek Larson, Sally Haselschwardt, Adam Mayer, Mike Sebring

ORBITEC HOSTS AIAA STUDENT CHAPTERS FROM UNIVERSITY OF WISCONSIN AND UNIVERSITY OF MICHIGAN

Students from the University of Michigan's and the University of Wisconsin's AIAA student chapters attended a weekend meeting on 16 March at Orbital Technologies Corporation (ORBITEC) and were given first-hand exposure to real-world aerospace research, design and engineering. Students began their day by learning about ORBITEC's Vortex-Cooled Rocket Engines, and learned about advantages for lighter-weight, lower costs to manufacture in comparison to conventional rocket engines. Students were shown a 20-foot sounding rocket that successfully launched in 2012 to demonstrate suborbital flight worthiness of a 3,000 lbf thrust vortex-cooled engine. They also got a chance to examine the sounding rocket and engine and learned about the development process, ground testing, flight, and recovery.

The next phase of learning involved scientific payload development followed by a tour of plant growth system technologies. Students were presented with information on human life support and instrumentation. Closed-loop environmental control of habitable spacecraft was reviewed with discussion on temperature, humidity, ventilation control, air and water processing, waste management, cabin instrumentation, and the many Earth-based tests required to qualify such products for the rigors of spaceflight. Precision gas mixing, gas chromatography mass spectrometry, vibration, thermal vacuum, thermal shock, humidity cycling, mechanical and pyrotechnic shock, lunar dust exposure, and reliability lifetime testing were a few of the Earth-based testing techniques reviewed for design, development, and qualification of aerospace technologies.

CALL FOR PAPERS FOR *JOURNAL OF AEROSPACE INFORMATION SYSTEMS*

Special Issue on "Software Challenges in Aerospace"

Special Issue on "Aerospace and Mechanical Applications of Reinforcement Learning and Adaptive Learning Based Control"

The *Journal of Aerospace Information Systems* (formerly the *Journal of Aerospace Computing, Information, and Communication* (*JACIC*)) is devoted to the applied science and engineering of aerospace computing, information, and communication. Original archival research papers are sought that include significant scientific and technical knowledge and concepts. In particular, articles are sought that demonstrate the application of recent research in computing, information, and communications technology to a wide range of practical aerospace problems in the analysis and design of vehicles, onboard avionics, ground-based processing and control systems, flight simulation, and air transportation systems.

Information about the organizers of these special issues as well as guidelines for preparing your manuscript can be found in the full Call for Papers under Featured Content in Aerospace Research Central; **arc.aiaa.org**. The journal website is **http://arc.aiaa.org/loi/jais**.

Special Issue on "Software Challenges in Aerospace"

Deadline: Submissions are due by **15 August 2013**.
Anticipated Publication Date: **November 2013**.
Contact Email: Misty Davies, misty.d.davies@nasa.gov or Lyle Long, lnl@psu.edu

Key research areas included in the special issue are:

- *Software Synthesis for Aerospace*: including model-based approaches to software and software-intensive system design, compositional and hierarchical design approaches for reducing and managing complexity, approaches to building intelligent and adaptive systems within a safety-critical framework, the generation of code that is correct-by-construction, and the design of maintainable systems.
- *Software Analysis for Aerospace*: including verification and validation for safety-critical software systems, security analysis for aerospace communications, compositional analysis of code for scalability, automated testing techniques, and statistical techniques (including data mining and learning) for program and software behavior analysis.
- *Aerospace System Integration*: including architectures for safety-critical aerospace systems containing software, hardware, and people; approaches to, benefits of, and limitations of Integrated Modular Avionics frameworks; human-computer interaction including intelligent cockpits/control towers; and adaptive airspace implementations.
- *Aerospace Software Policy and Implementation*: including the certification of software systems using traditional or safety-case based approaches and decision-making in air systems (including both autonomy and human factors issues).
- Creating and maintaining a skilled workforce for aerospace software, college curricula, and certification of software engineers.
- Intelligent systems software for aerospace systems.
- Software issues in cybersecurity related to aerospace systems.
- Use of COTS software in critical systems.

These areas are only indicative. The special issue is also open to manuscripts that are relevant to the applied science and engineering of aerospace computing, information, and communication but do not fit neatly into any of the above areas. We do envisage, however, that successful manuscripts will include experimental results, sophisticated simulations of aerospace systems, or (in the case of a paper in the areas of education or policy) well-researched and thorough arguments for policies and their implementations.

Special Issue on "Aerospace and Mechanical Applications of Reinforcement Learning and Adaptive Learning Based Control"

Deadline: Submissions are due by **15 August 2013**.
Anticipated Publication Date: **January 2014**.
Contact Email: Jonathan How, jhow@mit.edu

Key research areas included in the special issue are:

- Learning with limited data and/or in domains for which obtaining data is expensive or risky
- Real-time reinforcement learning with resource constraints (e.g., limited memory and computation time)
- Use of reinforcement learning for risk sensitive or safety critical applications
- Scaling reinforcement learning to multi-agent systems
- Distributed reinforcement learning
- Adaptive learning-based control in the presence of uncertainty

These areas are only indicative. The special issue is also open to manuscripts that are relevant to the applied science and engineering of aerospace computing, information, and communication but do not fit neatly into any of the above areas. We do envisage, however, that successful manuscripts will include experimental results, or at least sophisticated simulations of real-life mechanical or aerospace systems.

Reinforcement learning and learning-based adaptive control are powerful techniques to perform planning and control for systems with significant model errors and uncertainty. In the computer science community many benchmark types examples have been tackled successfully, showing the advantage of these learning techniques. The goal of this special issue is, however, to assemble high-quality papers that highlight the use of these techniques in more complex aerospace and mechanical engineering applications. In particular, papers are encouraged that demonstrate the use of these learning-based planning and control approaches on physical systems operating in real-world situations with significant disturbances and uncertainties. Classes of uncertainties could include modeling error, uncertainty due to environmental/external effect, hybrid/switched dynamics, sensing/actuation errors, noise, sensing/actuation failures, and structural damage/failures. Model-free and model-based control/planning techniques should highlight online long-term learning through construction and exploitation of (approximate) models of the agent, the environment, value functions, state/action constraints, etc. Long-term learning could be characterized by improved tracking, improved mission-score, online generation of optimal policy, predictive ability, and accurate prognosis.

Examples of classes of planning and reinforcement learning techniques include, but are not limited to: approximate dynamic programming, temporal difference learning, adaptive function approximation techniques, planning under uncertainty, intelligent exploration scheme, and learning with risk mitigation.

Examples of classes of control techniques of interest include, but are not limited to: indirect adaptive control, hybrid direct/indirect adaptive control, dual-control, adaptive model predictive control, direct optimal adaptive control using reinforcement learning, learning-focused neuro-adaptive and neuro-fuzzy control, non-parametric control. In general, papers that leverage exploitation of predictive ability of online learning and adaptation are encouraged, whereas papers that focus on adaptation based on reactive short-term learning would risk being outside the scope of this issue.

OBITUARIES

AIAA Fellow Price Died in June 2012

Edward W. Price, a world-renowned expert in the fields of solid propellants combustion and solid propellants rockets passed away on 11 June 2012, at the age of 91.

Mr. Price joined the Civilian Conservation Core (CCC) after high school. Upon completion of one year of service with the CCC in 1939, he enrolled in Pasadena Junior College where he studied mathematics. In 1941, he started working at Caltech on static firing of rocket motors. Mr. Price enlisted in the Navy in 1944 where he was assigned to work on solid propellants charge design and combustion at the Naval's Ordnance Test Station (NOTS) in China Lake, CA. He received an honorable discharge from the Navy in January 1946 and continued working in China Lake until October when he enrolled at UCLA, earning a double bachelor's degree in mathematics and physics in 1948.

Upon graduation, Mr Price returned to China Lake to work as a physicist at NOTS, which eventually became the Naval Weapons Center (NWC). In 1955, he became the head of NWC's Research Department Gas Dynamics Branch and was assigned to work on the design and testing of propellants charges and internal ballistics. During his years at NWC, he became an internationally respected expert in the fields of solid propellants combustion and solid propellants rockets. During these years, he made seminal contributions to the understanding of internal ballistics of solid propellant rocket motors, combustion instabilities in solid propellant rockets, ignition and combustion of solid propellants, aluminum and other metals, and the development of the "T-burner" testing method that has been further investigated by researchers and adapted by companies throughout the world. He also developed novel approaches and devices for controlling combustion instabilities and regulating thrust in solid propellants rockets and improving the combustion of solid propellants.

In 1974, after 30 years of service, Mr Price left the NWC to become a full professor at the Daniel Guggenheim School of Aerospace Engineering at Georgia Tech. He proceeded to develop an outstanding research program on solid propellants combustion at Georgia Tech while educating many undergraduate and graduate students. For his contributions to research and education, Price was promoted in 1986 to the rank of Regents' Professor, an honorary professorship. He retired from Georgia Tech in 1991, but continued to do research.

Mr. Price contributed to the advancement of solid propellants rockets technology in the United States by serving on important government and professional society committees. In 1961, he was nominated to serve as a member of the AIAA Solid Rockets Technical Committee and became its chair in 1963. He was also selected in 1963 to chair the Solid Rocket Combustion Instability Subcommittee that was established within the Department of Defense Interagency Chemical Rocket Propulsion Group. In 1964, Price was invited to serve on the AIAA Publications Committee, and in 1965 he was appointed to the AIAA Technical Activities Committee. In 1966 he was elected as one of the Directors–Technical of the AIAA Board, and AIAA Vice President in 1967. Mr. Price also served as a member of NASA's National Research Council Independent Panel on the Technical Evaluation of the Redesign of the Space Shuttle Solid Rocket Booster, following the 1986 explosion of the Orbiter *Challenger*.

Price's contribution to science, engineering, and the literature were recognized with the following awards: the Navy Superior Civilian Service Award (1974), the coveted AIAA Goddard Award (1976), the L.T.E. Thompson Award (1960), the AIAA Research Award (1967), the AIAA's Pendray Literature Award (1972), the Joint Army Navy Air Force (JANNAF) Interagency Propulsion Committee Certificate Of Recognition (1985), and the National Aeronautics and Space Administration Public Service Award (1988). Mr Price was elected to the NAE in 2000 in recognition of his "critical contributions to the understanding of solid propellants combustion and solid rockets developments."

AIAA Fellow Holmes Died in January

D.B. Holmes, NASA's first Director of Manned Space Flight; retired President of the world's largest supplier of guided missiles, Raytheon; designer of the Patriot anti-missile system; and retired Chairman of Beech Aircraft died on 11 January 2013. He was 91 years old.

Mr. Holmes received his B.S.E.E. degree from Cornell University in 1943. In 1943–1944, as an Ensign in the U.S. Naval Reserve, he completed graduate studies in radar at both M.I.T and Bowdoin College. He was awarded an honorary Doctor of Science degree by the University of New Mexico in 1963 and an honorary Doctor of Engineering degree from Worcester Polytechnic Institute in 1978.

From 1945 through 1953, Mr. Holmes was with Bell Telephone Laboratories and Western Electric Company where he developed advanced repeaters, amplifiers, and measuring equipment. Then from 1953 to 1961, Mr. Holmes led several key Radio Corporation of America (RCA) initiatives, most notably serving as overall Manager of the Ballistic Missile Early Warning System, for which RCA was the prime contractor to the U.S. Air Force. He was also Project Manager of the land-based system for both the U.S. Navy Talos missile system and the Launch Control and Checkout Equipment for the Atlas missile system.

As General Manager of RCA's Major Defense Systems Division, he provided the technical and management direction of advanced military electronic systems in the fields of detection oand warning, aerospace, and command and control.

In 1961, Mr. Holmes joined NASA. He led the national effort to go to the moon and directed the government and industry efforts in manned space flight, including the Mercury, Gemini, and Apollo programs. The basic program and system decisions were made under his direction. He left NASA upon successful completion of the Mercury program.

He joined Raytheon as a director in 1963, where he initially led military engineering, research and development, until 1975 when he was named President of Raytheon. Upon Raytheon's acquisition of Beach Aircraft in 1982, he also assumed the role of Chairman of Beech Aircraft.

Mr. Holmes was the recipient of the NASA Medal for Outstanding Leadership and the Arnold Air Society's Paul T. Johns Award for outstanding contributions to aeronautics and astronautics. He was a member of the National Academy of Engineering, and a fellow of AIAA and the Institute of Electrical and Electronics Engineers. Mr. Holmes was a commercial rated pilot, logging over 4,500 hours in a variety of aircraft, including jets and as a test pilot of experimental aircraft.

AIAA Associate Fellow Gibbens Died in February

Roy P. Gibbens died 24 February 2013.

Mr. Gibbens was a retired engineer for Lockheed Aircraft, a member of Civil Air Patrol and Past Commander for the State of Mississippi. He was involved with SCORE and a member of Lighter than Air Association. Mr. Gibbens was a member of the Lighter-than-Air Systems Technical Committee for over 10 years and served as vice chair (1998–2000) and chair (2000–2001) for the technical committee. Mr. Gibbens also started the Air Force Association in Meridian, MS.

AIAA Senior Member Nadworny Died In March

Henri C. Nadworny Sr., 83, died on 4 March.

Mr. Nadworny graduated from Georgia Tech with an Aeronautical Engineering Degree. He was employed by

Douglas Aircraft in Santa Monica, CA, and retired from Grumman Corporation in Bethpage, NY, where he worked on notable projects such as the Apollo Lunar Module, Jacques Piccard's submersible vehicle, the U.S. Navy hydrofoil, the F14 Fighter Jet, the Gulfstream Aircraft, and the U.S. Postal Service prototype, electric mail truck.

AIAA Honorary Fellow Brill Died in March

Yvonne C. Brill, the developer of the hydrazine resistojet propulsion system for satellite systems, and a 2011 recipient of the National Medal of Technology and Innovation from President Obama, died on 27 March. She was 88 years old.

Brill distinguished herself not only as an innovative engineer who spent most of her career in the communications satellite industry, but as a tireless advocate for attracting young people into the engineering field. She was committed to ensuring that aerospace and engineering professionals—especially women—received recognition for their accomplishments.

Brill, formerly of RCA Astro Electronics, Princeton, NJ, developed the hydrazine resistojet propulsion system, also known as the electrothermal hydrazine thruster (EHT). Brill's invention improved thruster efficiency on orbiting satellites by thirty percent, significantly decreasing the amount of propellant needed to maintain geosynchronous orbit. Brill's invention became the industry standard for satellite propulsion, significantly reducing costs across the satellite industry. Brill received the 2011 National Medal of Technology and Innovation for her "innovation in rocket propulsion systems for geosynchronous and low earth orbit communication satellites, which greatly improved the effectiveness of space propulsion systems."

She left RCA to serve as director of the Space Shuttle solid rocket motor program at NASA Headquarters from 1981 to 1983, then returned to RCA for three years before accepting the position of Space Segment Engineer for INMARSAT in London. Brill became a consultant when she returned to the United States and served as a member of NASA's Aerospace Safety Advisory Panel (ASAP) for several years.

Among her many honors was election to the National Academy of Engineering in 1987 and she was only the second woman to become an Honorary Fellow of AIAA in 2008; she had been an AIAA Fellow since 1986. She was very active in the Society of Women Engineers (SWE), was elected as an SWE Fellow in 1985, and received its Resnik Challenger Medal in 1993 for her "innovative concepts for satellite propulsion systems which have designated her as a pioneer in expanding space horizons." She also received the Institute of Electrical and Electronics Engineers (IEEE) Resnik Award in 2002 "for innovation in rocket propulsion systems for geosynchronous and low earth orbit communications satellites and the foresight to champion the hybrid electric mono-propellant rocket engine." She was a member of the Space Studies Board of the National Research Council.

Register TODAY!

www.aiaa.org/JPC2013AA

49th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and 11th International Energy Conversion Engineering Conference

15–17 July 2013 • San Jose Convention Center • San Jose, California

Continuing Education Short Courses

Liquid Propulsion Systems – Evolutions and Advancements

Thursday–Friday • 18–19 July 2013 • 0815–1700 hrs

Instructors: Alan Frankel, Ivett Leyva, and Patrick Alliot
Summary: This course will cover propulsion fundamentals and topics of interest in launch vehicle and spacecraft propulsion; non-toxic propulsion; microsat and cubesat propulsion; propulsion system design and performance; and human rating of liquid engines.

A Practical Introduction to Preliminary Design of Air-Breathing Engines

Thursday–Friday • 18–19 July 2013 • 0815–1700 hrs

Instructors: Ian Halliwell and Steve Beckel
Summary: This course will be an overview of the preliminary design of air-breathing engine systems that is determined primarily by the aircraft mission, which defines the engine cycle – and different types of cycles are investigated. Preliminary design activities are defined and discussed in the context of the overall engine development process and placed in perspective.

Missile Propulsion Design and System Engineering

Thursday–Friday • 18–19 July 2013 • 0815–1700 hrs

Instructor: Eugene L. Fleeman
Summary: This course will cover missile propulsion system design, development, analysis, and system engineering activities in addressing requirements such as cost, performance, risk, and launch platform integration.

Register for a course and attend the Conference for **FREE!** Registration fee includes full conference participation: admittance to technical and plenary sessions; receptions, luncheons, and online proceedings.

13-0169

CALL FOR NOMINATIONS

Recognize the achievements of your colleagues by nominating them for an award! Nominations are now being accepted for the following awards, and must be received at AIAA Headquarters no later than **1 July**. Awards are presented annually, unless other indicated. However AIAA accepts nomination on a daily basis and applies to the appropriate year.

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

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

Aerospace Design Engineering Award recognizes design engineers who have made outstanding technical, educational, or creative achievements that exemplifies the quality and elements of design engineering. (Presented odd years)

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

Aerospace Software Engineering Award is presented for outstanding technical and/or management contributions to aeronautical or astronautical software engineering. (Presented odd years)

Children's Literature Award is presented for an outstanding, significant, and original contribution in aeronautics and astronautics. (Presented odd years)

Dr. John Ruth Digital Avionics Award recognizes outstanding achievement in technical management and/or implementation of digital avionics in space or aeronautical systems, including system analysis, design, development, or application. (Presented odd years)

Excellence in Aerospace Standardization Award recognizes contributions by individuals that advance the health of the aerospace community by enabling cooperation, competition, and growth through the standardization process. (Presented odd years)

Faculty Advisor Award is presented to the faculty advisor of a chartered AIAA Student Branch, who in the opinion of student branch members, and the AIAA Student Activities Committee, has made outstanding contributions as a student branch faculty advisor, as evidenced by the record of his/her student branch in local, regional, and national activities.

Gardner-Lasser History Literature Award is presented for the best original contribution to the field of aeronautical or astronautical historical nonfiction literature published in the last five years dealing with the science, technology, and/or impact of aeronautics and astronautics on society.

History Manuscript Award is presented for the best historical manuscript dealing with the science, technology, and/or impact or aeronautics and astronautics on society.

Information Systems Award is presented for technical and/or management contributions in space and aeronautics computer and sensing aspects of information technology and science. (Presented odd years)

Intelligent Systems Award recognizes important fundamental contributions to intelligent systems technologies and applications that advance the capabilities of aerospace systems. (Presented odd years)

Lawrence Sperry Award is presented for a notable contribution made by a young person to the advancement of aeronautics or astronautics. The nominee must be under 35 years of age on **December 31** of the year preceding the presentation.

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.

Pendray Aerospace Literature Award is presented for an outstanding contribution or contributions to aeronautical and astronautical literature in the relatively recent past.

Structures, Structural Dynamics and Materials Award is presented for an outstanding sustained technical or scientific contribution in aerospace structures, structural dynamics, or materials. (Presented even years)

Survivability Award recognizes outstanding achievement or contribution in design, analysis implementation, and/or education of survivability in an aerospace system. (Presented even years)

Summerfield Book Award is presented to the author of the best book recently published by AIAA. Criteria for the selection include quality and professional acceptance as evidenced by impact on the field, citations, classroom adoptions, and sales.

Sustained Service Award recognizes sustained, significant service and contributions to AIAA by members of the Institute. A maximum of 20 awards are presented each year.

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

CORRECTION

In the January 2013 *AIAA Bulletin*, we incorrectly stated on page **B5** that the AIAA Sydney Section worked with students on a rocket avionics project. The article should have stated that the AIAA Adelaide Section worked with students on the rocket avionics project that culminated in the launch of their microprocessor payload from Karoonda, Australia.

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

Standard Information for all AIAA Conferences

This is general conference information, except as noted in the individual Event Preview information.

On-Site Check-In

Partnering with Expo Logic, we've streamlined the on-site registration check-in process! All advance registrants will receive an email with a registration barcode. To pick up your badge and conference materials, make sure to print the email that includes your ExpressPass Barcode, and bring it with you to the conference. Simply scan the ExpressPass barcode at one of the ExpressPass stations in the registration area to print your badge and receive your meeting materials.

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.

Certificate of Attendance

Certificates of Attendance are available for attendees who request documentation at the conference itself. Please request your copy at the on-site registration desk. AIAA offers this service to better serve the needs of the professional community. Claims of hours or applicability toward professional education requirements are the responsibility of the participant.

Conference Proceedings

Proceedings for AIAA conferences will be available in online proceedings format. The cost is included in the registration fee where indicated. Attendees who register in advance for the online proceedings will be provided with access instructions. Those registering on site will be provided with instructions at that time.

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 website, **http://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 Information Systems* (formerly *Journal of Aerospace Computing, Information, and Communication)*. You may now submit your paper online at **http://mc.manuscriptcentral.com/aiaa**.

Timing of Presentations

Each paper will be allotted 30 minutes (including introduction and question-and-answer period) except where noted.

Committee Meetings

Committee meeting schedule will be included in the final program and posted on the message board in the conference 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 Event Preview 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 attendees.

Membership

Nonmembers who pay the full nonmember registration fee will receive their first year's AIAA membership at no additional cost.

Nondiscriminatory Practices

The AIAA accepts registrations irrespective of race, creed, sex, color, physical handicap, and national or ethnic origin.

Restrictions

Videotaping or audio recording of sessions or 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.

AIAA AVIATION 2013

including

AIAA Aviation Technology, Integration, and Operations (ATIO) Conference
International Powered Lift Conference (IPLC)
Complex Aerospace Systems Exchange (CASE)

12–14 August 2013
Hyatt Regency Century Plaza
Los Angeles, California

Synopsis

Aviation is an essential component of the world economy and global security. The success of aviation is due to technological innovations that have provided an unprecedented level of capability, capacity, and efficiency. AIAA AVIATION 2013 is a premier, forward-looking forum designed to showcase recent innovations and achievements in aviation, highlight new initiatives and plans, and address key issues that need to be resolved in order to define clear roadmaps for future progress.

AVIATION 2013:

- Engages those involved in the entire product life-cycle from disciplinary research to product development to system operation and maintenance.
- Eliminates barriers by addressing the global nature of aviation requirements, opportunities, regulatory limitations, research activities, development programs, and operations.
- Provides the breadth and depth of content and audience participation that is necessary for tackling the issues critical to safeguarding and shaping the future of aviation.

AVIATION 2013 tackles these questions:

- What are the trends for commercial, military, business, general, unmanned, and rotorcraft aviation?
- What economic and investment considerations will affect the future of aviation?
- What major challenges face aviation—including operations, capacity, capability, efficiency, security, resource availability and environmental issues?
- How will these challenges drive technology development and implementation?
- What are the key emerging technologies?
- What policy and regulatory issues may constrain aviation's development?
- What effect will globalization have on the future of aviation?

Seven general sessions will focus on:

- Commercial Aviation: Global Outlook, Opportunities, and Challenges
- Military Aviation: Future Challenges Facing Military Aviation
- Business Aviation, General Aviation, and Rotorcraft: Global Outlook, Opportunities, and Challenges
- The Connectivity Challenge and Cybersecurity: Protecting Critical Assets in a Networked World
- The Energy Imperative
- Developing the Market for Unmanned Aerial Systems
- Shaping the Discussion: Key Policy Issues

Be a part of AIAA AVIATION 2013 and help define a shared vision for the future that will continue to transform our economy, security, and way life.

AIAA Programs

AIAA AVIATION 2013 will be further enriched by the inclusion of Complex Systems discussions and more than 300 technical papers in the following supporting conferences and events:

- **AIAA Aviation Technology, Integration, and Operations (ATIO) Conference** covers a broad range of topics, from the design and operation of aircraft of all kinds (including lighter-than-air and balloon systems, and unmanned aircraft), to the design and operation of the air traffic management system (from strategic traffic planning systems to tactical air traffic control methods and procedures), to the complex system-of-system connectivities to make it all operate smoothly, now and into the future.
- **International Powered Lift Conference (IPLC)**, focuses on the latest developments in Vertical and/or Short Take-Off and Landing (V/STOL) aircraft research, concepts, and programs.
- **Complex Aerospace Systems Exchange (CASE)** tackles some of the most important system development issues facing aerospace chief engineers, program managers, and systems engineers today, such as minimizing cost overruns and delays, and mitigating late test failures. Sessions include Lessons Learned in Complex Systems Development • Involvement of Test in Complex Systems Development • Program Management and Project Planning • Model Based Engineering • V&V Involvement Earlier in Complex System Development Cycle • Supplier Management and Logistics • Work Force Issues • Managing Complexity • Issues with Engaging M&S and Test Earlier in the Complex System Design Process • Program Organization Relative to Complex Systems Development

Why Attend?
- Hear from the industry and government leaders who are shaping the future direction of aviation.
- Share your views on issues and insights related to life-cycle management of complex aviation systems.
- Engage in dialogue with world-class researchers, engineers, developers, manufacturers, operators, economists, and policymakers.
- Discover ideas and solutions that have practical implications for your work.
- Establish and enhance personal and professional connections.

Who Will Attend?
- Chief Executives
- Chief Engineers
- Program and Project Managers
- Systems Integrators and Mission Planners
- Business Developers and Contractors
- Policymakers and Aviation Analysts
- R&D Engineers and Managers
- Prime Contractors, Subcontractors, and Suppliers
- Design Engineers and Researchers
- Students and Educators
- Press/Media

Plenary and Panel Discussions

Welcome Remarks
Sandra Magnus, Executive Director, AIAA

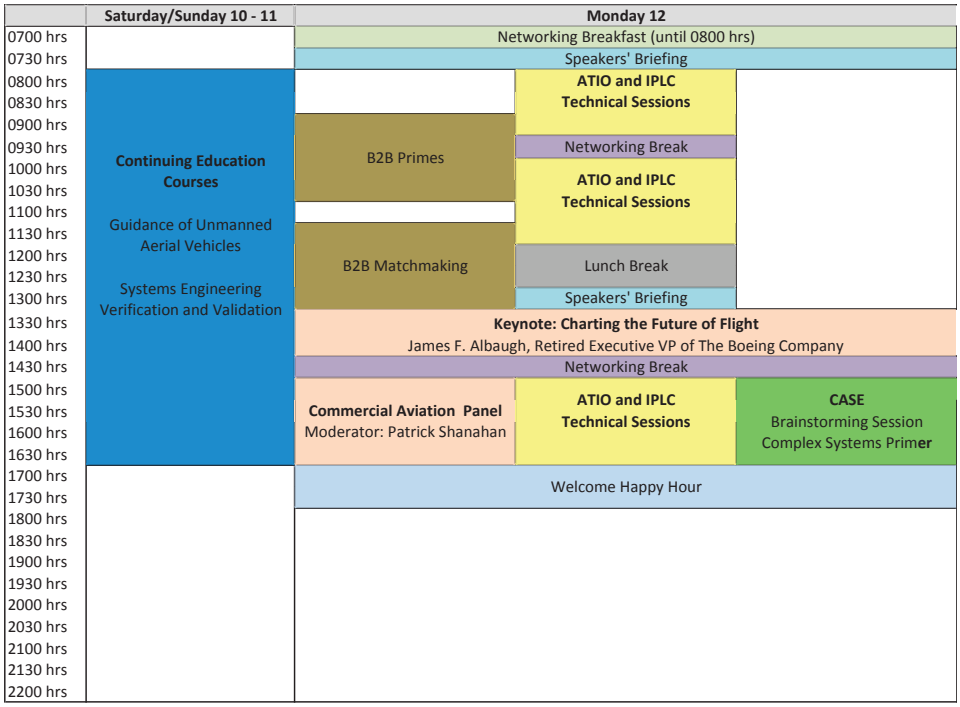
Opening Keynote Address: Charting the Future of Flight
Jim Albaugh, Executive Vice President, The Boeing Company, President and Chief Executive Officer, Boeing Commercial Airplanes (retired)

Commercial Aviation Panel Discussion: Global Outlook, Opportunities, and Challenges
Moderator: Patrick Shanahan, Senior Vice President and General Manager, Airplane Programs, Boeing Commercial Airplanes
Panelists: Tony Tyler, Director General and Chief Executive Officer, International Air Transport Association (invited); Michael P. Huerta, Administrator, Federal Aviation Administration (invited); Jaiwon Shin, Associate Administrator for Aeronautics Research Mission Directorate, NASA; Graham Warwick, Senior Editor, Aviation, *Aviation Week and Space Technology* (invited)

For a century, commercial aviation has improved capability, safety, security, and efficiency through the continued advancement of technology. Commercial aviation faces new challenges as it enters its second century. This discussion of the global outlook, opportunities, and challenges for commercial aviation will include perspectives from each individual panel member's unique areas of responsibility and experience. Panelists will focus on important questions affecting global aviation, including:

- What are the market trends?
- What are the key economic and investment considerations for the future?
- What challenges face commercial aviation operations, capacity, capability, efficiency, security, resource availability, and environmental stewardship?
- How will these challenges drive technology development and implementation?
- What policy issues may constrain the market?
- What effects will globalization have?

Military Aviation Keynote Address
Marion C. Blakey, President and Chief Executive Officer, Aerospace Industries Association (invited)



Military Aviation Panel Discussion: Future Challenges Facing Military Aviation
Moderator: Marion C. Blakey, President and Chief Executive Officer, Aerospace Industries Association (invited)
Panelists: James (Jim) O'Neill, President, Global Services & Support, Boeing Defense Space & Security; Vice Admiral William E. "Bill" Landay, III, Director, Defense Security Cooperation Agency, U.S. Navy (invited); Orlando Carvalho, Executive VP Aeronautics, Lockheed Martin (invited); Mark Gunzinger, Senior Fellow, Center for Strategic and Budgetary Assessments

The evolution of global defense and security priorities creates new opportunities and challenges for developing policy, priorities, technology, and defense capabilities. This discussion of the global outlook, opportunities, and challenges for military aviation will reflect insights drawn from each individual panel member's unique areas of responsibility and experience. The panel will identify key factors affecting military aviation, including:

- What are the trends for military procurement?
- How will the U.S. role in global peacekeeping and homeland security shape the industry?
- How will U.S. budgetary challenges affect the industry?
- What major challenges face military aviation, such as resource availability, operations, capacity, capability, efficiency, security, and environmental considerations?
- What technologies will address these challenges?
- How will increased use of unmanned systems change the nature of military aviation?

Luncheon Keynote Address
TBA

The Connectivity Challenge and Cybersecurity Panel Discussion: Protecting Critical Assets in a Networked World
Moderator: Paul Kurtz, Chief Strategy Officer, CyberPoint International
Panelists: Dominic Nessi, Deputy Executive Director/Chief Information Officer, Los Angeles World Airports

As connectivity of aviation services continues to increase, so too do potential vulnerabilities. This panel will examine the risks posed by the convergence of the global IT supply chain and the aviation sector it supports. Among the issues to be discussed are these:

- Securing enterprise architecture systems for communications
- Traditional and GPS navigation systems
- Surveillance, flight planning, passenger loads, and air traffic control systems
- Security systems for operators, airports, and aircraft
- Spectrum management

The Energy Imperative Panel Discussion
Moderator: Steve Csonka, Executive Director, Commercial Aviation Alternative Fuels Initiative (CAAFI)
Panelists: Thomas W. Hicks, Deputy Assistant Secretary of the Navy (Energy), U. S. Navy (invited); Mauro Kern, Executive Vice President, Engineering and Technology, Embraer; Alan H. Epstein, Vice President, Technology and Environment, Pratt & Whitney

AIAA Programs

	Tuesday 13			Wednesday 14		
0700 hrs	Networking Breakfast (until 0800 hrs)			Networking Breakfast (until 0800 hrs)		
0730 hrs	Speakers' Briefing			Speakers' Briefing		
0800 hrs	**Keynote: Military Aviation**			**Keynote: Future of Flight - Technology Vision**		
0830 hrs	Marion C. Blakey , President and CEO, Aerospace Industries Association(invited)			Charles F. Bolden Jr., Administrator, NASA		
0900 hrs	Networking Break			Networking Break		
0930 hrs	**Military Aviation Panel** Moderator: Marion C. Blakey (invited)	**ATIO and IPLC Technical Sessions**	**CASE** Introduction and Opening Plenary	**Business/General Aviation Rotocraft Panel** Moderator: Pete Bunce	**ATIO and IPLC Technical Sessions**	**CASE** Work Force Issues
1000 hrs						
1030 hrs						
1100 hrs						
1130 hrs	**Luncheon Keynote: The Connectivity Challenge and Cybersecurity**					
1200 hrs	TBA			**Luncheon Keynote—The Aircraft Market in an Age of Extremes: industry Overview and Forecast, Richard L. Aboulafia, Vice President, Analysis, The Teal Group**		
1230 hrs						
1300 hrs	Speakers' Briefing			Speakers' Briefing		
1330 hrs	**Connectivity Challenge and Cyber Security Panel** Moderator: Paul Kurtz	**ATIO and IPLC Technical Sessions**	Lessons Learned in Complex Systems Development	**Development Market for UAV Panel**	**ATIO and IPLC Technical Sessions**	**CASE** • Managing Complexity • Program Organization
1400 hrs						
1430 hrs						
1500 hrs						
1530 hrs	Networking Break			Networking Break		
1600 hrs	**The Energy Imperative Panel** Moderator: Steve Csonka	**ATIO and IPLC Technical Sessions**	**CASE** Model Based Engineering	**Shaping the Policy Panel** Moderator: Richard L. Aboulafia	**ATIO and IPLC Technical Sessions**	**CASE** Wrap up and Closing
1630 hrs						
1700 hrs						
1730 hrs						
1800 hrs	Reception Museum of Flying Sponsored by Gulfstream			Closing Reception (Sponsored by Lockheed Martin Corporation)		
1830 hrs						
1900 hrs						
1930 hrs						
2000 hrs						
2030 hrs						
2100 hrs						
2130 hrs						
2200 hrs						

Rising fuel costs and price volatility have dramatic implications for both commercial and military aviation. Experimentation with alternative fuels to hedge against price increases and availability issues in the long term has become a high-profile subject. This session will focus on the following topics:

- What are the future of alternative fuels and propulsion?
- What global trends in energy will impact the aerospace industry?
- To what extent can alternative fuel sources achieve cost reductions or reduce price volatility?
- Are defense aviation and commercial aviation competitors or partners—or both—for alternative fuels?

Keynote Address: Future of Flight—Technology Vision
Charles F. Bolden, Jr., Administrator, NASA

Business Aviation, General Aviation, and Rotorcraft: Global Outlook Opportunities and Challenges
Moderator: Pete Bunce, President and CEO, General Aviation Manufacturers Association
Panelists: Pres Henne, Senior Vice President, Engineering and Test, Gulfstream; Mike Hirschberg, Executive Director, AHS International; John S. Langford, Chairman and Chief Executive Officer, Aurora Flight Sciences Corporation; Jack Pelton, Chairman of the Board, Experimental Aircraft Association

Business aviation, general aviation, and rotorcraft markets continue to push technology advancements to improve capability and efficiency. The topics to be covered during the panel discussion include:

- What market trends will drive technology development and implementation in these areas?
- What major challenges—including operations, capacity, capability, efficiency, security, and environmental issues—face aviation in these sectors?
- What policy issues may constrain the market?
- What technologies can improve capacity, capability, efficiency, security, and environmental issues?
- What economic and investment constraints exist?

Luncheon Keynote Address: The Aircraft Market in an Age of Extremes—Industry Overview and Forecast
Richard L. Aboulafia, Vice President, Analysis, The Teal Group

Developing the Market for UAVs Panel Discussion
Moderator: John S. Langford, Chairman and Chief Executive Officer, Aurora Flight Sciences Corporation
Panelists: David McBride, Center Director, NASA Dryden Flight Research Center; Michael Neale, RF System Design Manager, General Atomics Aeronautical Systems; Randy Willis, Air Traffic Manager, Unmanned Aircraft Systems Integration Office

Unmanned aerial vehicles offer tremendous potential to create benefits for the public, for the economy, and for technology advancement, especially if the introduction of these systems into the market proceeds in an orderly fashion. The topics to be covered by the panel include:

- What are the opportunities for the UAV market in the U.S. and globally?
- What critical issues—such as privacy, policy formation, regulation, operations, investment, and insurance—will affect the development of the market?
- Is a new regulatory model required for UAVs?
- How far can we push the technology?
- How will the increasing application of UAVs change the nature of aviation? Will the public accept UAVs?

Shaping the Discussion—Key Policy Issues Panel Discussion
Moderator: Richard L. Aboulafia, Vice President, Analysis, The Teal Group
Panelists: Gina Marie Lindsey, Executive Director, Los Angeles World Airports

Aviation's success will be determined by the degree to which its customers achieve the full potential of their products in the marketplace. The safety, security, and efficiency of the air transportation system are all necessary to the future development of aviation. Policy development is often undertaken without fully comprehending the impacts on the government, the users and providers of air transportation, and the sectors of the economy that depend on the efficiency and vitality of the air transportation system. The topics to be covered by the panel include:

- What trends in the global economy will shape aviation's future?
- What current policy priorities are most pressing?
- What key policy issues will shape the development of U.S. and global aviation?
- What policy priorities are needed to spur growth?
- Can innovative financing and globally integrated infrastructure improve efficiency?

Social and Networking Activities

AIAA Corporate Member Business-to-Business (B2B) Networking
Monday, 12 August 2013, 0900–1330 hrs
This B2B event will help both our prime and our small business members of the aviation supply chain to learn about the latest technology opportunities, to form new alliances and partnerships, and to maximize business resources. Companies will outline what they're looking for in partnerships, followed by one-on-one matchmaking and detailed discussion about programs and opportunities. Registration is required for this event, which is complimentary for AIAA corporate members. There is a $200 fee for non-corporate members.

Networking Breakfasts
Monday–Wednesday, 12–14 August 2013, 0700–0800 hrs
Start the day sharing breakfast and discussion with colleagues and new contacts.

Networking Coffee Breaks
Monday–Wednesday, 12–14 August 2013
Morning and afternoon coffee breaks offer additional opportunities to meet with colleagues and develop new business relationships. Times will be noted in the final program.

Luncheons

Tuesday, 13 August 2013, 1130–1300 hrs
Keynote: TBA

Wednesday 14 August 2013 1200–1300 hrs
Keynote: The Aircraft Market in an Age of Extremes: Industry Overview and Forecast, Richard Aboulafia, Vice President, Analysis, The Teal Group

Welcome Happy Hour
Monday, 12 August 2013, 1700–1800 hrs
Catch up with old and new colleagues. Talk business. Share stories. Unwind.

Reception at the Museum of Flying
Tuesday, 13 August 2013, 1800–2000 hrs
Enjoy an evening reception among exhibits on the history of flight and the development of the aviation and aerospace industry in Southern California. The museum has nearly two dozen aircraft and a broad collection of aviation art, rare artifacts, and ephemera from famous aviators. This event, with heavy hors d'oeuvres, beer, and wine, is included in the full conference registration. Transportation is included. (Sponsored by Gulfstream Corporation)

Closing Reception
Wednesday, 14 August 2013, 1800–1900 hrs
Join us on the outdoor lawn (weather permitting) for drinks and discussion. What was the most surprising piece of information you learned at AIAA AVIATION 2013? How will you apply what you learned when you return to work? Who did you meet? What should we focus on for 2014? (Sponsored by Lockheed Martin)

Post-Conference Event: STEM K–12 Outreach
Are you interested in community outreach to K–12 students? Engineers from the local community will be visiting schools in the Los Angeles area on Thursday, 15 August 2013, to interest children in the math and science required to make an airplane fly. A fun, interactive "Engineers as Educators" training program is scheduled for Wednesday, 14 August, 1500–1700 hrs. Check the final program for details.

AIAA Awards Presentation
Recognizing individuals who have made outstanding achievements has long been a tradition at AIAA. During the conference, the AIAA Aircraft Design Award, the AIAA F. E. Newbold/VSTOL Award, and the AIAA History Manuscript Award will be presented. Dates and location to be determined.

AIAA Continuing Education Courses and Workshops

On 10–11 August, AIAA will be offering the following Continuing Education courses in conjunction with AVIATION 2013:

- Guidance of Unmanned Aerial Vehicles, taught by Rafael Yanushevsky, University of Maryland
- Systems Engineering Verification and Validation, taught by John C Hsu, California State University, University of California at Irvine, Queens University and The Boeing Company

Register for one of these courses and attend AVIATION 2013 for FREE. (Registration fee includes full conference participation: admittance to technical and plenary sessions, receptions, luncheons, and online proceedings.) A full course description and registration information are on the AIAA website at **www.aiaa.org/Aviation2013AAB**.

Protecting Intellectual Property Workshop
Investing in innovation is one of the keys to maintaining a competitive edge and for expanding business opportunities. Protecting this investment through intellectual property rights such as patents, copyrights, and trademarks is essential in today's global economy, particularly when contracting with government entities. The United States recently implemented extensive changes to the patent system with far-reaching effects for companies who wish to obtain and enforce their intellectual property rights. This workshop will explore various methods of protecting intellectual property, contracting with government

AIAA Programs

Registration Costs

Option	Registration Type	By 15 July 2013 Conference Rate	By 15 July 2013 AIAA Member Discount	16 July–10 Aug 2013 Conference Rate	16 July–10 Aug 2013 AIAA Member Discount	Conference Sessions	Online Proceedings	Welcome Happy Hour ***	Museum of Flying Off-Site Event	Tuesday Networking Lunch	Wednesday Lunch	Wednesday Reception ***	B2B Networking
1	Full Conference	$1,000	$840	$1,100	$940	•	•	•	•	•	•	•	
2	Full-Time Undergraduate Student	$60	$25	$70	$35	•		•				•	
3	Full-Time Undergraduate Student with Tickets	$335	$300	$345	$310	•		•	•	•	•	•	
4	Full-Time Graduate or Ph.D. Student	$110	$75	$120	$85	•		•				•	
5	Full-Time Graduate or Ph.D. Student with Tickets	$385	$350	$395	$360	•		•	•	•	•	•	
6	Full-Time Retired AIAA Member Only	N/A	$60	N/A	$70	•		•		•	•	•	
7	Discounted Group Rate *	N/A	$756	N/A	$756	•	•	•	•	•	•	•	
8	Continuing Education Courses **	$1,430	$1,320	$1,530	$1,420	•	•	•	•	•	•	•	
9	One-Day Rate	$350	$350	$350	$350	•							
	Extra Tickets						$200		$130	$67	$67		$200

Pricing subject to change.

* 10% discount off early-bird member rate for 10 or more persons from the same organization who register and pay at the same time with a single form of payment.

** Register for any course and attend the Conference for FREE! Registration fee includes full conference participation: admittance to technical and plenary sessions; receptions, luncheons, and online proceedings. Course standard registration deadline is 9 August.

*** Welcome Happy Hour and Wednesday Reception are open to all attendees. One drink ticket provided for full paid attendees, all others may purchase drinks at the bar.

agencies, and how the new patent laws will impact your vital business IP assets.

Registration Information

Online registration opens 16 April 2013 at **www.aiaa.org/Aviation2013AAB**. Advance registration saves conference attendees time, and up to $200. A PDF registration form is also available on the AIAA website. Print, complete, and mail or fax with payment to AIAA. Payment must be received in order to process registration. Early-bird registration forms must be received by **15 July 2013**. If you require more information, please contact registrar Sandra Turner at 703.264.7508 or sandrat@aiaa.org.

Hotel Information

AIAA has reserved a room block at:

Hyatt Regency Century Plaza
2025 Avenue of the Stars
Los Angeles, California, USA 90067

The group rate is $189 for single and double occupancy plus applicable taxes. Government rated rooms can be accessed by selecting "I have an access code" under guest type and using the code **AIAGOV13**. The rate includes internet access in your guest room. Rooms will be available until **1 August 2013** or until the block is full.

Book your room today at **https://resweb.passkey.com/go/Aviation2013**. Reservations can also be made by calling 1.888.421.1442 and referring to the AIAA block/Aviation 2013.

Please contact Anna Kimmel at annak@aiaa.org if you have any trouble booking your room.

Airport/Transportation Information

The Hyatt Regency Century Plaza is located approximately 10 miles from the Los Angeles International Airport (LAX). Directions, shuttle, and parking information can be found on the AIAA website: **www.aiaa.org/Aviation2013AAB**.

Notice on Visas

If you require a visa for travel to AVIATION 2013, you will find information on the Plan Your Trip page of the AIAA website at **www.aiaa.org/Aviation2013AAB**, or contact registrar Sandra Turner at sandrat@aiaa.org or 703.264.7508. AIAA strongly suggests that you submit your formal application to U.S. authorities a minimum of 120 days in advance of the date of anticipated travel. AIAA cannot directly intervene with the U.S. Department of State, consular offices, or embassies on behalf of individuals applying for visas.

Product and Program Displays

In an effort to engage your organization further, we are pleased to offer product and program displays that will allow your organization to showcase your products and services. These tabletop displays include a 10 x 10 space, draped table, and electrical outlet. In addition, your organization will be considered an official sponsor of the event and will receive one complimentary invitation to the VIP reception, a credit toward your AVIATION 2014 exhibit, and brand recognition at the event. To reserve your display area, please contact Chris Grady at 703.264.7509 or chrisg@aiaa.org.

Register today at **www.aiaa.org/Aviation2013AAB**

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Michael P. Delaney, VP Engineering, Boeing Commercial Airplanes

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AIAA Webinars

Sharpen your skills with our 90-minute webinars, taught by some of our most popular instructors. Webinars start at ***$60!***

UPCOMING WEBINARS:
REGISTER EARLY—SPACE IS LIMITED.

5 June 2013 • 1300–1430 hrs EDT
Nuclear and Future Flight Propulsion: Advanced Concepts in Rocket Propulsion, Nuclear Systems, Advanced Physics, and High-Energy Density Propellants
Bryan Palaszewski

11 September 2013 • 1300–1430 hrs EDT
Missile Defense: Past, Present and Future
Peter Mantle

Register Today!
www.aiaa.org/webinars

Contact Megan Scheidt, at 703.264.3842 or megans@aiaa.org, for any questions about AIAA's Continuing Education offerings.

Courses are subject to change. Please refer to the AIAA website for any updates.

AIAA

Did you miss the live webinar? Webinars are available for purchase at **www.aiaa.org/webinars.**

- **Advanced Composite Materials and Structures**
- **CADAC++ Framework for Aerospace Simulations**
- **Deciding on the Form of Missile Defense**
- **Flight Dynamics and Einstein's Covariance Principle**
- **Fundamentals of Communicating by Satellite**
- **Introduction to Bio-Inspired Engineering**
- **Introduction to Communication Satellites and their Subsystems**
- **Lessons from Subsonic Ultra Green Aircraft Research (SUGAR) Study**
- **Overview of Missile Design and System Engineering**
- **Risk Analysis and Management**
- **Space Radiation Environment**
- **UAV Conceptual Design Using Computer Simulations**

13-0239

AIAA Guidance, Navigation, and Control Conference
AIAA Atmospheric Flight Mechanics Conference
AIAA Modeling & Simulation Technologies Conference
AIAA Infotech@Aerospace 2013 Conference

19–22 August 2013
Marriott Boston Copley Place
Boston, Massachusetts

Conference Overview

The AIAA Guidance, Navigation, and Control Conference; AIAA Atmospheric Flight Mechanics Conference; AIAA Modeling and Simulation Technologies Conference; and AIAA Infotech@Aerospace Conference will combine in 2013 to provide the world's premier forum for presentation, discussion, and collaboration of science, research, and technology in these highly related aerospace fields. It will bring together experts from industry, government, and academia on an international level to cover a broad spectrum of issues concerning flight mechanics, modeling, simulation, information systems, and the guidance, navigation, and control of aerospace vehicles. The co-location of these events provides attendees with a unique opportunity to expand their knowledge of technological advances of these interrelated disciplines and explore areas of common technical expertise.

Why Attend?

- Meet other professionals from government, academia, and industry, including U.S. and international constituencies
- Present recent advances before a knowledgeable international audience
- Learn from experts about the latest advancements and research in the field
- Educate industry customers and providers on their latest research and product developments
- Draw lessons learned from past system applications and programs to result in increased technical success, cost savings, and schedule savings for current or ensuing projects or programs
- Network to engage new contacts and refresh old ones
- Recognize significant achievements from within the community

Who Should Attend?

- All levels of engineers, researchers, and scientists from government, academia, and industry
- Engineering managers and executives
- Business development personnel
- Young aerospace professionals
- Educators and students
- Press/media

What to Expect?

- *Program*
  - Access to more than 80 technical papers and presentations
  - Keynote speeches by renowned experts and decision makers during the plenary sessions
  - Continuing Education courses to refresh your knowledge and keep professionals at their technical best
  - Student paper competitions to encourage and engage young minds as they enter the aerospace industry

- *Networking*
  - **New for 2013**! Networking breakfasts and happy hour receptions to allow even more time for making new contacts
  - Networking coffee breaks to continue the discussions from technical sessions or give time to check emails and voicemails throughout the day
  - Networking luncheon and awards luncheon to recognize outstanding members of the technical community and celebrate their contributions to the industry

Plenary Sessions and Keynotes

AIAA Guidance, Navigation, and Control Conference Plenary
Monday, 19 August 2013, 0800–0900 hrs
Speaker: Werner J.A. Dahm, Security & Defense Systems Initiative (SDSI), and ASU Foundation Professor of Aerospace & Mechanical Engineering, Arizona State University, Tempe, AZ

	Saturday	Sunday	Monday
0700 hrs			Networking Breakfast
0730 hrs			Speakers' Briefing in Session Rooms
0800 hrs	Continuing Education Courses	Continuing Education Courses	Plenary Session (GNC)
0830 hrs			
0900 hrs			Networking Coffee Break
0930 hrs			Technical Sessions
1000 hrs			
1030 hrs			
1100 hrs			
1130 hrs			
1200 hrs			Lunch Break/WIE Luncheon
1230 hrs			
1300 hrs			
1330 hrs			Speakers' Briefing in Session Rooms
1400 hrs			Technical Sessions
1430 hrs			
1500 hrs			
1530 hrs			
1600 hrs			Networking Coffee Break
1630 hrs			Technical Sessions
1700 hrs		Networking Happy Hour	
1730 hrs			
1800 hrs			Networking Happy Hour
1830 hrs			
1900 hrs			
1930 hrs			
2000 hrs			
2030 hrs			
2100 hrs			
2130 hrs			
2200 hrs			

Duane McRuer Atmospheric Flight Mechanics Plenary
Tuesday, 20 August 2013, 0800–0900 hrs
Speaker: Andy Thurling, Chief Pilot and Program Manager, AeroVironment, Inc., Simi Valley, CA

AIAA Awards Luncheon
Tuesday, 20 August 2013, 1200–1400 hrs
Speaker: George T. Schmidt, Editor-in-Chief, *AIAA Journal of Guidance, Control, and Dynamics*, Lexington, MA

AIAA Modeling and Simulation Technologies Conference Plenary
Wednesday, 21 August 2013, 0800–0900 hrs
Speaker: Paul Barnard, Design Automation Marketing Director, MathWorks, Natick, MA

Networking Luncheon and AIAA Infotech@Aerospace Conference Plenary
Wednesday, 21 August 2013, 1200–1330 hrs
Speaker: Mark T. Maybury, Chief Scientist, U.S. Air Force, Washington, DC

For the full conference program, including all paper titles and speakers, visit **www.aiaa.org/boston2013** and click on "Detailed Program."

Networking Activities and Special Events

NEW EVENT! *Networking Breakfasts*
A great way to start the day and interact with conference participants! Networking continental breakfasts will be offered on Monday–Thursday, 0700–0800 hrs, in the Ballroom Foyer at the Marriott Boston Copley Place. This event is open to all attendees (no tickets required).

NEW EVENT! *Networking Happy Hour Receptions*
Join us every evening for a networking "happy hour" at the Marriott Boston Copley Place. Have a drink and catch up with other participants before heading outside to explore the city of Boston. All attendees are welcome to attend. A drink ticket for each happy hour is included in the registration fee where indicated and there will also be a cash bar. Additional drinks can be purchased at the event.

AIAA Programs

	Tuesday	Wednesday	Thursday
0700 hrs	Networking Breakfast	Networking Breakfast	Networking Breakfast
0730 hrs	Speakers' Briefing in Session Rooms	Speakers' Briefing in Session Rooms	Speakers' Briefing in Session Rooms
0800 hrs	Plenary Session (AFM)	Plenary Session (MST)	Technical Sessions
0830 hrs			
0900 hrs	Networking Coffee Break	Networking Coffee Break	
0930 hrs	Technical Sessions	Technical Sessions	
1000 hrs			Networking Coffee Break
1030 hrs			Technical Sessions
1100 hrs			
1130 hrs			
1200 hrs	Awards Luncheon (GNC)	I@A Plenary Session and Networking Luncheon	
1230 hrs			
1300 hrs			
1330 hrs		Speakers' Briefing in Session Rooms	
1400 hrs	Speakers' Briefing in Session Rooms	Technical Sessions	
1430 hrs	Technical Sessions		
1500 hrs			
1530 hrs			
1600 hrs		Networking Coffee Break	
1630 hrs	Networking Coffee Break	Technical Sessions	
1700 hrs	Technical Sessions		
1730 hrs			
1800 hrs			
1830 hrs		Networking Happy Hour	
1900 hrs	Networking Happy Hour		
1930 hrs			
2000 hrs			
2030 hrs			
2100 hrs			
2130 hrs			
2200 hrs			

Networking Coffee Breaks

Standalone networking coffee breaks are included in the program to allow even more time for making new contacts, continuing discussions from technical sessions, or checking emails and voicemails to keep in touch with the office while you are at the conference.

Women in Engineering Luncheon

The Women in Engineering Luncheon, hosted by the AIAA Guidance, Navigation, and Control Technical Committee, will be held Monday, 19 August, 1200–1330 hrs, in the Provincetown Room at the Marriott Boston Copley Place. The speaker will be Christyl Johnson, Deputy Director for Technology and Research Investments, NASA Goddard Space Flight Center, Greenbelt, MD. Women participating in any of the co-located conferences are invited to attend at no charge. Women are underrepresented in the engineering sciences and industry, and this luncheon provides an opportunity for women to meet informally, network, discuss experiences, and identify women who are leaders in their fields for possible special recognition by AIAA.

AIAA Awards Luncheon

Join fellow conference participants to recognize the achievements of your peers at the AIAA Awards Luncheon on Tuesday, 20 August, 1200–1400 hrs, in Salon F&G at the Marriott Boston Copley Place. Several awards will be presented, as well as a keynote speech by George T. Schmidt, Editor-in-Chief, *AIAA Journal of Guidance, Control, and Dynamics*, Lexington, MA. A ticket for the luncheon is required, and is included in the conference registration fee where indicated. Additional tickets for guests may be purchased upon registration or on site. The following awards will be presented at this year's conference:

- Mechanics and Control of Flight Award
- DeFlorez Award for Modeling and Simulation
- AIAA Foundation Guidance, Navigation, and Control Graduate Award
- Best Papers Certificate of Merit
- AFM Student Paper Competition Certificate of Merit: Overall Winner
- GNC Graduate Student Paper Competition Certificate of Merit: Overall Winner
- Infotech@Aerospace Student Paper Competition Certificate of Merit: Overall Winner

Networking Luncheon

A networking luncheon will be held Wednesday, 21 August, 1200–1330 hrs, in Salon F&G at the Marriott Boston Copley Place. Join your colleagues to catch up on the technical discussions of the week and solidify new contacts, and listen to AIAA Infotech@Aerospace keynotes speaker Mark T. Maybury, Chief Scientist, U.S. Air Force, Washington, DC. A ticket to the luncheon is required, and is included in the conference registration fee where indicated. Additional tickets for guests may be purchased upon registration or on site.

	Registration Type	By 22 July 2013 Conference Rate	By 22 July 2013 AIAA Member Discount	23 July–17 August 2013 [2] Conference Rate	23 July–17 August 2013 [2] AIAA Member Discount	Conference Sessions	Online Proceedings	Awards Luncheon	Networking Luncheon	Happy Hours [3]
Option 1	Full Conference [3]	$870	$710	$970	$810	■	■	■	■	■
Option 2	Full-Time Undergraduate Student	$60	$25	$70	$35	■				
Option 3	Full-Time Undergraduate Student with Tickets	$180	$145	$190	$155	■		■	■	
Option 4	Full-Time Graduate or Ph.D. Student	$110	$75	$120	$85	■				
Option 5	Full-Time Graduate or Ph.D. Student with Tickets	$230	$195	$240	$205	■		■	■	
Option 6	Full-Time Retired AIAA Member Only	N/A	$60	N/A	$70	■		■	■	
Option 7	Discounted Group Rate [1] [3]	$639	$639	$639	$639	■	■	■	■	■
Option 8	Continuing Education (CE) Course and Full Conference [2] [3]	$1,365	$1,255	$1,465	$1,355	■	■	■	■	■
	Extra Tickets						$200	$60	$60	

Pricing subject to change.

[1] 10% discount off early-bird member rate for 10 or more persons from the same organization who register and pay at the same time with a single form of payment.

[2] The Continuing Education Course standard registration deadline is **16 August 2013.**

[3] Tickets for the Happy Hours are included in the registration fees where indicated; however, there is a cash bar and all attendees are welcome to attend.

Registration

AIAA is committed to sponsoring world-class conferences on current technical issues in a safe and secure environment. As such, all delegates will be required to provide proper identification prior to receiving a conference badge and associated materials. All delegates must provide a valid photo ID (driver's license or passport) when they check in. For student registrations, a valid student ID is also required. We thank you for your cooperation.

All participants are urged to register online at **www.aiaa.org/boston2013**. Registering in advance saves conference attendees time and up to $200. A check made payable to AIAA or credit card information must be included with your registration form. A PDF registration form is also available on the AIAA website. Print, complete, and mail or fax the form with payment to AIAA. Address information is provided. Payment must be received in order to process registration.

Early-bird registration forms must be received by **22 July 2013**, and standard registration forms will be accepted until **17 August 2013**. Preregistrants may pick up their materials at the advance registration desk at the conference. All those not registered by 17 August 2013 may do so at the on-site registration desk by paying the on-site registration fee. All nonmember registration fees include a one-year AIAA membership.

Cancellations must be received no later than **5 August 2013**. There is a $100 cancellation fee. Registrants who cancel beyond this date or fail to attend the conference will forfeit the entire fee. For questions, please contact Sandra Turner, conference registrar, at +1 703.264.7508 or sandrat@aiaa.org.

AIAA Registration and Information Center Hours

The AIAA Registration and Information Center will be located in the Ballroom Foyer at the Marriott Boston Copley Place. Hours are as follows:

Saturday, 17 August	0715–0815 hrs (course only)
Sunday, 18 August	1500–1900 hrs
Monday, 19 August	0700–1700 hrs
Tuesday, 20 August	0700–1700 hrs
Wednesday, 21 August	0700–1700 hrs
Thursday, 22 August	0700–1200 hrs

Notice on Visas

If you plan to attend an AIAA conference or course held in the United States and you require a visa for travel, it is incumbent upon you to apply for a visa with the U.S. Embassy (consular division) or consulate with ample time for processing. To avoid bureaucratic problems, AIAA strongly suggests that you submit your formal application to U.S. authorities a minimum of 120 days in advance of the date of anticipated travel.

To request a letter of invitation, please fill out and submit the

Best Atmospheric Flight Mechanics Student Paper Competition

The AIAA Atmospheric Flight Mechanics (AFM) Technical Committee, with the support of Calspan Corporation (**www.calspan.com**), is sponsoring a Best Student Paper Competition at the 2013 AIAA AFM Conference. Entrants will be judged by Technical Committee members and the winner will receive a certificate and $500 award at the conference awards luncheon. To be eligible for this award, the student must be the primary author of the paper and the work must have been performed while the author was a student. Students will present their papers in the relevant conference technical sessions on Monday and Tuesday morning. The scoring for the award will be equally based on written paper content and oral presentation. The written paper will be judged on: 1) relevance of the topic to atmospheric flight mechanics; 2) organization and clarity; 3) appreciation of the technical issues and sources of errors; and 4) meaningful conclusions of the research. The oral presentation will be judged for overall clarity, including 1) background and problem definition statement; 2) explanation of technical approach; and 3) explanation of research results.

GNC Graduate Student Paper Competition

The AIAA Guidance, Navigation, and Control (GNC) Technical Committee is sponsoring a Graduate Student Paper Competition. Papers have been sought from graduate students on GNC technical research topics, and six finalists will be selected by a panel of judges for inclusion in the AIAA GNC Conference. To be eligible for the competition, graduate students must be enrolled at an institution of higher education and be in good academic standing at the time of submission of their manuscript. The student must be the first author on the paper with their graduate advisor as the second author. Selection will be based on a review of a full draft manuscript not exceeding a total length of 15 pages. Finalists will make two presentations at the conference: once in the Graduate Student Paper Competition session (held Sunday, 18 August, 1800–2200 hrs, in Salon D at the Marriott Boston Copley Place) and again in an appropriate regular session. Finalists will receive a $1,200 award after attending and presenting their papers. An overall best paper and presentation will be selected from the Graduate Student Paper Competition session. The winner will receive a $2,500 prize and be recognized at the awards luncheon. Prizes are sponsored by the AIAA GNC TC.

Infotech@Aerospace Student Paper Competition

The 5th Intelligent Systems Student Paper Competition, hosted by the AIAA Intelligent Systems Technical Committee (ISTC), has sought papers from numerous disciplines within the aerospace information systems realm. Up to four finalists will present their papers during a special student paper competition session. The winner will be selected by a panel of judges for inclusion in the AIAA I@A Conference and will be recognized during the awards luncheon. Final manuscripts are due by **30 July 2013**.

online Invitation Letter Request Form. You can also request a letter of invitation by contacting:

ATTN: Customer Service
American Institute of Aeronautics and Astronautics
1801 Alexander Bell Drive, Suite 500
Reston, VA 20191-4344
703.264.7500 • 703.264.7657 FAX
Email: custserv@aiaa.org

AIAA cannot directly intervene with the U.S. Department of State, consular offices, or embassies on behalf of individuals applying for visas.

Location

Boston may be the most historic city in America—a significant player in American history for more than 300 years. Boston was founded in 1630, nearly 150 years before the colonies formed a new nation, and has been the site of many significant historic events, such as the Boston Tea Party and Paul Revere's ride. The capital of the state of Massachusetts, Boston is now a thriving metropolis, but it has retained its historic landmarks and its charm. Boston sites and landmarks include the Massachusetts State House, Paul Revere House, Bunker Hill Monument, numerous museums, galleries, and gardens, and of course, Fenway Park—home of the Boston Red Sox. Do you know why Boston is called "Beantown"? For more information on Boston, visit www.bostonusa.com.

Hotel Information

AIAA has made arrangements for a block of rooms at the Boston Marriott Copley Place, 110 Huntington Ave, Boston, MA 02116, Tel: +1 617.236.5800. The Boston Marriott Copley Place is located in the desirable and vibrant Back Bay neighborhood with a direct connection to Copley Place and Prudential Center. The hotel is within walking distance of a wide range of restaurants, cultural institutions, theaters, and nightlife. We have negotiated special event rates of $183 per night for single or double occupancy. Book your rooms online at **https://resweb.passkey.com/go/aiaaAug2013**. Rooms will be held until **27 July 2013** or until the block is full. You must mention AIAA when calling to make your reservations to receive this special rate.

Help Keep Our Expenses Down (And Yours Too!)

AIAA group rates for hotel accommodations are negotiated as part of an overall contract that also includes meeting rooms and other conference needs. Our total event costs are based in part on meeting or exceeding our guaranteed minimum of group-rate hotel rooms booked by conference participants. If we fall short, our other event costs go up. Please help us

Continuing Education Courses

AIAA will offer three Continuing Education courses in conjunction with the AIAA Guidance, Navigation, and Control and Co-located Conferences. Please check the conference website for up-to-date information regarding the courses. Register for any course and attend the GNC and Co-located Conferences for FREE! Registration fee includes full conference participation: admittance to technical and plenary sessions, receptions, luncheons, and online proceedings.

Emerging Principles in Fast Trajectory Optimization

Instructors: I. Michael Ross, Professor, Program Director, Naval Postgraduate School, Monterey, CA, and Qi Gong, Assistant Professor, University of California, Santa Cruz, Santa Cruz, CA

The confluence of major breakthroughs in optimal control theory and new algorithms has made possible the real-time computation of optimal trajectories. This implies that mission analysis can be carried out rapidly with the only limitation being the designer's imagination. This course will introduce the student to the major advancements that have taken place over the last decade in both theory and algorithms for fast trajectory optimization. Students will acquire a broad perspective on recent developments in the mathematical foundations of trajectory optimization; "old hats" will acquire a new perspective on some old ideas. The overall objective of this course is to outline the new foundations related to convergence of solutions that have emerged in recent years and the accompanying breakthroughs in general techniques for problem solving. These techniques are intended to enhance, not replace, special techniques that are in common use. Anyone involved in aerospace research will benefit from this course.

Recent Advances in Adaptive Control: Theory and Applications

Instructors: Tansel Yucelen, Research Engineer, School of Aerospace Engineering, Georgia Institute of Technology, Atlanta, GA; Eric Johnson, Professor, School of Aerospace Engineering, Georgia Institute of Technology, Atlanta, GA; Anthony Calise, Professor of Aerospace Engineering, School of Aerospace Engineering, Georgia Institute of Technology, Atlanta, GA; Girish Chowdhary, Research Engineer, School of Aerospace Engineering, Georgia Institute of Technology, Atlanta, GA

Research in adaptive control theory is motivated by the presence of uncertainties. Uncertainties may be due to a lack of accurate modeling data combined with modeling approximations that result in unmodeled dynamics. They may also be due to external disturbances, failures in actuation and airframe damage. Adaptive control is also motivated by the desire to reduce control system development time for systems that undergo frequent evolutionary design changes, or that have multiple configurations or environments in which they are operated. Model reference adaptive control (MRAC) is a leading methodology intended to guarantee stability and performance in the presence of high levels of uncertainties. This course will present a review of a number of well-established methods in MRAC. Starting with MRAC problem formulation and an overview of classical robustness and stability modifications, this course will continue to introduce the adaptive loop recovery approach that allows the approximate retention of reference model loop properties such as relative stability margins. The course will also present Kalman filtering in adaptive control, in which a Kalman filter framework is used to update adaptation gains that enables meeting a given performance criteria without excessive tuning.

Two novel adaptive control laws are also presented: concurrent learning adaptive control and derivative-free adaptive control. Concurrent learning is a memory-enabled adaptive control method that uses selected recorded data concurrently with instantaneous measurements for adaptation. Concurrent learning guarantees exponential tracking combined with parameter identification for a wide class of adaptive control problems, without requiring persistency of excitation. Derivative-free adaptive control is particularly well suited for systems with sudden (and possibly discontinuous) changes in uncertain dynamics, such as those induced through reconfiguration, payload deployment, docking, or structural damage. It provides superior adaptation and disturbance rejection properties, and computable transient and steady-state performance bounds. The course will also discuss emerging results in connecting machine learning with adaptive control. A special section will be devoted to implementation and flight testing of adaptive control methods, including discussion of the pseudo control hedging methods for handling actuator dynamics and saturation. The course will conclude with discussing extensions to decentralized adaptive control, output feedback adaptive control, unmodeled dynamics, and unmatched uncertainties.

keep the costs of presenting this conference as low as possible—reserve your room at the designated hotel, and be sure to mention that you're with the AIAA conference. Meeting our guaranteed minimum helps us hold the line on costs, and that helps us keep registration fees as low as possible. All of us at AIAA thank you for your help!

"No Paper, No Podium" & "No Podium, No Paper" Policies

If a written paper is not submitted by the final manuscript deadline, authors will not be permitted to present the paper at the conference. Also, if the paper is not presented at the conference, it will be withdrawn from the conference proceedings. It is the responsibility of those authors whose papers or presentations are accepted to ensure that a representative attends the conference to present the paper. These policies are intended to improve the quality of the conference for attendees.

Cyber Café

Wireless Internet access will be available for attendees in the Ballroom Foyer during the conference. In addition, computers with complimentary Internet access for conference attendees will be available at the AIAA Cyber Café.

Conference Proceedings

Proceedings for these conferences will be available in online proceedings format. The cost is included in the registration fee where indicated. The online proceedings will be available on 19 August 2013. Attendees who register in advance for the online proceedings will be provided with instructions on how to access them. Those registering on site will be provided with instructions at that time.

AIAA Programs

AIAA Guidance, Navigation, and Control Conference

General Chair
David B. Doman
Air Force Research Laboratory

Technical Program Chairs
Joseph S. Brinker
The Boeing Company

John Valasek
Texas A&M University

AIAA Atmospheric Flight Mechanics Conference

General Chair
Rick Lind
University of Florida

Technical Program Chairs
Michael Grant
Purdue University

Daniel Murri
NASA Langley Research Center

AIAA Modeling and Simulation Technologies Conference

General Chair
Julien Scharl
The Boeing Company

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Judith Bürki-Cohen
U.S. Department of Transportation – Volpe, The National Transportation Systems Center

Jean Slane
ESI

AIAA Infotech@Aerospace 2013 Conference

General Chair
Fernando Figueroa
NASA Stennis Space Center

Technical Program Chair
Natasha Neogi
National Institute of Aerospace

Technical Program Deputy Chairs
Charles "Patrick" Collier
Air Force Research Laboratory

Mark Derriso
Air Force Research Laboratory

For more detailed program information, visit the website at **www.aiaa.org/boston2013**.

Calls for Papers

SpaceOps 2014: Exploring Innovation The 13th International Conference on Space Operations

5–9 May 2014
Pasadena Convention Center
Pasadena, California

Abstract Deadline: 5 August 2013

About SpaceOps

The International Committee on Technical Interchange for Space Mission Operations and Ground Data Systems (also known as the SpaceOps Organization) is a spacecraft operations oriented international association consisting of representatives from the major space-faring institutions of the world. SpaceOps was founded to foster continuous technical interchange on all aspects of space mission operations and ground data systems, and to promote and maintain an international community of space operations experts.

In 1990, the SpaceOps Organization established the SpaceOps Conference series as a technical forum for the space operations community that addresses state-of-the art operations principles, methods, and tools. The biennial event attracts engineers, technologists, scientists, managers, and experts from space agencies, industry, and academia. The scope is intended to cover all spaceflight missions, including human and robotic, near Earth and deep space.

Conference Overview

SpaceOps 2014: Exploring Innovation. The capability of our space missions and the supporting ground infrastructure is growing, fueled by exciting new technologies, but with that growth comes increased complexity, and daunting reliability and security challenges. And, like most complex enterprises, space operations are being asked to do more with less. To deliver cost-effective space operations services we must explore innovative ways to build and operate our systems, and integrate operations personnel into the space operations equation. Innovation is the engine that drives progress in today's high-tech global economy.

The SpaceOps 2014 Conference provides the opportunity for you to share your experiences, challenges, and innovative solutions with colleagues from around the globe, and take home new ideas and new connections. Be it civil or military applications, educational, scientific, or commercial objectives, space segments or ground segments, the SpaceOps community greatly values, and benefits from, collaboration and the sharing of ideas. To this end, we enthusiastically invite you to Explore Innovation!

The SpaceOps 2014 Conference Organizing Committee is staffed by representatives from NASA's Jet Propulsion Center and AIAA. The SpaceOps 2014 Conference Technical Program Committee (TPC) is staffed by volunteers from the agencies and industry partners of the SpaceOps Organization. For more information about the SpaceOps 2014 Committees, please visit **www.SpaceOps2014.org**.

Abstract Submission

We invite you to submit abstracts for SpaceOps 2014 via the conference website at **www.spaceops2014.org**. The submission of abstracts will start on **22 April 2013**. Simply click the "Submit A Paper" button to begin. Abstracts will be evaluated on the following criteria: 1) relevance to space operations; 2) innovation; 3) substantive merit (content and realism); and 4) applicability and benefit to future missions. Please do not hesitate to contact us with any questions. Authors having trouble submitting abstracts electronically should contact ScholarOne Technical Support at ts.acsupport@thomson.com, 434.964.4100, or (toll-free, U.S. only) 888.503.1050. Questions pertaining to the abstract or technical topics, or general inquiries concerning the program format or policies of the conference, should be directed to the Technical Program Chair.

Important Dates

Abstract submission deadline	5 August 2013
Notification to authors	15 November 2013
Final paper submission deadline	1 April 2014
Conference dates	5–9 May 2014

Technical Program

The SpaceOps 2014 Conference will bring together space operators from around the world to discuss the current status and future direction of space operations. For 2014, we have modified the division of technical topics as follows:

- Mission Design and Management
- Operations Concepts, Methods, Systems, and Automation
- Flight System Monitor and Control
- Planning and Scheduling
- Guidance, Navigation, and Control
- Human Systems and Operations
- Communications, Data Management and Processing
- Cross-Support, Interoperability, and Standards
- Launcher, Rocket, and Balloon Operations
- Small Satellite Operations

Our intent is to bring the users of a particular area together with their system development counterparts. For example, those who do planning and scheduling will be in the same topic area as those who build the planning and scheduling applications.

While Commercial Space Operations is not a specific topic, we would encourage commercial entities to submit papers in the specific topic areas of interest. Similarly, Training and Knowledge Transfer are not specific topics, yet we would encourage papers in areas of specific interest.

For questions on the Technical Program contact:

SpaceOps 2014 Technical Program Chair
William Weber
wjweber@jpl.nasa.gov
818.354.0490

Topic Descriptions

Mission Design and Management

- Mission Design
- Mission Architectures
- Mission Management
- Space Debris and Collision Avoidance
- Evolving Mission Capabilities
- International, Public, and Private Cooperation
- Mission Designs for Complex Constellations
- Multi-Mission Approaches and Strategies
- Revectoring Old Missions to New Tasks
- End-of-Life Operations

Operations Concepts, Methods, Systems, and Automation

- Operations Concepts and Methods
- Flight Operations
- Advanced Technologies for Space Operations
- Ground System Architectures and Design
- Ground System Development and Validation
- Operations Automation and Optimization

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- Lunar and Planetary Surface Operations
- Simulations and Training
- Operations Engineering
- Contingency Operations and Disaster Recovery

Flight System Monitor and Control
- Fault Management and Recovery
- Flight Control Systems

Planning and Scheduling
- Mission Planning and Scheduling
- Mission Planning Systems
- Planning and Scheduling Systems
- Asset Scheduling

Guidance, Navigation, and Control
- Flight Dynamics and Navigation

Communications, Data Management and Processing
- Network Operations and Management
- Ground Network Implementation
- Ground Communications
- Ground Network and Antenna Concepts
- Data Management and Distribution
- Archive Systems and Data Mining
- Ground Data Systems
- IT Security
- Planetary Relay and Surface Communications

Human Systems and Operations
- Human Spaceflight
- ISS
- Training for Human Operations
- Crew Safety
- Operations Security

Cross Support, Interoperability, and Standards
- Communications Standards—Space Link Extension
- Communications Standards—Networks
- Communications Standards—Application Layer
- Software Standards—Architecture
- Software Standards—Mission Operations
- International Cross Support

Launcher, Rocket, and Balloon Operations
- Launchers and Facilities
- Balloons and Sounding Rockets
- Launch and Rocket Operations

Small Satellite Operations
- TT&C Systems
- Cubesat and Nanosat Operations
- Flight Operations
- Constellations Operations

Abstract Requirements

The SpaceOps 2014 conference organizing committee's highest priority is to accept abstracts and papers that emphasize

unique and innovative practices, technologies, and experiences from which others in the Space Operations community will benefit. When all abstracts are received, the Technical Program Committee (TPC) will evaluate the submitted abstracts based upon (but not limited to) these five evaluation criteria:

- Relevance to space operations
- Innovation
- Substantive merit (content and realism)
- Applicability and benefit to future missions
- Balance and variety in the sessions

Oral/Poster/ePoster Sessions

When you submit your abstract, you will be able to choose your preferred presentation approach: Oral Session, Traditional Poster Session, or Electronic Poster Session.

The characteristics of these sessions are:

- Oral Sessions are 20-minute lectures followed by 10 minutes of Q&A.
- Electronic Poster Sessions are longer sessions (1 to 2 hours) of completely interactive dialogue with attendees supported by a conference-provided active electronic display.
- Traditional Poster Sessions run for several days and are also completely interactive around the presenter's hardcopy display.

Manuscripts and Oral Sessions

For all manuscripts submitted, and for presentations in the oral sessions, we will not accept overt marketing material or "sales pitches." These forums and products are for the exchange of technical information, not for marketing. Marketing and commercial promotion is welcome and encouraged in the exhibit venue—see the section on Exhibition Opportunities.

Poster Session Presentations

Poster session presentations are more interactive and graphical, and ePosters will have a unique ability to display software demonstrations. The manuscripts submitted by the authors of poster sessions must meet the same standard as the manuscripts submitted by the authors of oral sessions—they must not have a marketing emphasis. All submitted abstracts and manuscripts must meet the same evaluation criteria, and their information must impart some benefit to the space operations community independent of any product or service that may be incidentally mentioned in the manuscript.

Procedures for Abstract Submission

We invite you to submit your 500-word abstract electronically through the conference website at **www.SpaceOps2014.org**. This website will be open for the submission of abstracts until **5 August 2013 (2000 hrs Eastern Daylight Time)**.

We request that you limit your abstract to text only, no graphics. You will have the opportunity to indicate your preference of presentation style (technical paper/poster/ePoster) and the most appropriate Topic Area. The TPC will then make the best effort at placing your submission in the program in a way that best connects you with your audience.

Submit your abstract at www.SpaceOps2014.org and select the "Submit A Paper" button.

Authors having trouble submitting abstracts electronically should email AIAA Technical Support at paper_tech_support@aiaa.org. Questions about the abstracts should be referred to William Weber, Technical Program Chair, at wjweber@jpl.nasa.gov or 818.354.0490.

Special Reminder for Conference Participation

- All conference presenters in both oral and poster sessions are required to submit manuscripts that comply with the standard requirements for professional conferences, as documented in the AIAA "Author's Kit" that is supplied to accepted authors.
- If you do not submit a paper, you will not be allowed to present at any session.
- If you do not appear in person to present at your session, your paper will not be published in the (electronic) proceedings. Videotaped presentations will not be allowed.
- If your organization/agency/nation requires export approval of your material for this international conference, you must follow that process, and you must do it on a schedule that allows you to meet the conference deadlines.
- All authors are required to register for the conference in the same fashion as all other attendees.

U.S. nationals are reminded to comply with International Traffic in Arms Regulations (ITAR) and Technology Transfer restrictions. Please visit the conference website at www.SpaceOps2014.org for more information.

Exhibition Opportunities

The 2014 SpaceOps Conference will feature an impressive exhibit showcasing leading industry products and services. The conference venue at the Pasadena Conference Center provides ample space for exhibitors. We encourage industry members to bring their best and most innovative products, systems, and services to the SpaceOps 2014 Exhibition for broad exposure to the space operations professionals in attendance. The Exhibition forum excels at connecting industry providers with space operations customers, bringing maximum benefit to both. Exhibition space is currently available for SpaceOps 2014.

For more information about the exhibition or to request an exhibitor prospectus, please contact Chris Grady at chrisg@aiaa.org or 703.264.7509.

Sponsorship Opportunities

Various sponsorship opportunities are available for SpaceOps 2014. Sign on as a sponsor and demonstrate your support for the space operations community. For more information on sponsorship opportunities, contact Merrie Scott at merries@aiaa.org or 703.264.7530.

Upcoming AIAA Professional Development Courses

5 June 2013
This 90-minute webinar will take place at 1300–1430 EST

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

AIAA Member	$149
Nonmember*	$189
AIAA Student Member	$60
Full-Time Student (Nonmember)*	$70

*Nonmember fee does not includes a one-year AIAA membership

Nuclear and Future Flight Propulsion: Advanced Concepts in Rocket Propulsion, Nuclear Systems, Advanced Physics, and High-Energy Density Propellants (Instructor: Bryan Palaszewski)

The Nuclear and Future Flight Propulsion Course includes information on many different topics in advanced nuclear space propulsion. A short overview is provided on the wide breadth of advanced propulsion concepts, ranging from advanced chemical propulsion to solar sails, to aerocapture, to fission, fusion, and antimatter. The remaining discussions will focus on vehicle system design, construction, and operation for missions throughout the Solar System. These presentations will include Radioisotope Thermoelectric Generators (RTGs), nuclear thermal propulsion, nuclear electric propulsion, nuclear spacecraft options and configurations, and a basic overview of future nuclear power and propulsion systems.

10–11 June 2013
The following standalone course is being held at The Ohio Aerospace Institute in Cleveland, Ohio.

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

	Early Bird by 10 May	*Standard (11 May–3 Jun)*	*On-site (4–10 Jun)*
AIAA Member	$950	$1075	$1175
Nonmember*	$1070	$1195	$1295

*Includes a one-year AIAA membership

Introduction to Spacecraft Design and Systems Engineering (Instructor: Don Edberg)

This course presents an overview of factors that affect spacecraft design and operation, beginning with an historical review of unmanned and manned spacecraft, including current designs and future concepts. All the design drivers, including launch and on-orbit environments and their affect on the spacecraft design, are covered. Orbital mechanics is presented in a manner that provides an easy understanding of underlying principles as well as applications, such as maneuvering, transfers, rendezvous, atmospheric entry, and interplanetary transfers. Considerable time is spent defining the systems engineering aspects of spacecraft design, including the spacecraft bus components and the relationship to ground control. Design considerations, such as structures and mechanisms, attitude sensing and control, thermal effects and life support, propulsion systems, power generation, telecommunications, and command and data handling are detailed. Practical aspects, such as fabrication, cost estimation, and testing, are discussed. The course concludes with lessons learned from spacecraft failures.

10–11 June 2013
The following standalone course is being held at The Ohio Aerospace Institute in Cleveland, Ohio.

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

	Early Bird by 10 May	*Standard (11 May–3 Jun)*	*On-site (4–10 Jun)*
AIAA Member	$995	$1125	$1220
Nonmember*	$1115	$1245	$1340

*Includes a one-year AIAA membership

Aircraft and Rotorcraft System Identification: Engineering Methods and Hands-on Training Using CIFER® (Instructor: Dr. Mark B. Tischler)

The objectives of this course are to 1) review the fundamental methods of aircraft and rotorcraft system identification and illustrate the benefits of their broad application throughout the flight vehicle development process; 2) provide the attendees with an intensive hands-on training of the CIFER® system identification, using flight test data and 10 extensive lab exercises. Students work on comprehensive laboratory assignments using student version of software provided to course participants (requires student to bring NT laptop). The many examples from recent aircraft programs illustrate the effectiveness of this technology for rapidly solving difficult integration problems. The course will review key methods and computational tools, but will not be overly mathematical in content. The course is highly recommended for graduate students, practicing engineers, and managers. The AIAA textbook, *Aircraft and Rotorcraft System Identification: Engineering Methods with Flight-Test Examples, Second Edition*, is included in the registration fee.

29–30 July 2013
The following standalone course is being held at the National Aerospace Institute in Hampton, Virginia.

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

	Early Bird by 1 Jul	*Standard (2–22 Jul)*	*On-site (23–29 Jul)*
AIAA Member	$950	$1075	$1175
Nonmember*	$1070	$1195	$1295

*Includes a one-year AIAA membership

Introduction to Space Systems (Instructor: Mike Gruntman)

The course provides an introduction to the concepts and technologies of modern space systems, which combine engineering, science, and external phenomena. We concentrate on scientific and engineering foundations of spacecraft systems and interactions among various subsystems. These fundamentals of subsystem technologies provide an indispensable basis for system engineering. The basic nomenclature, vocabulary, and concepts will make it possible to converse with understanding with subsystem specialists. Designed for engineers and managers of

diverse background and varying levels of experience who are involved in planning, designing, building, launching, and operating space systems and spacecraft subsystems and components, the course facilitates integration of engineers and managers new to the space field into space-related projects.

29–30 July 2013
The following standalone course is being held at the National Aerospace Institute in Hampton, Virginia.

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

	Early Bird by 1 Jul	*Standard (2–22 Jul)*	*On-site (23–29 Jul)*
AIAA Member	$950	$1075	$1175
Nonmember*	$1070	$1195	$1295

*Includes a one-year AIAA membership

Phased Array Beamforming for Aeroacoustics

(Instructor: Robert Dougherty)

This course presents physical, mathematical, and some practical aspects of acoustic testing with the present generation of arrays and processing methods. The students will understand the capabilities and limitations of the technique, along with practical details. They will learn to design and calibrate arrays and run beamforming software, including several algorithms and flow corrections. Advanced techniques in frequency-domain and time-domain beamforming will be presented. The important topics of electronics hardware and software for data acquisition and storage are outside the scope of the course, apart from a general discussion of requirements.

29–30 July 2013
The following standalone course is being held at the National Aerospace Institute in Hampton, Virginia.

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

	Early Bird by 1 Jul	*Standard (2–22 Jul)*	*On-site (23–29 Jul)*
AIAA Member	$950	$1075	$1175
Nonmember*	$1070	$1195	$1295

*Includes a one-year AIAA membership

Turbulence Modeling for CFD **(Instructor: David Wilcox)**

The course begins with a discussion of turbulence physics in the context of modeling. The exact equations governing the Reynolds stresses, and the ways in which these equations can be closed, is outlined. Starting with the simplest turbulence models this course charts a course leading to some of the complex models that have been applied to a nontrivial turbulent flow problem. It stresses the need to achieve a balance among the physics of turbulence, mathematical tools required to solve turbulence-model equations, and common numerical problems attending use of such equations.

23–24 September 2013
The following standalone course is being held at The AERO Institute in Palmdale, California.

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

	Early Bird by 23 Aug	*Standard (24 Aug–15 Sep)*	*On-site (16–23 Sep)*
AIAA Member	$950	$1075	$1175
Nonmember*	$1070	$1195	$1295

*Includes a one-year AIAA membership

Gossamer Systems: Analysis and Design

(Instructor: Chris Jenkins)

An evolving trend in spacecraft is to exploit very small (micro- and nano-sats) or very large (solar sails, antenna, etc.) configurations. In either case, success will depend greatly on ultra-lightweight technology, i.e., "gossamer systems technology." Areal densities of less than 1 kg/m2 (perhaps even down to 1 g/m2!) will need to be achieved. This course will provide the engineer, project manager, and mission planner with the basic knowledge necessary to understand and successfully utilize this emerging technology. Definitions, terminology, basic mechanics and materials issues, testing, design guidelines, and mission applications will be discussed. A textbook and course notes will be provided.

22–23 June 2013
This Continuing Education course is being held at the AIAA Fluid Dynamics and collocated conferences in San Diego, CA. Registration includes course and course notes; full conference participation: admittance to technical and plenary sessions; receptions, luncheons, and online proceedings.

To register for one of the Fluid Dynamics 2013 courses, go to **www.aiaa.org/fluids2013.**

	Early Bird by 29 May	*Standard (30 May–21 Jun)*	*On-site (22 Jun)*
AIAA Member	$1278	$1378	$1478
Nonmember	$1388	$1488	$1588

Verification and Validation in Scientific Computing

(Instructors: William Oberkampf, Engineering Consultant, WLO Consulting and Chris Roy, Aerospace and Ocean Engineering Department, Virginia Tech)

The performance, reliability, and safety of engineering systems are becoming increasingly reliant on modeling and simulation. This course deals with techniques and practical procedures for assessing the credibility and accuracy of simulations in science and engineering. It presents modern terminology and effective procedures for verification of numerical simulations and validation of mathematical models that are described by partial differential equations. While the focus is on scientific computing, experimentalists will benefit from the discussion of techniques for designing and conducting validation experiments. A framework is provided for estimating various sources of errors and uncertainties identified both in simulations and in experiments, and then combining these in total prediction uncertainty. Application examples techniques and procedures are taken primarily from fluid dynamics, solid mechanics, and heat transfer. This short course follows closely the instructors' book *Verification and Validation in Scientific Computing* (Cambridge University Press, 2010).

18–19 July 2013

The following Continuing Education courses are being held at the 49th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and the 11th International Energy Conversion Engineering Conference in San Jose, CA. Registration includes course and course notes; full conference participation: admittance to technical and plenary sessions; receptions, luncheons, and online proceedings.

To register for one of the JPC 2013 courses, go to **www.aiaa.org/JPC2013.**

	Early Bird by 17 Jun	*Standard (18 Jun–12 Jul)*	*On-site (13–18 Jul)*
AIAA Member	$1293	$1393	$1493
Nonmember	$1403	$1503	$1603

Liquid Propulsion Systems—Evolution and Advancements

(Instructors: Alan Frankel, Business Development, Moog-ISP, Space and Defense Group; Dr. Ivett Leyva, Combustion Devices Group, AFRL/RZSA; Patrick Alliot, Senior Technical Expert, Space Engine Division of SNECMA)

Liquid propulsion systems are critical to launch vehicle and spacecraft performance, and mission success. This two-day course, taught by a team of government, industry, and international experts, will cover propulsion fundamentals and topics of interest in launch vehicle and spacecraft propulsion; non-toxic propulsion; microsat and cubesat propulsion; propulsion system design and performance; and human rating of liquid engines. In keeping with the theme of the 2011 JPC, "Turning Propulsion Ideas into Reality," lessons learned from development and flight of components and systems will be discussed.

A Practical Introduction to Preliminary Design of Air Breathing Engines

(Instructors: Dr. Ian Halliwell, Senior Research Scientist, Avetec; Steve Beckel, Director for Advanced Propulsion, Alliant Techsystems (ATK) Missile Products Group)

The course presents an overview of the preliminary design of air-breathing engine systems that is determined primarily by the aircraft mission, which defines the engine cycle—and different types of cycle are investigated. Preliminary design activities are defined and discussed in the context of the overall engine development process and placed in perspective. Some basic knowledge of aerodynamics and thermodynamics is assumed so the mathematical material that appears in many good textbooks is minimized and the question "What do you actually do as an engine designer?" is addressed. The practical means and processes by which thermodynamic concepts are turned into hardware are covered and some design techniques are demonstrated. The fact that an air breathing engine is much more than the flowpath component is discussed and the future of engine design methods is raised. Class participation is encouraged throughout.

Missile Propulsion Design and System Engineering

(Instructor: Eugene L. Fleeman, International Lecturer on Missiles)

A system-level, integrated method is provided for the missile propulsion system design, development, analysis, and system engineering activities in addressing requirements such as cost, performance, risk, and launch platform integration. The methods presented are generally simple closed-form analytical expressions that are physics-based, to provide insight into the primary driving parameters. Sizing examples are presented for rocket-powered, ramjet-powered, and turbo-jet powered baseline missiles. Typical values of missile propulsion parameters and the characteristics of current operational missiles are discussed as well as the enabling subsystems and technologies for missile propulsion and the current/projected state of the art. Videos illustrate missile propulsion development activities and performance. Attendees receive course notes.

10–11 August 2013

The following Continuing Education courses are being held at the AVIATION 2013 Conference in Los Angeles, CA. Registration includes course and course notes; full conference participation: admittance to technical and plenary sessions; receptions, luncheons, and online proceedings.

To register for one of the AVIATION 2013 courses, go to **www.aiaa.org/aviation2013.**

	Early Bird by 15 Jul	*Standard (16 Jul–9 Aug)*	*On-site (10 Aug)*
AIAA Member	$1320	$1420	$1520
Nonmember	$1430	$1530	$1630

Guidance of Unmanned Aerial Vehicles

(Instructors: Dr. Rafael Yanushevsky, University of Maryland)

The developed course presents a rigorous guidance theory of unmanned aerial vehicles. It can be considered as the further development and generalization of the missile guidance theory presented in the author's book *Modern Missile Guidance* (2007). Guidance of the unmanned aerial vehicles (UAVs) differs from missile guidance; its goal is different. Moreover, since UAVs can perform a variety of functions, the goal depends on a concrete area of their application. To address a wide class of guidance problems for UAVs, a more general guidance problem is formulated and a class of guidance laws is developed. In addition, the obstacle avoidance problem for UAVs is discussed and avoidance algorithms are considered. The material of the course can serve as a basis for several graduate courses in the aerospace departments. It can be used by researchers and engineers in their everyday practice and will help them to generate new ideas in the area of unmanned aerial vehicles.

Systems Engineering Verification and Validation

(Instructor: John C Hsu, CA State University, The University of CA at Irvine, Queens University and The Boeing Company, Cypress, CA)

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

17–18 August 2013

The following Continuing Education courses are being held at the Guidance, Navigation, and Control and collocated conferences in Boston, MA. Registration includes course and course notes; full conference participation: admittance to technical and plenary sessions; receptions, luncheons, and online proceedings.

To register for one of the GNC 2013 courses, go to **www.aiaa.org/boston2013.**

	Early Bird by 22 Jul	*Standard (23 Jul–16 Aug)*	*On-site (17 Aug)*
AIAA Member	$1255	$1355	$1455
Nonmember	$1365	$1465	$1565

Emerging Principles in Fast Trajectory Optimization

(Instructors: I. Michael Ross, Professor, Program Director, Naval Postgraduate School, Monterey, CA, and Qi Gong, Assistant Professor, University of California, Santa Cruz)

The confluence of major breakthroughs in optimal control theory and new algorithms has made possible the real-time computation of optimal trajectories. This implies that mission analysis can be carried out rapidly with the only limitation being the designer's imagination. This course will introduce the student to the major advancements that have taken place over the last decade in both theory and algorithms for fast trajectory optimization. Students will acquire a broad perspective on recent developments in the mathematical foundations of trajectory optimization; "old hats" will also acquire a new perspective to some old ideas. The overall objective of this course is to outline the new foundations related to convergence of solutions that have emerged in recent years and the accompanying breakthroughs in general techniques for problem solving. These techniques are intended to enhance, not replace, special techniques that are in common use. Anyone involved in aerospace research will benefit from this course.

Recent Advances in Adaptive Control: Theory and Applications

(Instructors: Tansel Yucelen, Research Engineer, School of Aerospace Engineering, Georgia Institute of Technology, Atlanta, GA; Eric Johnson, Professor, School of Aerospace Engineering, Georgia Institute of Technology, Atlanta, GA; Anthony Calise, Professor of Aerospace Engineering, Georgia Institute of Technology, Atlanta, GA; Girish Chowdhary, Research Engineer, Georgia Institute of Technology, Atlanta, GA)

Research in adaptive control theory is motivated by the presence of uncertainties. Uncertainties may be due to a lack of accurate modeling data combined with modeling approximations that result in unmodeled dynamics. They may also be due to external disturbances, failures in actuation and airframe damage. Adaptive control is also motivated by the desire to reduce control system development time for systems that undergo frequent evolutionary design changes, or that have multiple configurations or environments in which they are operated. Model reference adaptive control (MRAC) is a leading methodology intended to guarantee stability and performance in the presence of high levels of uncertainties.

This course will present a review of a number of well-established methods in MRAC. Starting with MRAC problem formulation and an overview of classical robustness and stability modifications, this course will continue to introduce the adaptive loop recovery approach that allows the approximate retention of reference model loop properties such as relative stability margins. The course will also present Kalman filtering in adaptive control, in which a Kalman Filter framework is used to update adaptation gains that enables meeting a given performance criteria without excessive tuning.

Two novel adaptive control laws are also presented: concurrent learning adaptive control and derivative-free adaptive control. Concurrent learning is a memory-enabled adaptive control method that uses selected recorded data concurrently with instantaneous measurements for adaptation. Concurrent learning guarantees exponential tracking combined with parameter identification for a wide class of adaptive control problems, without requiring persistency of excitation. Derivative-free adaptive control is particularly well suited for systems with sudden (and possibly discontinuous) change in uncertain dynamics, such as those induced through reconfiguration, payload deployment, docking, or structural damage. It provides superior adaptation and disturbance rejection properties, and computable transient and steady-state performance bounds.

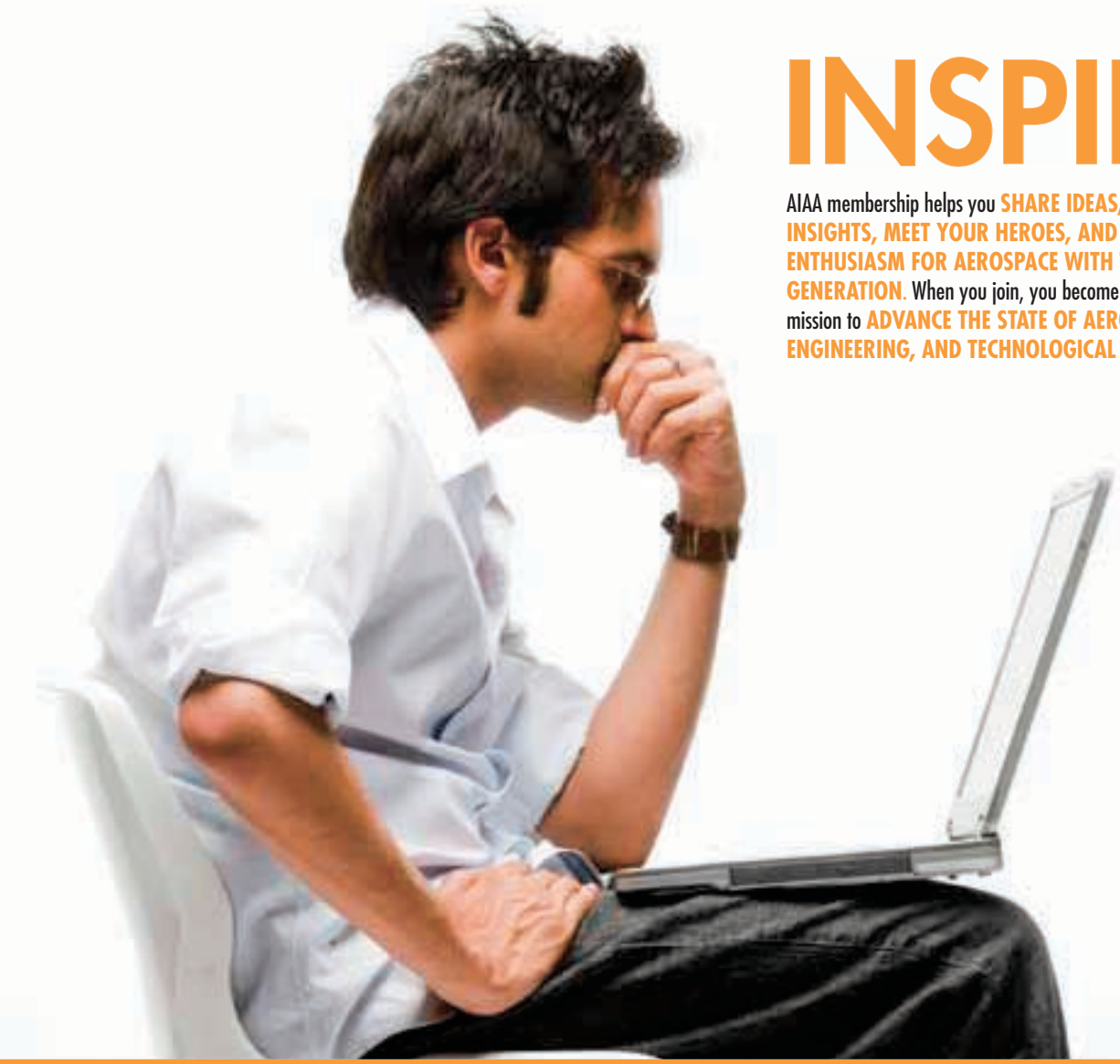
The course will also discuss emerging results in connecting machine learning with adaptive control. A special section will be devoted to implementation and flight testing of adaptive control methods, including discussion of the pseudo control hedging methods for handling actuator dynamics and saturation. The course will conclude with discussing extensions to decentralized adaptive control, output feedback adaptive control, unmodeled dynamics, and unmatched uncertainties.

CONNECT

When you join AIAA, you gain countless **OPPORTUNITIES TO CONNECT WITH MORE THAN 30,000 OTHERS** in the field of aerospace science, engineering, technology, management, education, and policy.

ACHIEVE

AIAA connections and educational programs provide a **LIFETIME OF OPPORTUNITIES** for you to **ADVANCE PERSONALLY AND PROFESSIONALLY** and **TO BE RECOGNIZED FOR YOUR ACHIEVEMENTS.**



INSPIRE

AIAA membership helps you **SHARE IDEAS, SPARK INSIGHTS, MEET YOUR HEROES, AND BUILD ENTHUSIASM FOR AEROSPACE WITH THE NEXT GENERATION.** When you join, you become part of AIAA's mission to **ADVANCE THE STATE OF AEROSPACE SCIENCE, ENGINEERING, AND TECHNOLOGICAL LEADERSHIP.**

AIAA PROFESSIONAL MEMBERSHIP

Your annual $110 investment in AIAA membership provides the professional development resources and contacts to advance your career … expand your potential impact on the future of aerospace … and keep you at the forefront of aerospace technology.

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www.aiaa.org/join

AIAA Fluid Dynamics and Co-located Conferences and Exhibit

24–27 June 2013
Sheraton San Diego Hotel
San Diego, California

#aiaaFluids

This event includes the following conferences:

43rd AIAA Fluid Dynamics Conference and Exhibit
44th AIAA Plasmadynamics and Lasers Conference
44th AIAA Thermophysics Conference
31st AIAA Applied Aerodynamics Conference
21st AIAA Computational Fluid Dynamics Conference
5th AIAA Atmospheric and Space Environments Conference
AIAA Ground Testing Conference

Hotel Information

AIAA has made arrangements for a block of rooms at the:
Sheraton San Diego Hotel
1380 Harbor Island Drive
San Diego, California 92101

Room rates are **$222** per night for single or double occupancy. For reservations, please call 1.866.716.8106. Please identify yourself as being with the AIAA conference. These rooms will be held for AIAA until **22 May 2013** or until the block is full. After 22 May 2013, any unused rooms will be released to the general public. You are encouraged to book your hotel room early.

REGISTER TODAY!

www.aiaa.org/aafluids

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The World's Forum for Aerospace Leadership