May 2014

AEROSPACE AMERICA

Cancer and deep spaceflight

Cosmic radiation threatens to smash DNA and human exploration plans. Meet the researchers who aim to point NASA toward solutions. page 30

Airline safety crusader, page 24

Apache upgrades bring firepower, page 36

A PUBLICATION OF THE AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS

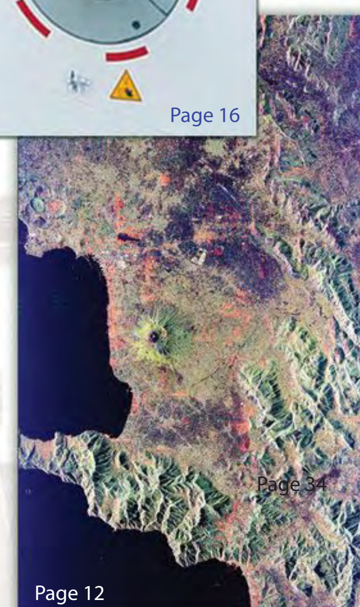
AEROSPACE
AMERICA

May 2014


Page 4


Page 8


Page 16


Page 34

Page 12

DEPARTMENTS

EDITOR'S NOTEBOOK 2
On display: Cross-sector tech sharing

LETTERS TO THE EDITOR 3
The case for returning to the moon

INTERNATIONAL BEAT 4
Ariane 6; Hypersonics; GPS

WASHINGTON WATCH 8
Budget doubts; Due in May; Simulation competition

THE VIEW FROM HERE 12
Fresh look at Earth

CAREER PROFILE 14
Thinking differently about an engineering degree

ENGINEERING NOTEBOOK 16
Detecting Pitot tube obstructions

INDUSTRY INSIGHTS 20
Dronecast: For American manufacturers, time to look abroad

CONVERSATION 24
The Crusader: Seymour Levine

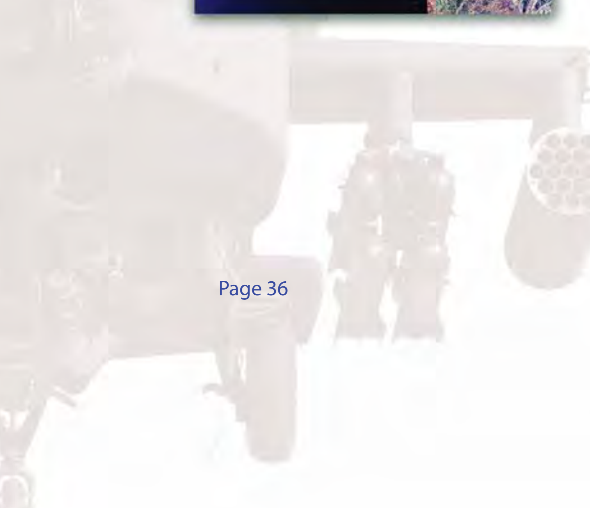
BOOKS 27
An American success story

OUT OF THE PAST 43

FEATURES

CANCER AND SPACEFLIGHT 30
NASA aims to keep galactic cosmic radiation from becoming a showstopper for human missions to Mars and beyond.
by Natalia Mironova

MANNED-UNMANNED TEAMING 36
Pairing the crews of piloted craft with unmanned planes is ready to be tried in combat in Afghanistan.
by Keith Button


Page 36

BULLETIN

AIAA Meeting Schedule B2
AIAA News B5
SPACE 2014 Event Preview B14
AIAA Courses and Training B19

Aerospace America (ISSN 0740-722X) is published monthly by the American Institute of Aeronautics and Astronautics, Inc. at 1801 Alexander Bell Drive, Reston, Va. 20191-4344 [703/264-7577]. Subscription rate is 50% of dues for AIAA members (and is not deductible therefrom). Nonmember subscription price: U.S. and Canada, $163, foreign, $200. Single copies $20 each. **Postmaster: Send address changes and subscription orders to address above, attention AIAA Customer Service, 703/264-7500.** Periodical postage paid at Herndon, Va., and at additional mailing offices. 40,000 copies of this issue printed. This is Volume 52, No. 5.

AEROSPACE AMERICA®

is a publication of the American Institute of Aeronautics and Astronautics

Ben Iannotta
Editor-in-Chief
Patricia Jefferson
Associate Editor
Greg Wilson
Production Editor
Jerry Grey
Editor-at-Large
Christine Williams
Editor AIAA Bulletin

Contributing Writers
Lauren Biron, Philip Butterworth-Hayes, Dave Majumdar, Natalia Mironova, Erik Schechter, Marc Selinger, Robert van der Linden, Frank Winter

Jane Fitzgerald
Art Direction and Design

James F. Albaugh, *President*
Sandra H. Magnus, *Publisher*
Craig Byl, *Manufacturing and Distribution*

LETTERS AND CORRESPONDENCE
Ben Iannotta, *beni@aiaa.org*

QUESTIONS AND ADDRESS CHANGES
custserv@aiaa.org

ADVERTISING MATERIALS
Craig Byl, *craigb@aiaa.org*

May 2014, Vol. 52, No. 5

AIAA
The World's Forum for Aerospace Leadership

Editor's Notebook

On display: Cross-sector tech sharing

If I had to identify a theme running through this month's issue, it would be the value of the free flow of technology and talent across different sectors of the economy. This flow is a strength of western economies. We need to nurture and enhance it to keep the aerospace endeavor moving forward.

Our cover story explores how researchers at Georgetown University's Lombardi Cancer Center have crossed into the space arena to help NASA figure out ways to protect astronauts on missions to Mars or beyond. Deep space exploration by humans is a long way off, but NASA is wisely planning ahead. The findings could guide technology investments and exploration strategies.

In "Detecting Pitot tube obstructions," Page 16, we describe how nuclear reactor engineers are adapting coolant-monitoring technology to the problem of warning pilots when ice or debris is blocking their airspeed sensors. This is an example of the country's small-business research dollars at work.

Seymour Levine, featured in our conversation on Page 24, began his career making navigation systems for submarines. Now in semi-retirement (he teaches college courses), he's made a crusade of trying to get high bandwidth data links on airliners. Cross-domain technologies are sure to feature prominently in the debate over what should be done to prevent more mysteries like that of Malaysia Airlines Flight 370. Whether the solution turns out to be Levine's concept or someone else's, it's bound to require cybersecurity, sophisticated networking software and the use of communications satellites.

This month's book review, Page 27, dives into the memoir of Bernard L. Schwartz, a transplant to the defense and aerospace world who created a profitable giant from a failing company called Loral Corporation. The memoir is a thought-provoking read from a man whose collegiate science and technology experience can be summed up as a single physics class. Yet, he learned to interact easily with technologists. Schwartz also gives modern readers a glimpse at a bygone age: The post-World War II decades, when business and technology were pushed forward through human relationships. Deals were framed up with handshakes, and acquisitions were made as a growth strategy. Then came the venture capital firms with their strategy of buying companies to take them apart, he writes.

In "Manned-unmanned teaming," Page 36, we show how piloted aircraft and unmanned planes are being linked through technology. The newest Apache helicopters give their crews control over Gray Eagle unmanned planes and their weapons, in addition to more power and altitude. The wall is coming down between these two domains: traditionally piloted planes and unmanned aircraft.

This month's issue is a reminder about the good that can happen when people look beyond their traditional scopes.

Ben Iannotta
Editor-in-Chief

The case for returning to the moon

Within expected NASA budgets, we are not going anywhere at the moment, so we have the opportunity to consider various mid-century options for the future of human exploration of space. Edward Goldstein's recent article "Mars or bust" [March, Page 38] provides one such consideration. Allow me to offer another, in the chorus of many others advocating a return to the moon.

The quest to find life on other worlds certainly includes the intriguing features indicating the flow of water on Mars, but there are other targets, including the possible oceans of Europa and Enceladus. Perhaps before committing major resources to deliver a human geologist to Mars, we should invest instead in the development of space propulsion technology that would allow a broader and safer means for human exploration of space. Propulsion technology that reduces trip times to less than a few months vs. upwards of a year or more decreases the opportunity for exposure to radiation (solar flares or cosmic) and relaxes many of the physiological (and psychological) concerns for long voyages. Given the severe radiation environments near Europa, for example (~500 R/day), hundreds of tons of shielding would be required for extended explorations. While much of this could be transported ahead of time by electric propulsion, there are still substantial masses needed by the crew vehicle. By making the moon our next target for humans in space, we can focus on the technologies that will enable a proper basis for human exploration of the solar system.

Within our present knowledge, the necessary technologies must involve fission or fusion energy sources. Goldstein notes the difficulties encountered in the pursuit of nuclear propulsion concepts. These include environmental impact (for which the Kiwi tests at Jackass Flats now represent an alternative universe) and the need for very substantial vacuum facilities. The moon offers a potential site for an Advanced Space Propulsion Laboratory that could explore and develop the high specific impulse and high thrust density needed for crewed missions to Mars and the outer planets using fission or fusion power. Success in such technology would reduce the dangers of prolonged spaceflight by our astronauts and allow the necessary scale for proper laboratories delivered to distant targets. Apart from the technical goals of an Advanced Space Propulsion Laboratory, a return to the moon would re-assert a U.S.-based capability for crewed launch and return within the earlier Apollo history, so there might be clearer specification of technical costs and milestones and more support for the necessary NASA budget.

Peter J. Turchi
Santa Fe, N.M.
nmturchi1@aol.com

✈✈✈

Deja vu: **Gerald Ouellette of Plymouth, Mass.** felt that a quote in "Test time for seamless wings" [Page 16, April] missed a critical piece of history. He said the claim that "Flexfoil is the world's first seamless" wing "whose edges morph" neglects the work of the Wright brothers. "Give credit for first to those who thought of it first," he wrote.

✈✈✈

Good feedback: **Rik F. Van Hemmen of Red Bank, N.J.**, said he is trained as an aerospace and ocean engineer, but now works in the maritime industry. He reads Aerospace America "simply to feed my overall technical interest," and said he finds the latest issue, in particular, a "useful read." He wants us to "keep up the good work!" We will.

✈✈✈

Correction

The article, "Malaysia Airlines case stirs call for streaming data," (April, page 8) misstated the time it took to find the black boxes after the 2009 Air France crash. It took 23 months.

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

Events Calendar

May 14-19
International Space Development Conference, Los Angeles, Calif.
Contact: pat.montoure@nss.org, http://isdc.nss.org/2014

MAY 26-28
Twenty-first 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

May 26-29
Sixth International Conference on Research in Air Transportation, Istanbul, Turkey.
Contact: dresz@comcast.net

June 2-4
Global Space Applications Conference, Paris, France.
Contact: lisa.antoniadis@iafastro.org

June 16-20
AIAA Aviation and Aeronautics Forum and Exposition, Atlanta, Ga.
Contact: 703/264-7500

Critical decisions due for Europe's Ariane 6

Representatives of the European Space Agency's 20 governments plan to meet in December to decide whether to proceed with full development of the Ariane 6 rocket.

The new satellite launcher would be a potential replacement sometime after 2020 for the European-built Ariane 5 and the Russian Soyuz rockets that Europe currently markets for launches from French Guiana.

Europe is working to finalize the proposed design of the Ariane 6 and to decide the makeup of the industrial consortium that would manufacture the rockets. ESA has told Europe's industry to form this consortium by June.

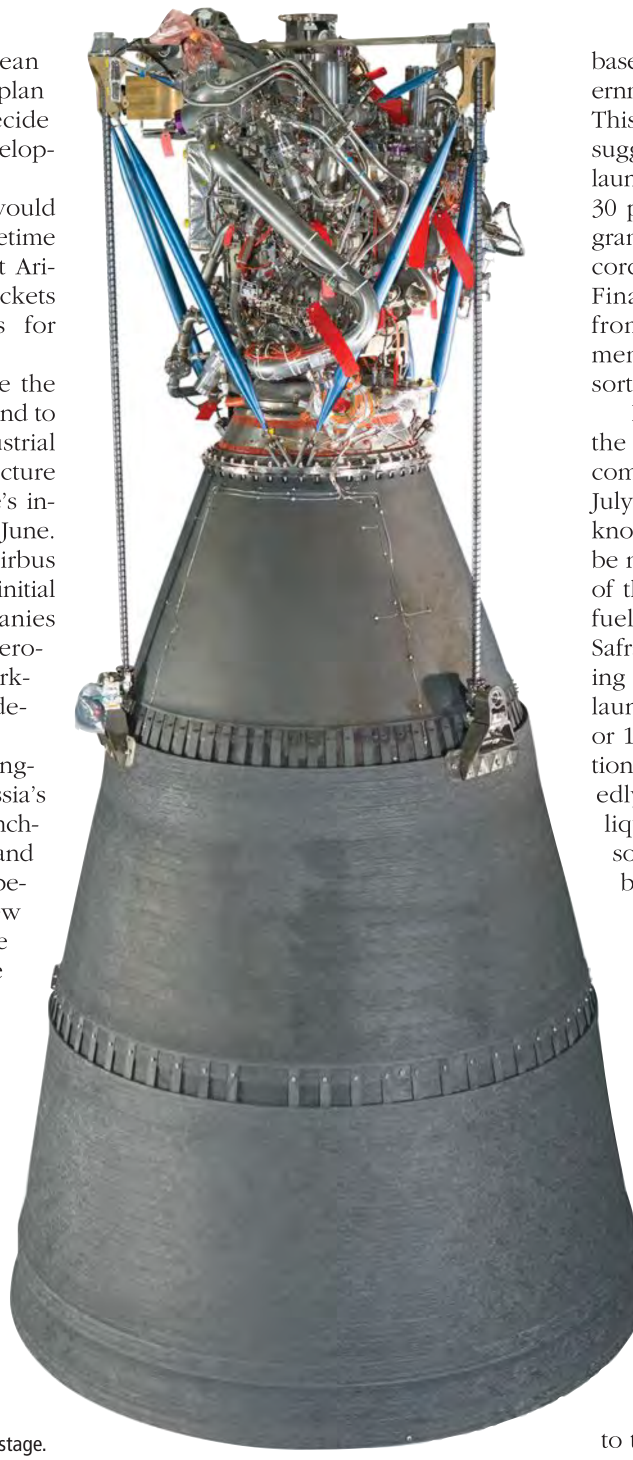
ESA has contracted with Airbus Defence and Space to undertake initial design studies. European companies including Safran, Avio, MT Aerospace, SABCA and Ruag are working with Airbus to finalize the design by the end of the year.

At stake for Europe is its long-term competitiveness against Russia's Proton, SpaceX's Falcons, and launchers under development in China and India. One competitor is getting special attention in Europe: "The new player that current launch vehicle providers are worried about is the Falcon 9 from SpaceX," says U.K.-based Wilfred Oliver of Global Space Consulting Limited. "It is much cheaper, and if the reliability proves to be good then Falcon 9 would be serious competition for Arianespace."

ESA is using the Ariane 6 as an opportunity to sharpen its business processes. Until now, Ariane work has been distributed to companies based on how much their national governments have invested in the project. This time, ESA has asked industry to suggest the best way to meet a target launch cost of €70 million, or about a 30 percent reduction in cost per kilogram compared to the Ariane 5, according to an analysis by one expert. Financing would then be sought from the governments where the members of the manufacturing consortium are based.

Europeans remain anxious about the design choices ahead and the competitiveness of the Ariane 6. Last July, Airbus Defence and Space, then known as Astrium, said savings could be made by powering the upper stage of the Ariane 6 with the same liquid-fueled Vinci engine design that Safran's Snecma company is developing for the Ariane 5 Midlife Evolution launcher, which is due to fly in 2017 or 18. The first stage could be a question mark, however. Germany reportedly advocates propelling it with a liquid-fueled engine rather than the solid rocket motors described in the baseline design.

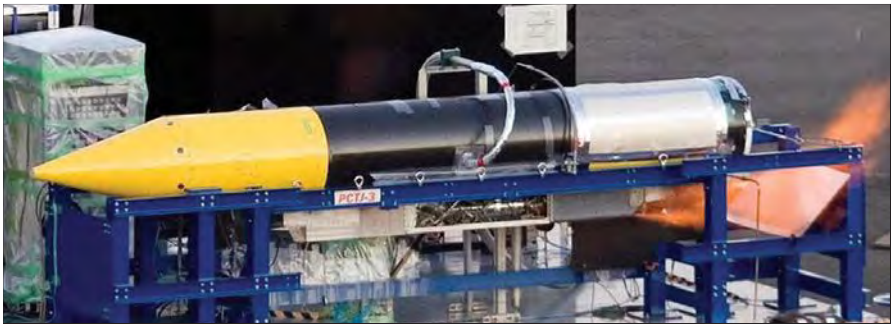
Time is pressing for European launch advocates. "Europe isn't really competitive yet, but it's on the way," says analyst Michael Blades of Frost & Sullivan Aerospace and Defense. "I don't know whether ESA states will agree to develop a full-up Ariane 6. I think the Midlife Evolution of Ariane 5 might be enough. If they want to have something that's going to be competitive, they will need to make a decision on the program in the next couple of years. The longer they wait, the more opportunities there will be for other companies to take that business from them."



The Vinci engine, under development for the Ariane 5 Midlife Evolution launcher, might someday power the Ariane 6 upper stage.

Snecma

Europe, Japan closer to hypersonics tech plan



JAXA

The Japan Aerospace Exploration Agency tested a pre-cooled turbojet engine for a future hypersonic airliner.

A consortium of aerospace companies and research organizations from Japan and the European Union is in the final stages of writing a common technology roadmap toward a supersonic airliner.

The Hikari consortium is identifying key enabling technologies, drawing up a demand analysis, and agreeing on areas of technical cooperation as it enters the final six months of its two-year research initiative.

Hikari means light in Japanese, a play on the speed of light, although the study group doesn't figure to fly quite that fast. It wants people to be able to have lunch in Tokyo and breakfast in Paris, "in that order," as its website says.

The group's goal is to complete "a joint technology and demonstration roadmap showing what the Europe/Japan cooperation will look like and what the economic benefits of this cooperation on high-speed transport may be," says Tom Rogers, senior economist with Oxford Economics of Oxford, U.K., a forecasting and modeling company and one of the consortium members.

The European Commission and the Japanese Ministry of Economy, Trade and Industry are funding the study, which has seven work strands: project management, conceptual guidelines, market analysis, fuel and environment, thermal systems and energy management; propulsion, and raising public awareness.

There are multiple research projects for next-generation high-speed airliners underway in Europe and Japan, based on different propulsion and airframe concepts. An objective of the Hikari study is to combine these into a single program. The Airbus ZEHST — Zero Emission High Supersonic Transport — study being undertaken with the French national aerospace research laboratory ONERA, envisages an airliner that would fly between Paris and Tokyo in 2 hours and 30 minutes, flying at a Mach 4 cruising speed at an altitude of 32 kilometers using engines developed for the Ariane launcher. ZEHST is a product of the Supersonic Technologies Cooperation Agreement signed between the Groupement des Industries Françaises Aéronautiques et Spatiales and the Society of Japanese Aerospace Companies during the 2005 Paris Air Show.

Technologies for aircraft that would cruise at Mach 5 and Mach 8 were examined under the European Commission's recently completed Long-Term Advanced Propulsion Concepts and Technologies 2 research. This work was based on several different propulsion concepts, including liquid hydrogen fuels. JAXA, the Japan Aerospace Exploration Agency, has been working on technologies for hypersonic aircraft that would cruise at Mach 5. Research has focused on developing a pre-cooled turbojet engine that could operate from takeoff to Mach 5 continuously, with liquid hydrogen as the fuel and liquid nitrogen as the pre-coolant. Flight trials of the engine took place in September 2010.

For next-generation transports of 30 to 50 years from now, "the big question is what the real costs are going to be, compared to the initial ballpark figures based on today's best knowledge and predictions. That's the difficult area where more work will be needed," says Rogers of Oxford Economics.

Hikari consortium members are outlining proposals for testing key enabling technologies on the ground and in the air over the next few years.

Besides establishing a common technology baseline for the vehicle, Hikari members are analyzing the direct and indirect impact of the aircraft on airline economics and evaluating the time saved by passengers shifting from conventional to high-speed transports. The focus of this work is now on determining which routes would offer the best business opportunities.

European Space Agency

A concept drawn up under Europe's Long-Term Advanced Propulsion Concepts and Technologies 2 program. The Japanese-European Hikari consortium wants to combine this and other hypersonics work into one program.

GOING WORLDWIDE:
India leads embrace of GPS landing tech

Air India

The Boeing 787 is among the aircraft whose standard equipment now includes the receivers needed for use of ground-based satellite augmentation systems. India will soon test its own augmented navigation system.

The Airports Authority of India plans to conduct the first test flight of its augmented navigation system, known as GAGAN, in June, using a Beechcraft King Air turboprop.

Global navigation satellite systems, whose precision is typically augmented by ground and sometimes airborne aids, are being rapidly introduced as replacements for instrument landing systems, the runway antennas that transmit signals that airliners follow to maintain proper glide slope and heading during landings. This year is expected to bring a sharp increase in the availability of these services beyond North America and Europe, where implementation is already underway; India is a case in point.

GAGAN, short for GPS-Aided Geo Augmented Navigation, was developed by the Airports Authority of India, the Indian Space Research Organization and Raytheon. It will be the world's fourth satellite-based augmentation system.

As with the other systems, GAGAN must augment the accuracy of the GPS position fixes that airliners receive, because the raw locations are not precise enough in three dimensions to safely steer an airliner to the ground. To solve that problem, ground stations measure the accuracy and integrity of the GPS signals and send corrections to one or more geosynchronous communications satellites, which then broadcast the corrected signals regionally to air traffic. The GAGAN network covers the entire Indian Flight Information Region by transmitting reference signals from 15 ground stations up to the Indian-built GSAT 8 and GSAT 10 communications satellites. If the tests go as expected, this approach will provide a precision of 1.5 meters in the horizontal plane and 2.5 meters in the vertical plane — broadly equivalent to the U.S. Wide Area Augmentation System.

GAGAN will join the U.S. system, Europe's Geostationary Navigation Overlay Service and Japan's Multi-functional Satellite Augmentation System. Meanwhile, Russia is developing the System for Differential Corrections and Monitoring; China, the Satellite Navigation Augmentation System; and Latin America, the Augmentation Solution for the Caribbean and Central and South America, known by its Spanish acronym SACCSA.

The availability of new satellite-based augmentation services offers the possibility of automatic precision approaches into airports in low visibility without the need for expensive ground equipment: Once established on an approach, the pilot follows the descent path indicated by the satellite-based signal to a fixed point where he or she must decide whether to continue with the descent — because the runway is now in view — or abort the landing. This fixed point is called the "decision height"; a Category One landing system will automatically guide the aircraft to within 200 feet, or 61 meters, of the runway threshold.

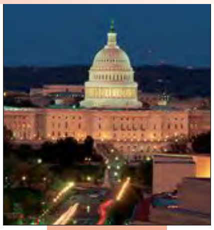
In the U.S., augmented GPS navigation now provides "over two thirds of the total United States precision approach capability," according to a U.S. statement released in February during a meeting of the United Nations Committee on the Peaceful Uses of Outer Space.

This is also the year when experts expect to see an increase in the number of airports seeking to replace instrument landing systems with ground-based satellite augmentation systems, using ground stations to communicate GPS navigation corrections rather than satellites. The ground-based systems offer considerably higher levels of precision than satellite-based augmentation system networks, but implementation has been slowed by a lack of compatible avionics, GNSS [Global Navigation Satellite System] Landing System receivers, aboard airliners. Now, however, these receivers are being offered as standard equipment on new jets including the Airbus A350 and Boeing 787. More airports are looking at ground-based satellite augmentation systems as an alternative to instrument landing systems.

It is now likely that safety regulators will certify ground-based augmentation system approaches to Category Two levels — allowing for automatic precision approaches to within 100 feet, or 30 meters, of the runway end — and Category Three levels — an automatic landing on the runway — by 2019, according to Patrick Reines, senior manager for Honeywell Aerospace "SmartPath" ground-based augmentation systems. "Each airport-specific installation will be capable of providing up to 26 precision approaches," says Reines. "Furthermore, our estimates indicate that by 2016 there will be more than 4,000 airliners equipped with GLS [GNSS Landing System] avionics and capable of flying these approaches."

Sydney airport is due to start ground-augmentation operations in the second quarter of 2014 and Frankfurt in the third quarter of this year.

Philip Butterworth-Hayes
phayes@mistral.co.uk



Budget doubts hover over autonomous flight tests

Now that competing packages of sensors and software have autonomously steered two different models of military helicopters to the ground, the question is whether the Navy will allocate long-term funding to continue the research.

The Office of Naval Research is funding development of AACUS, the Autonomous Aerial Cargo/Utility System, for the Marine Corps, which might someday use the technology to deliver supplies to Marines without putting human pilots in danger.

In February, a Marine operator on the ground tapped on a tablet computer to request that the helicopters land in an open field on U.S. Marine Corps Base Quantico in Virginia. The Navy described the flights at its annual Navy League convention.

Max Snell, the current AACUS program manager, says he has the funds he needs to keep the program going through fiscal 2018. But a former AACUS manager, Mary "Missy" Cummings, is sounding the alarm over what might happen after that.

She told Aerospace America that AACUS was underfunded when first budgeted at $100 million in 2012, and "by the time I left, $25 million of that had disappeared, and then there were plans to reduce it even further," she said.

In the test flights, a group led by Aurora Flight Sciences of Manassas, Va., attached its Talos package onto an MH-6 Little Bird. Lockheed Martin attached its Optimus package on a Kaman K-MAX. Safety pilots were on board but did not touch any controls. ONR officials are expected to notify defense contractors in May about the demo results and plans for potential follow-on work.

Snell, the AACUS program manager, acknowledged questions about AACUS's future. "It could be a total flop — I don't think it's going to be – and it may not find a home, but certainly pieces" could be transitioned elsewhere, he said.

Erik Schechter
ejs1776@hotmail.com

Safer delivery: A Kaman K-MAX helicopter takes off at Quantico, Va. It tested new sensors and software that could enable the Marine Corps to fly the craft unmanned and carry supplies to troops without endangering crews.

U.S. Navy

DUE IN MAY

United Launch Alliance

Made in Russia: The RD-180 engines power U.S. Atlas 5 rockets. The Air Force is assessing the domestic stockpile of these engines in case Russia interrupts exports in the wake of U.S. sanctions.

Russian engine report: Concerned that Moscow might retaliate against Western sanctions by halting RD-180 rocket engine exports to the U.S., the Air Force is exploring whether a cutoff could hinder its ability to launch satellites. The engine review is to be completed by the end of May, Air Force Secretary Deborah Lee James told lawmakers last month. The reviewers are looking into news reports that the United Launch Alliance, the Air Force's main rocket supplier, has at least a two-year stockpile of RD-180s for the Atlas 5s. An inventory of that size might ease concerns about a potential supply interruption. The Air Force also wants to determine whether enough spare parts for those engines are on hand, and what would be entailed financially and otherwise in starting U.S. production of an Atlas 5 engine if the Air Force opted to go that route. The engine issue has led some members of Congress to question why the Air Force intends to open fewer launches to competition over the next few years than previously planned. They say allowing another company, namely SpaceX, to supply rockets could reduce U.S. dependence on Russian engines. James said the Air Force is committed to competition but has delayed some launches simply because GPS satellites are lasting longer than expected, allowing the Air Force to hold off on sending up replacements.

Space Fence decision: While the U.S. Air Force routinely monitors manmade debris in space to help satellites and other spacecraft avoid harm's way, its current surveillance system has trouble seeing small objects. The Space Fence, a planned system of ground radars, is supposed to provide a more detailed picture, increasing the number of objects the Air Force can track by 10 times, to 200,000.

Lockheed Martin and Raytheon have been working on competing designs for the Space Fence for years, and in mid-May the Air Force plans to pick either Lockheed Martin or Raytheon to build the Space Fence.

The Air Force intended to make the selection a year ago but postponed action, citing budget constraints. To address those financial limitations, the Air Force trimmed the Space Fence budget from $1.9 billion to $1.84 billion and delayed the system's initial fielding by about two years, to fiscal 2019, according to a revised request for proposals.

Space junk includes defunct satellites, depleted space boosters, and fragments from decaying, colliding or exploding spacecraft. The Air Force says the new system will be able to detect and track a softball-sized object orbiting more than 1,200 miles above Earth. The Space Fence was designed to do the job of the Air Force Space Surveillance System, which was operational from 1961 until last October, when the Air Force shut it down to save money. The Air Force has stitched together a patchwork of other sensors to maintain "space situational awareness" until the new radar system comes online.

NASA

Better vision: Computer-generated image shows space debris concentrated in low-Earth orbit. Plans call for a new Space Fence that would spot smaller, softball-sized objects.

Marc Selinger
marc2255@yahoo.com

FAA rules bring competition

Simulation companies are vying to meet the enhanced training requirements sparked by a spate of new FAA rules covering everything from the actions of airline pilots in stall scenarios to runway safety and crosswind training.

CAE of Montreal holds the lion's share of civil and military simulation contracts, but a growing number of companies are trying to compete in this already crowded arena. The latest is multi-industry giant Textron, which absorbed simulation companies OPINICUS Corporation and Mechtronix late last year. In April, Textron announced it would wrap the companies into a newly branded Textron company called TRU Simulation + Training, based in Goose Creek, S.C.

Jim Takats, chief executive officer of the new venture, told reporters that although the two acquisitions have been around for 25 years, they need more financial investment to make an impact — something Textron is willing to provide.

TRU will be a natural to support Textron's major divisions of Bell Helicopter, Cessna and Beechcraft, Takats said. But there are also plans to tackle emerging markets like China, as well as small players that want a turnkey package rather than a massive training center.

According to Takats, TRU has multiple projects already underway, including a Relentless 525 simulator for Bell Helicopter, a training center in Reykjavik with Icelandair and flight school programs in Iceland.

While Takats's company has a split focus on military and civil aviation markets, opportunities could be more plentiful away from the brass.

"Military spending is going down," Takats said. "You've seen, in the last probably two years, acquisitions by Lockheed Martin and L-3 in a similar space. There's obviously a trend to move into the civil market by the big U.S. defense contractors."

Not that the company plans to neglect the military side. TRU is already bidding for Navy contracts and discussing simulation devices for the Scorpion, Textron's ISR — intelligence, surveillance and reconnaissance — aircraft. Takats noted that because there are a limited number of new military platforms being built, the focus will be on the technology refreshes, major upgrade programs, ISR platforms and improvements to existing simulators.

As with many of the big players, TRU provides a range of simulation options, from maintenance trainers all the way up to full flight simulators. Both Opinicus and Mechtronix continue to offer their products, but designers of TRU's next generation of simulators will get to pick and choose the best possible technology. Emulating the complicated new avionics systems going into planes will demand the best tools.

Lauren Biron
laurenbiron@gmail.com

Textron Systems

New scenario: TRU Simulation + Training's full-flight simulator. The company is one of many players vying to meet pilot training needs sparked by new FAA rules.

High stakes launch

Once control of the military's new DMSP-19 satellite is handed over to NOAA operators this month, it will spruce up space-based weather coverage and prevent a once-possible near-term gap in such coverage. But the Lockheed Martin-built satellite will do little to lessen the threat of a coming gap in coverage for the civilian sector. At issue is the accuracy of the National Weather Service's all-important long-range weather forecasts.

The National Oceanic and Atmospheric Administration, which runs the National Weather Service and operates the Defense Meteorological Satellite Program constellation for the Pentagon, will continue to use DMSP data in its weather models for the civilian sector. Even so, NOAA still needs to replenish its own distinctive system of polar-orbiting weather satellites. Inaction would have "catastrophic national consequences" for the U.S. economy and quality of life, a NOAA-commissioned review team has warned.

NOAA's polar-orbiting environmental satellites supply weather and climate data for the civilian sector. But data requirements are different for military and civilian weather forecasting, and the DMSP satellites do not specialize in particular kinds of data, including temperature and humidity, that are essential to long-range forecasting.

The DMSP-19 satellite was built by Lockheed Martin in 1988 and put into storage for subsequent deployment as needed. Its navigation and operating systems have been upgraded through the years. DMSP-19 supplants a forerunner satellite that far exceeded its life expectancy on orbit. The newcomer in space is scheduled to be joined there in 2016 by the DMSP-20 satellite still in storage. The Air Force once had plans for a new constellation of defense meteorological satellites that would have complemented the NOAA satellites more closely in terms of orbiting timetables and atmospheric data collection. That program was canceled in January 2012.

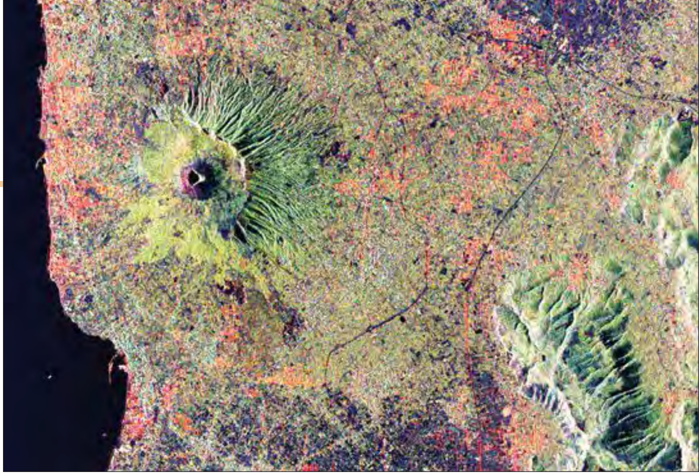
Lockheed Martin

Gap-filler: Lockheed Martin workers perform final integration of the DMSP-19 satellite. The craft will stave off a looming gap in weather coverage, but operator NOAA has needs unmet by the military satellite.

NOAA spokesman John Leslie says the agency "will use some of the DMSP-19 data," such as "imagery of environmental features, including clouds, bodies of water, snow, fire and pollution, in the visual and infrared spectra." Even so, he says, "NOAA, NASA and the [Obama] administration will continue to consider options" for shoring up weather observation of Earth for civilian forecasting and warding off the weather coverage gap that looms ahead.

NOAA may be running out of time. A new NOAA weather satellite called JPSS-1, the first of four planned Joint Polar Satellite System spacecraft, will not be ready for deployment until 2017. NOAA's pair of currently operational polar satellites will have exceeded their design lives well before then, causing a coverage gap of a year and a half to four years. NOAA is considering but has yet to follow through on its review panel's recommendation to build and launch a stripped-down but sufficiently capable "gapfiller" satellite.

James W. Canan
jwcanan@comcast.net



Italy's Mt. Vesuvius in a 1994 image from the Spaceborne Imaging Radar-C/X-band Synthetic Aperture Radar, SIR-C/X-SAR. Radar echoes were stored on tapes aboard shuttle Endeavour for processing later.

Fresh look at Earth

Twenty years ago, six astronauts aboard the shuttle Endeavour recorded stunningly detailed radar images of Earth's geology, biosphere and oceans. One of those aboard was Tom Jones, who looks back on the STS-59 mission and its significance.

For 11 days in April 1994, a thousand-mile vista filled my office window. Each time I glanced outside, I plunged into a view saturated in geography, science, culture and history. It was my introduction to spaceflight.

The scientific target of my first space mission was our own familiar Earth. Yet from the space shuttle Endeavour, circumnavigating the globe every 90 minutes at an altitude of 222 kilometers, it was a world of endless wonder. From our unique vantage point, we would scan our changing planet with the Space Radar Laboratory-1. The science team in Houston used our payload computers to command three flat radar transceivers mounted on a massive truss in the payload bay. This radar instrument was known as SIR-C/X-SAR, short for Spaceborne Imaging Radar-C/X-band Synthetic Aperture Radar. The radars bounced a sharp beam of radio energy off the varied surface below, collecting echoes for processing into imagery. This prototype radar imaging system, a joint product of NASA's Jet Propulsion Lab and the German and Italian space agencies, would examine more than 400 science targets across the globe and show details as small as 25 meters across. The objective was to demonstrate the broad utility of a space-based SAR, synthetic aperture radar, in experiments across the range of Earth sciences.

Endeavour would provide power, aim the flat, 12-meter-long SAR antennas at science targets, and record and transmit imaging data. Our crew would provide onboard troubleshooting, data recording, and visual observations of the science sites in parallel with the radar. After return to Earth, SRL-1 would be adjusted, repaired and launched again.

For me, a planetary scientist and pilot, helping operate one of the most sophisticated observatories ever flown in orbit was a fantastic opportunity. But on my first trip, the stakes were high: I would have to perform my crew and scientific duties with near perfection, all while adapting to a strange and unfamiliar environment. Watching me would be my family, my crew, Mission Control and all of NASA. A single question dominated my thoughts during two and a half years of training: Would I measure up?

When Bob Sieck, our launch director, cleared us for launch with a "Vaya con Dios," I added my own plea to heaven for success and safety. Endeavour's twin solid rocket boosters exploded into life at T-minus-zero, kicking us with a massive jolt that was nevertheless a welcome relief from the tensions of the countdown. We were on our way: I felt our ship roll toward our 57-degree launch azimuth, even as 7 million pounds of thrust rattled our cabin and pierced its walls with a spine-tingling scream of power.

When the spent boosters tumbled away at Mach 3, some 30 miles up, I reached out instinctively to grip the gloved right hand of Linda Godwin, my friend and payload commander, seated just to my left. A couple of minutes later, Endeavour's commander, Sid Gutierrez, called down to me on the middeck intercom: "Congratulations, Tom! You're now an astronaut!" The others — Jay Apt, Kevin Chilton and Rich Clifford, along with Sid and Linda — had all been to space before, and now I'd qualified for my own NASA wings. But a successful mission and return still lay 10 days and 7 million kilometers ahead.

> *We'd grown up on this world, but none of us had really seen it until we witnessed its beauty and complexity from above.*

Eight and a half minutes after launch, we soared into orbit with main engine cutoff. I toyed with my first moments in free fall by removing my left glove, turning it loose to tumble a foot from my face. For just a moment, I was a kid waking up on Christmas morning.

Play could come later. Our mission clock was running, and all hands turned to outfitting Endeavour for orbit and activating the SRL. We raced to doff our suits, stow the cabin seats, and equip the flight deck for science operations. The flight plan and the digital readout of the bulkhead clock were our relentless taskmasters, driving us daily from the first insistent beep of our wakeup alarm until our designated bedtime, 16 hours later.

On the job in orbit

That first night in orbit, I'd struggled to shake off adrenaline and catch five hours of restless sleep while our crew's Red Shift — Sid, Linda and Kevin — activated the payload bay radars and an accompanying atmospheric carbon monoxide sensor. Jay, Rich and I, on the Blue Shift, relieved them some 12 hours after launch. Our orbital routine was 12 hours on, 12 hours off.

On Earth, Jet Propulsion Lab controllers, along with their German and Italian colleagues and partners, commanded each radar data take. On orbit, our responsibility was to point Endeavour precisely at each target, keying dozens of entries into the flight computers, a process repeated 412 times during the mission — a shuttle program record. Sid once remarked to the press that his biggest challenge as commander was ensuring we set up and initiated each of these maneuvers flawlessly, so as not to miss a single science opportunity for the SRL's far-flung experimenters. We all enjoyed this chance to "fly" the orbiter so precisely, setting up the targeting coordinates, getting confirmation from Mission Control, then watching the thrusters pirouette the orbiter to track the target and reduce radar image smear caused by Earth's rotation.

Radar echoes at L-, C- and X-band were processed into a flood of imagery streaming in at 150 megabits per second, triple the speed at which Endeavour could radio it to Earth. So my crew pampered and fed three Schlumberger high-speed data recorders adapted from military reconnaissance aircraft. These recorders, installed on the aft flight deck, each filled a 50-gigabyte cassette in about 30 minutes.

We fed the machines a steady diet of these overgrown VCR tapes, stowing precious stacks of the full ones in our middeck lockers. It was a mundane job in some ways, but absolutely vital and time critical: None of us wanted to lose a data take because a tape wasn't loaded and ready. Some data was piped to the ground, but two-thirds had to be stored on 110 cassettes, each of which was literally worth more than a million bucks, representing a discrete fraction of the resources invested in the SRL mission by NASA and its partners. We couldn't see this valuable imagery in real time, so the science team in Houston regularly relayed samples up by fax, giving us a good sense of the variety and quality of the data we were getting.

Without question, our most rewarding duty on STS-59 was to operate our flight deck camera suite — 14 still, movie and video cameras used to document environmental conditions and help interpret the radar imagery. We worked hard to cover each daylight target with video and wide- and narrow-angle still imagery. Obtaining those 14,000 images forced us to become very familiar with our home planet's features. Our months of geography and Earth science studies, learned in the classroom and the field, paid off as we swept across active volcanoes, migrating dune fields, fertile farm districts, tectonic faults, sunlit ocean currents and the circular scars of asteroid and comet impacts. We'd grown up on this world, but none of us had really seen it until we witnessed its beauty and complexity from above.

As on any spaceflight, we encountered the unexpected. Three days in, our galley rehydration station was injecting our drink packages with air as well as water, bloating the stomachs of several astronauts. Flight controllers improvised a repair technique using spare rubber washers from the toilet system. A stray grain of asteroid dust or space junk pitted the outer pane of our side hatch window. A short circuit sent sparks and smoke swirling from a camera power cable; we installed a spare. One of the C-band antenna panels failed late in the mission, but its loss didn't appreciably affect image quality, and it was replaced after landing in time for SRL-2 in September. Near the end of our flight, one of our high-rate recorders dropped offline, but Jet Propulsion Lab controllers re-routed the radar data to the remaining pair without missing a beat. In scanning a carefully chosen 12 percent of the planet, the SRL-1 team returned 47 terabytes of imagery, enough to fill 20,000 paper encyclopedia volumes (remember them?).

For me, STS-59 was 11 days of a flat-out, scientific sprint, but I was in love with spaceflight. Who wouldn't be, as each day brought dozens of opportunities to explore this marvelous globe anew.

Hundreds of space shuttle crewmembers experienced similar rewards during the program's 30-year span. The International Space Station is a much more capable laboratory, but cannot match the orbiter fleet in variety and number of payloads, probes, satellites and experiments deployed, many returned to be refurbished and flown again. Today we lack the regular access to orbit provided by the Space Transportation System, and its ability to integrate, launch and execute a completely different scientific mission every few months. As a spacefaring nation, we need more than space taxis to our orbital outpost. We need a far-reaching vision, and the versatile vehicles to carry it out at new and distant scientific frontiers.

As Endeavour's tires touched Earth again after 11 days, 5 hours and 49 minutes in space, perhaps my biggest satisfaction had come from being part of a team of six — professionals and friends aloft, and hundreds of ingenious, talented scientists and engineers on Earth, all working toward a new understanding of our home world. When I stepped from Endeavour with my crewmates on that day in 1994, I knew that whatever my future held, no terrestrial worries or challenges could ever take back that sense of accomplishment. I thank all those who made that voyage possible.

Flat radar antennas in Endeavour's payload bay are lit by the aurora australis, or southern lights, in a photo from the flight deck.

Tom Jones detailed STS-59's journey with the Space Radar Lab in "Sky Walking: An Astronaut's Memoir."

Skywalking1@gmail.com
www.AstronautTomJones.com

Ball Aerospace's Debra Facktor Lepore, vice president and general manager for strategic operations

Ball Aerospace

Thinking differently about an engineering degree

Debra Facktor Lepore has never designed a part for a rocket, satellite or airplane, even though she holds undergraduate and graduate degrees in aerospace engineering from the University of Michigan. She considered getting an MBA degree, too, but opted for what she calls a "walking MBA" — time spent in the world of entrepreneurship. Lepore followed an unusual path to her latest role: Ball Aerospace's voice in Washington. A turning point came in 1988, when she worked as a summer intern at the non-profit company ANSER in Washington, D.C. She discovered she liked the hubbub in the nation's capital and ANSER's role of conducting detailed technical analyses. ANSER hired her, and she became an expert on Russian rocket engines and chief of Moscow operations during the critical early years of collaboration to build the International Space Station. ANSER became a springboard into a long stretch as an entrepreneur, followed by an academic sabbatical at the Stevens Institute of Technology in Hoboken, N.J. In 2013, Ball hired Lepore as the lead executive in its Washington office. She spoke with Ben Iannotta by phone and email.

Do what's new >> I grew up outside of Detroit, where things are very much automotive, and I thought cars were boring. I went to a presentation by the Society of Women Engineers, for a career day for high school girls. And I remember this gal who said the best day of her life was when the car engine she designed drove down the street. And I thought, "Oh my gosh, that's so boring! Now what am I going to do? Engineering is out." But instead, I just shifted to a focus on doing things that had never been done before. The shuttle had first flown when I was in high school, and I was very intrigued by that.

Think "credibility" >> Working at ANSER for the summer inspired me to change my master's from a joint MBA/engineering degree to just engineering. Most would find this crazy, but it was because I recognized that to me having advanced technical skills was essential and gave credibility, especially for a woman. When I was in Russia, it was a challenge to be young and female and in a leadership role. I found that having an engineering background was a common language — and also gave credibility that I had suspected earlier would be important in my career.

Don't sweat nature vs. nurture >> People ask, "Is an entrepreneur born or bred?" And I say, "Yes." I think it's a little bit of each. I do believe that there's some level of entrepreneurship that has to be in your blood or in your bones. There are certain people who really like to innovate, to try new things, to take risks that to them seem normal but to somebody else might seem very extreme.

Find loopholes >> Another part of being an entrepreneur is the business side. What is the environment in which you want to do business? How can you enter a market that may be new? What are the rules? How do you get around them? Where are the loopholes? It's one thing to have good ideas. It's another to implement them; and even another to make them work in what is often a dynamic market.

Make lemonade >> To an entrepreneur, the definition of success is in the eye of the beholder. Often you have a technology in mind or a program that is intended to do one thing, and then it completely changes yet lives on in another way. Kistler Aerospace Corporation was doing two-stage fully reusable vehicles intended for the telecommunications market — Iridium and Teledesic and Globalstar — and that market changed dramatically. That vehicle never flew. Yet there was a lot of great hardware, so we repurposed the business plan toward what is now commercial resupply for the International Space Station. The [Kistler] alumni are at multiple places: They came with me to Air Launch, [they went to] Orbital Sciences Corp., Blue Origin, Andrews Space and Technology, SpaceX, Boeing. The technology flew — Orbital's Antares vehicle used the engines and the avionics, and [Orbital used] the business model of commercial practices.

Waste nothing >> There were different perspectives on whether it was good or bad to launch a rocket out of the back end of a C-17. So the [DARPA and Air Force] funding ended, and priorities changed. What lives on is [that] the C-17 aircraft drop capability was expanded as a result of what Air Launch did — twice Air Launch set new records. That's a huge capability that went into military airlift, which certainly we would not have expected going into that program.

In defense of Washington >> When I started in my career, it was the height of the Cold War, I had lots of job offers after undergrad and grad school. I had done summer internships at Beacon Automotive, at General Motors Hydramatic in Michigan, at McDonnell Aircraft in St. Louis, and then I did a summer in Washington, D.C. I really liked being where the center of decisions was, and creating and influencing policy and new system development. You have money here, and you also have policy. So people who are willing to take a risk and do things differently still need decisions with players who are probably in D.C. Whether that's through the White House, through Congress, through FAA, the Pentagon. I think there was a time when we thought that you didn't really need Washington, D.C., in order to have a good commercial business. Unfortunately, then you figure out that there's influence that happens here, directly or indirectly, that does affect entrepreneurs.

Ball Aerospace

Lowering the Kepler space telescope photometer onto the satellite. Lepore advocates for this and other Ball Aerospace programs at the company's Washington, D.C., office.

Notice things others miss >> Entrepreneurs are most successful when they can bring together the big picture, see all the elements that could link together, find those synergies — which might be completely different from what you'd originally intended — and take a systems approach. I think entrepreneurs do that naturally in their heads — see things and make connections that maybe other people don't see as naturally.

Get started >> Students today who are looking for their first jobs want a perfect fit, and to make the perfect decision. The reality is that you never know what a job's going to be — it could be a down market; or you could get [only] one job offer. So do you take it, or do you not? And I always tell them, you know it's not your last job offer, it's your first job offer. Sometimes it may not be exactly what you'd hoped, or you may be worried it's not perfect. But it really doesn't matter, because every job's going to have things that you like and things that you learn that you don't like. And you learn so much from whatever it is you do. I don't think there's an expectation that you're going to stay forever.

Keep searching >> You have to be passionate about what you do, and find something that you really truly believe in, whatever guiding principle it is that's important to you. You can find that in your job, and if you don't, well then, look for another one, which might be in the same company, or it might be somewhere else.

The payoff — interesting, rewarding work >> It was really exciting to me to contribute to [Ball Aerospace] an organization that's got a great reputation, a great culture, great people, and does things that are really cool and, again, that haven't been done before. We've formed a new organization within the company called strategic operations, which covers all of Washington, D.C., operations, communications, and strategic planning and development.

One project we're working on is with the B612 Foundation, for a telescope that would look for asteroids that could potentially impact the Earth. That's a really super, clever mission with an innovative business model. Another one is [the] Kepler [space telescope]. That was a joint mission with Ball and NASA Ames and JPL, [that] discovered over 3,600 new planets. And now we're looking at repurposing that mission and continuing doing really great science.

Closer look: Mounted on an Airbus A350, the Pitot tube (blue arrow) is used by planes to measure airspeed. Inset shows a Pitot tube – the pencil-point shape – with a static port and black angle-of-attack vane.

Airbus

Detecting Pitot tube obstructions

Experts are borrowing a bit of nuclear-reactor technology to try to solve the vexing problem of undetected blockages in the air-pressure sensing tubes on airliners and other planes. Erik Schechter looks at a small technology that could make a big difference for air safety.

It's not the kind of work the experts at the Analysis and Measurement Services Corporation normally take on. About four years ago, the nuclear engineering company ventured into the aerospace arena to develop a prototype device that might someday enhance air safety.

Using Small Business Innovation Research funds managed by NASA, AMS of Knoxville, Tenn., has developed a box of electronics called an Integrated Pitot Health Monitor. It's designed to warn crews if ice or debris is clogging the small tubes on the front of the plane that contribute to accurate airspeed readings. AMS engineers got the idea from equipment they designed to warn nuclear reactor operators about sensor blockages that can produce inaccurate coolant-pressure readings. Faulty pressure readings were blamed for the 1979 Three Mile Island partial reactor meltdown, and Pitot obstructions have been implicated in air crashes — including the 2009 Air France crash off Brazil, which French authorities blamed at least in part on ice crystals in the jet's Pitot tubes.

Last October, the company proved in the wind tunnel that its Pitot monitor can detect when tubes are compromised. The next challenge will be creating a version that can be incorporated into aircraft for flight testing and then marketing the device. This month, Andrew Reehorst, a mechanical engineer and Icing Branch researcher at the NASA Glenn Research Center in Cleveland, Ohio, plans to hold a meeting with government experts from outside the project to expose the technology to a wider audience.

Reehorst, who was the Small Business Innovation Research contract's technical monitor, describes the Integrated Pitot Health Monitor as potentially a "very attractive" backup safety feature for airplanes, but he stops short of bold predictions about whether it will take hold in the aircraft industry. "It's completely in the air as to where it could go, even if everyone is very happy with the technology," he says.

Sensing trouble

Pitot tubes are named for the 18th-century French physicist Henri Pitot, who devised a tube for measuring water velocity, according to Encyclopedia Britannica. On aircraft, Pitot tubes, also known as probes, are L-shaped devices that jut from the front of the fuselage or the wings. The plane uses pressure readings from its Pitot tubes and flush-mounted static ports to display airspeed to the pilot or crew.

Clogged Pitot tubes produce incorrect airspeed readings, something that's especially dangerous when an aircraft is climbing and has a natural tendency to lose airspeed. Pilots compensate by pushing forward on the throttle or adding power to the flight management system. Clogged Pitot tubes can mislead a crew into thinking there's no need to do that. "They can think that their speed is fine when in actuality it's not; it's dropping," says Steve Johnson, a senior engineer at AMS. "And if they get slow enough, they'll stall, and they'll crash."

As a safety precaution, some planes employ three separate Pitot tubes. If one starts acting suspiciously, the crew can always consult the other two and follow the majority "vote." But things can get tricky when multiple Pitot tubes fail, especially when they provide the same wrong reading. "If you start having multiple failures, then you don't know which is correct and which is incorrect," says Reehorst.

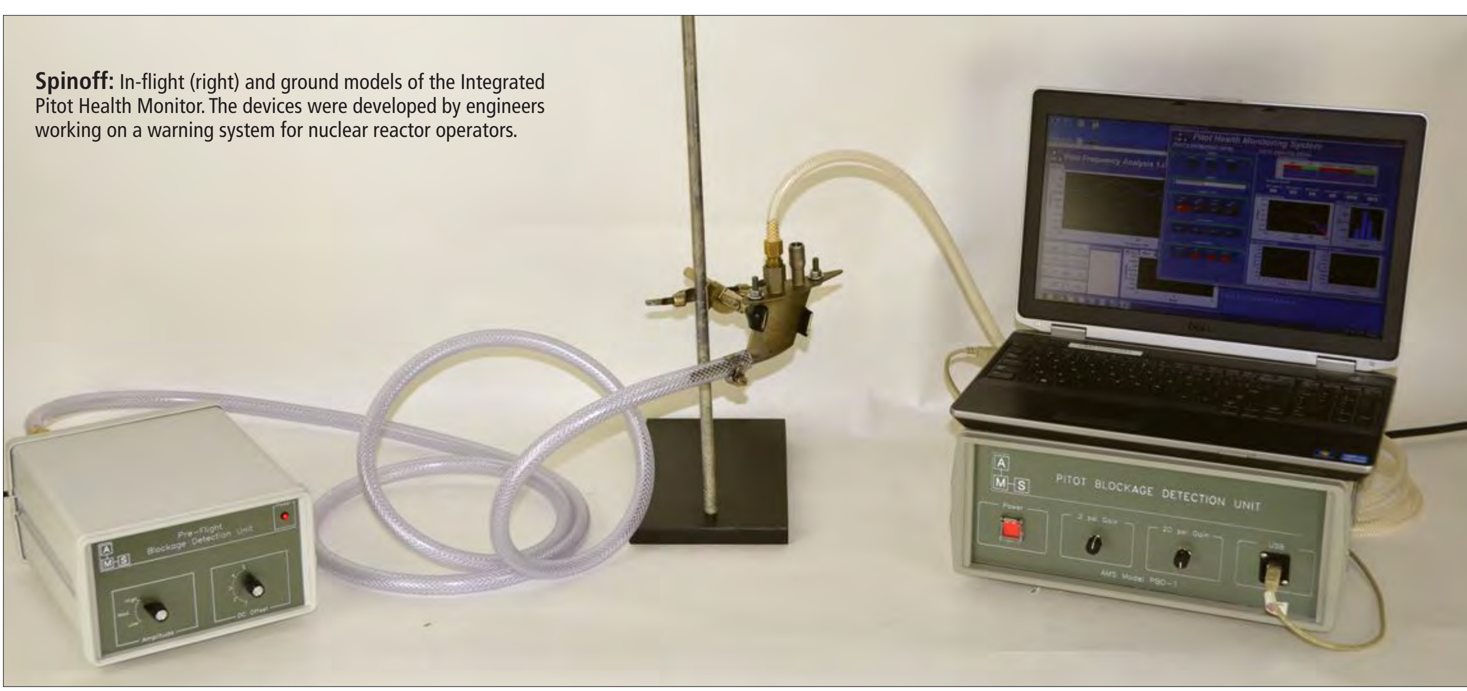
The AMS engineers needed to devise a technique to closley monitor the unpredictable variations or "noise" in the pressure readings from the Pitot tubes. These fluctuations are actually a good thing in the case of Pitot tubes, because they indicate the tube is reacting to the air pressure outside. When the noise stops, it means a Pitot tube is blocked. "Static is never the case when you're flying," Johnson says.

Going nuclear

So, the trick for knowing when a tube is blocked is to know when fluctuations have ceased. The AMS engineers achieved that by borrowing a signal analysis technique from their work with nuclear power plants. Nuclear plant operators rely on water-filled sensing lines to measure the coolant pressure inside the main reactor coolant tubes. Dirt or impurities can accumulate inside these sensing lines, causing their pressures to "lock in" in much the same way that Pitot tubes can ice up, AMS engineers say. The importance of accurate pressure monitoring was underscored by the 1979 partial meltdown at the Three Mile Island nuclear power plant in Pennsylvania. Reactor personnel didn't realize that cooling water was pouring out of an open valve, because they were receiving faulty sensor readings.

The prototype Pitot monitoring box is wired to a pressure transducer, a device that senses air pressure and converts the pressure into an electrical signal. Circuits inside the monitor filter the signal, which is then run through a data acquisition and software monitoring unit, also within the box. The monitor has a USB — universal serial bus — port, so a user can plug in a computer, set the sampling frequencies and monitor certain regions of the data.

In an operational setting, "all of this would probably be put on an FPGA — a field programmable gate array — and then it would be integrated into the airplane's air data computer. So, theoretically, it would have a display inside the cockpit," says Chris Ritchey, a mechanical engineer at AMS.



Spinoff: In-flight (right) and ground models of the Integrated Pitot Health Monitor. The devices were developed by engineers working on a warning system for nuclear reactor operators.

AMS Corporation

> ***"They can think that their speed is fine when in actuality it's not; it's dropping.... And if they get slow enough, they'll stall, and they'll crash."***
>
> **Steve Johnson, AMS senior engineer**

Once they developed their prototype monitor, AMS officials purchased a variety of Pitot tubes from SpaceAge Control, Aero-Instruments and Dwyer Instruments and then took those tubes to a subsonic dry wind tunnel at the University of Tennessee in 2012. The idea, Ritchey says, was "to play with the angle of attack and see what effect it would have on the signal produced by the pressure transducer" — in this case, one from Honeywell.

After that, the company team whittled down its selection to one test article: an Aero-Instruments 0851HL-AI Pitot tube, which is typically found on Airbus A300s and A400s, Ritchey says. Last October, the AMS engineers took the tube to the LeClerc Icing Research Laboratory in Plainview, N.Y. There, they put the Pitot tube in a wind tunnel and subjected it to various cold weather conditions.

"We were able to detect ice blockages in the tube under all conditions," Ritchey says.

Reehorst is keen to see the device "go someplace," which is why he organized the meeting set to take place this month in Cleveland.

By exposing the technology to experts from the FAA and his own Icing Branch, Reehorst hopes more design work and testing will be done on the technology. "NASA could potentially invest more money in it. FAA could invest more money in it, or we could just…get [AMS] tied in with companies tighter, and it could go completely private," Reehorst says.

Johnson says his best shot is with an aerospace instrument company, either a Pitot sensor manufacturer or a control system designer. An ideal outcome of the Cleveland presentation would be gaining entrée to private industry. This, he says, might lead to more demonstrations, further prototype development and even some low-rate manufacturing for potential clients to test the Integrated Pitot Health Monitor on their own.

"We think they'll be interested in the technology, primarily because it is relatively simple and straightforward," he says.

Erik Schechter
erik.schechter@gmail.com

Dronecast

For American manufacturers, time to look abroad

U.S. unmanned aircraft manufacturers enjoyed a booming domestic market when orders rose during the Iraq and Afghanistan wars. But with military budgets now under pressure, companies are scrambling to develop international markets for their planes. Philip Finnegan analyzes sales and trends.

Competition for international sales of unmanned aircraft promises to heat up as U.S. manufacturers undertake new export campaigns to make up for slowing Defense Department orders.

Focusing on exports makes sense — international demand is expected to be a major engine for growth in this market over the next decade. Teal Group, in its annual market forecast from 2013 to 2022, projects that demand for these planes in the Asia-Pacific region will increase more than sixfold, to $1.9 billion a year, by 2022. European demand grows fourfold to $2 billion annually in the forecast. The Middle East more than doubles to $549 million a year over the same period.

By comparison, U.S. procurement rises only about 60 percent by 2022, to $3.3 billion a year. The U.S. accounted for two-thirds of worldwide procurement in 2013, but in the forecast it sinks to slightly above 40 percent by 2022.

U.S. inroads

U.S. manufacturers have scored several victories recently in their efforts to bolster exports. Last year, the U.S. Defense Security Cooperation Agency, which provides financial, technical and materiél assistance to allies, notified Congress of the possible sale of 16 MQ-9 Reapers to France. The first two planes have already been delivered, and the sale of 14 more is expected to follow. The total estimated cost of the 16 aircraft, with associated equipment, training and logistical support, would be $1.5 billion.

Another Reaper MQ-9 customer is the Netherlands, whose Ministry of Defense notified parliament in November of its plan to purchase four of the planes.

In winning the French order, General Atomics Aeronautical Systems of San Diego displaced IAI — Israel Aerospace Industries — whose Heron TP served as the basis for France's Harfang. IAI also offered the Heron TP for the Dutch requirement. With the U.K. and Italy also possessing the Reaper, there is a growing standardization of European militaries on this U.S. system. Even Turkey — after a lack of action on its request for an armed Reaper — has been considering coming back to ask for an unarmed version.

General Atomics also scored an important victory in the United Arab Emirates. There the company won an order for its Predator XP, an aircraft modified to ease export control restrictions. It was a key sale for a plane that the company also hopes to export elsewhere in the Middle East and in South Asia. In particular, the order may open the way for a sale to Saudi Arabia, possibly for as many as 50 of the planes.

Northrop Grumman's aspirations to export Global Hawk appear to be gaining traction. South Korea plans to spend $850 million to acquire four RQ-4 Global Hawks under a contract expected to be signed this year. The aircraft were originally requested in 2009, and the U.S. Congress was notified of the potential sale in 2012. The Global Hawks reportedly would be part of South Korea's plan to be ready to launch a preemptive strike to destroy North Korean missiles before they can be launched.

Japan recently included an acquisition of three Global Hawks in its five-year plan. The country has not yet made a formal request to the U.S. government for the planes, but the plan is a sign of the aircraft's growing momentum in Asia.

Cassidian

The French Harfang, developed in cooperation with Israel Aerospace Industries. The Harfangs are being supplanted by MQ-9 Reapers built by General Atomics Aeronautical Systems.

Small and smaller

AAI Unmanned Aircraft Systems, a Maryland-based Textron company, also shows promise for increasing its international sales, having sold its RQ-7 Shadow to Australia, Italy and Sweden over the past few years. It is now focusing on selling its new Shadow M2 tactical aircraft to international customers. The company has done a demonstration for Saudi Arabia and hopes the country will be a major market for the plane.

Even at the smaller end of the spectrum, there has been progress on international sales. AeroVironment, a Monrovia, Calif., manufacturer of mini-aircraft such as the RQ-11 Raven and the RQ-20 Puma, reported $36 million in exports in 2013, up from $16 million the previous year. Boeing's Insitu, the Bingen, Wash., company that builds the ScanEagle, has sold the plane and its control systems to 10 European, Latin American and Asia-Pacific countries.

Israeli muscle

U.S. progress in international markets is noteworthy considering Israeli manufacturers' dominance in this arena in recent years. With Israel representing a relatively small domestic market, the focus of Israeli companies is heavily international. IAI, the country's largest unmanned aircraft manufacturer, has been exporting three-quarters of its production in recent years, while Elbit Systems, the second largest, exports two-thirds of its production.

Israeli manufacturers have worked to attain a strong position around the world, with impressive results. European nations relied heavily on Israeli technology during their troop deployments in Afghanistan. Germany has leased three IAI Herons since 2010. France based its Harfang on the Heron TP. The U.K., pending delivery of its Watchkeeper, leased Hermes 450s in Afghanistan. Watchkeeper, a joint venture between Thales and Elbit Systems, is the largest tactical unmanned aircraft program in Europe. The Netherlands and Poland contracted for the Aerostar, a tactical plane from Aeronautics, another Israeli company.

Northrop Grumman

The RQ-4 Global Hawk. South Korea plans to buy four of the planes to build a preemptive strike capability against North Korean missiles.

Other key U.S. allies, including Canada and Australia, signed fee-for-service contracts to use the Heron in Afghanistan.

U.S. Army

Israel Aerospace Industries' Heron TP. Choosing whether to standardize on the Reaper or purchase the Heron will be a key decision for Germany.

Despite Heron's strength in Europe, the Reaper is gaining traction there to become the system of choice. Germany's decision on whether to follow its allies in France, the U.K. and Italy to standardize on the Reaper or purchase the Heron will be a key decision in the next year or two.

Emerging markets

In emerging markets, Israeli companies are still the dominant players. They have shown a willingness to develop customized aircraft for even small clients. They have also been able to aggressively take business with fee-for-service contracts that U.S. industry has been unable to rival for larger medium-altitude, long-endurance planes. In addition, Israeli companies have been willing to develop a strong domestic presence and have allowed considerable technology transfer.

India, which has the world's largest fleet of Israeli unmanned aircraft, approved a $200-million acquisition of Heron 1 planes in December for border patrol. The country has also been upgrading its IAI Searcher 2 and Heron 1s with satellite communications to increase their operable range.

In Brazil, another coveted emerging market, Israeli companies also dominate, competing with each other for primacy. The Brazilian Air Force operates the Hermes 450, and the country's Federal Police use Herons.

U.S. Air Force

India in December approved a $200-million purchase of Heron 1s made by Israel Aerospace Industries.

To establish the domestic presence so vital in Brazil, both IAI and Elbit Systems have joint ventures with Brazilian companies to make planes for the domestic market. Elbit Systems created the Harpia Sistemas SA joint venture with Embraer, Brazil's aerospace national champion, in 2011. Elbit and Embraer later brought in Avibras as a partner with a 9 percent stake in the joint venture. Embraer has a minority stake of 40 percent, with the remaining 40 percent held by Elbit. In a competitive move, IAI formed a joint venture with the Brazilian Synergy group in 2011.

New players

U.S. progress in international markets may prove fleeting. New competitors, many of them less concerned about maintaining a restrictive arms control agreement, are emerging and could undercut U.S. companies.

Turkey's Ministry of Defense ordered 10 Turkish Aerospace Industries Anka medium-altitude, long-endurance planes last year, with deliveries planned between 2016 and 2018. The Turkish government held discussions about a possible export of 10 Ankas to Egypt before relations between the two countries soured following the Egyptian military coup that overthrew the country's Muslim Brotherhood government.

South Africa's Denel, which has sold its planes to the United Arab Emirates and Brazil, has held discussions with Saudi Arabia about selling it a Seeker 400 armed with the Makopa missile. It's not clear whether an actual sale has been made, but for some time the Saudis have sought to buy an armed unmanned plane from the U.S., which has shown no interest in the offer.

United Arab Emirates' Adcom Systems has made sales of medium-altitude long-range planes to three unnamed customers, including two to a Russian customer for evaluation. The country imported knowledgeable people to develop these planes, something that could be done by other countries as well. This example shows how difficult it will be to control the technology in coming years.

Over the longer term, China represents a much larger potential market threat to existing companies, spending lavishly on development. It first develops a prototype, then identifies problems and creates a new version. The result is very rapid technological progress. Chinese industry is working on tactical systems in particular, but also on much larger systems in the medium- and high-altitude, long-endurance categories as well as much smaller systems.

A Defense Science Board report prepared in 2012 expressed concern about China's rapidly developing prowess. "China might easily match or outpace U.S. spending on unmanned systems, rapidly close the technology gaps and become a formidable global competitor," the report said.

Another hurdle

The U.S. lead in this arena will not last long. Rapid technology development in China and elsewhere will put pressure on the U.S. to revise its export control policies or lose out to countries with looser standards.

The Missile Technology Control Regime is a serious obstacle to continued U.S. leadership in arms exports. It is a voluntary agreement established in 1987 to limit proliferation of delivery systems for weapons of mass destruction, including missiles and unmanned planes. The agreement created categories intended to restrict the export of such items. Category 1 is for craft that would deliver a 500-kilogram payload at least 300 kilometers. For this category, which includes Global Hawk and Reaper, there is to be a presumption of denial of exports. The agreement is unaffected by revisions of the International Traffic in Arms Regulations.

Neither China nor Israel is a signatory to the agreement, although they have said they will abide by its requirements. But China's export standards in particular are not seen as acceptably strict by countries that are signatories. And even those countries have different interpretations of what systems are acceptable to export.

Moreover, other countries are willing to offer unmanned planes that are armed. The U.S. has provided such aircraft only to the U.K. — even a request by Italy for kits to arm its Predators has been mired in the U.S. Congress for several years.

A revision of this Missile Technology Control Regime is a prospect the U.S. ultimately will have to face if its unmanned aircraft industry is to remain healthy. The U.S. government has not been willing to consider any sweeping changes in the agreement, fearing these could make it easier for Iran to obtain missile technology. Still, the Obama administration has expressed some willingness to change its interpretation of the strictures to make it easier for U.S. companies to export to close allies.

Philip Finnegan
pfinnegan@tealgroup.com

Continuing Education Courses and Workshops

AVIATION 2014

14–15 June 2014 — Atlanta, Georgia

Business Management for Engineers
Instructors: Alan Tribble and Alan Breitbart

Summary: This course will help individuals with a strong technical background in science or engineering prepare for the transition from a role as a technical contributor to a business leader.

Optimal Design in Multidisciplinary Systems
Instructors: Joaquim R. R. A. Martins and Jaroslaw Sobieski

Summary: You will learn how to evaluate sensitivity of the design to variables, initial requirements, and constraints, and how to select the best approach among the many that are currently available.

3rd AIAA Workshop on Benchmark Problems for Airframe Noise Computations (BANC-III)

Summary: The major emphasis of this workshop will be coordinated computational, modeling, and measurement efforts based on collaborative definition of a hierarchical set of benchmark configurations representing major sources of airframe noise; joint development of datasets that would eventually achieve benchmark quality.

PROPULSION ENERGY 2014

31 July–1 August 2014 — Cleveland, Ohio

Hybrid Rocket Propulsion
Instructor: Joe Majdalani

Summary: The purpose of this course is to present and discuss fundamental theory alongside research findings with emphasis on unsolved problems, open questions, and benchmark tests.

Missile Propulsion Design, Technologies, and System Engineering
Instructor: Eugene Fleeman

Summary: Attendees will gain an understanding of missile propulsion design, missile propulsion technologies, launch platform integration, missile propulsion system measures of merit, and missile propulsion system development process.

The Application of Green Propulsion for Future Space
Instructors: Alan Frankel, Ivett Leyva, and Patrick Alliot

Summary: Topics include a brief history of hypergols; what is considered green and what is driving the green propulsion movement; figures of merit and lessons learned in the development of green propellants; flight experience and applications for the various classes of satellites; and challenges for current and future green thrusters and systems.

2nd AIAA Propulsion Aerodynamics Workshop

Summary: The focus of the workshop will be on assessing the accuracy of CFD in obtaining multi-stream air breathing jet performance and flow structure to include nozzle force, vector and moment; nozzle thrust (Cv) and discharge (Cd) coefficients; and surface pressure prediction accuracy.

SPACE 2014

3–4 August 2014 — San Diego, California

Decision Analysis
Instructor: John Hsu

Summary: Different decision analysis methods will be introduced starting from the traditional trade study methods; then continue to trade space for Cost as Independent Variable (CAIV), Analytic Hierarchy Process (AHV) which is part of the Analytic Network Process (ANP), Weighted Sum Model (WSM), Potentially All Pairwise Rankings of All Possible Alternatives (PAPRIKA), and Decision Analysis with Uncertain information/data.

Register TODAY!

For more information, visit: www.aiaa.org/confcourses

AIAA — *Shaping the Future of Aerospace*

The Crusader

***Seymour Levine** wants the Malaysia Airlines crash to be the turning point in his long effort to stream voice and data from the cockpit, and do something even bolder — give pilots on the ground the ability to take over an airliner in an emergency. Levine, 79, patented such a technology, called Safelander, in 2006, and he also holds a patent for a data-streaming concept called RAFT for Remote Aircraft Flight Recorder and Advisory Telemetry system. Levine got into the air safety business after a colleague, Northrop Grumman software expert Dave Garber, died in a 1994 USAir crash near Aliquippa, Pa. Levine had sent Garber on the trip. He took a retirement buyout, confident he could make commercial flight even safer. Years earlier, while working at Sperry, he led work on an inertial navigation system for submarines, and he is listed on the patent for a version for airliners. Convincing regulators and industry leaders to adopt his latest proposals has turned out to be more difficult than Levine expected. He spoke by phone with Ben Iannotta.*

photo by Jonathan Alcorn

Interview by Ben Iannotta

Do you think the Malaysian case will change the game and bring streaming onto airliners?

No. I don't think it will. It has to be the publicity from, say, a magazine. This madness has to stop. The idea that the data from the flight recorder is private doesn't make any sense at all. That data is needed to prevent crashes. If you want to privatize the voice recorder, I don't care that much about it.

You've said pilots resist change. Why do you think they resist new technologies?

This is a complicated thing. I'm not sure it's good to say it, but there's a big difference between designers and pilots. It's like people who design cars, and race car drivers. They're different people. And the drivers usually get flowers put around them, and public appearances, all that stuff. But the technology is what makes change.

Maybe that's good, because I don't want pilots to be like, "Yeah, put the next new thing in there. I want to see if it works."

Well, it's a complex thing of getting things certified and everything else. I really believe that for most of the flights, say between Washington and New York, you only need one pilot. You have a bus driver. He could crash the thing. I believe the second pilot should be a remote pilot — Safelander — so if there's smoke in the cockpit or decompression, he could take control. On a long flight, six to eight hours, then there should be two pilots, but I still think there should be a remote pilot just in case something crazy happens.

So with Safelander, it's sending commands to the autopilot that's already on the plane, and nobody's flying the plane from the ground with a joystick?

You could have the joystick too — controls without the autopilot. Once you have the data on the ground, then

(Continued on page 26)

The case against streaming

Many in the airline industry are less than enamored with Seymour Levine's proposal to stream audio from the cockpit and perhaps even empower people on the ground to take control of a wayward airliner.

Airline pilot Capt. Sean P. Cassidy, the safety coordinator at the Airline Pilots Association, says Levine and others advocating for live data streaming are oversimplifying the issue and overlooking the logistical concerns that come with managing large volumes of data. He'd rather tap into existing technology, like ACARS — the Aircraft Communications Addressing and Reporting System that today sends short status messages about engine performance — and see time and funds invested in global satellite tracking of airliners, steps he says would have made a difference in investigating the disappearance of Malaysia Airlines flight 370.

Cassidy sees two major issues with the proposal to stream in-flight data live: the technical feasibility of managing such colossal amounts of data from thousands of jets internationally, and the challenge of making sure the data is handled securely. Simply pulling in-flight data, audio and video off every jetliner in the sky and beaming it to a "ground station somewhere" doesn't necessarily contribute to flight safety. You would have to apply resources and human power to securely digest all this data and discern if anything in it is cause for alarm. "If everybody has the opportunity to tap into these streams of information, that could be a really unwelcome item. Can you envision the situation, say some unfortunate airplane accident happens, and some tabloid outlet gets a hold of conversation between the pilots? And ends up putting it on the news show that evening?" he asks.

Cassidy thinks more advantage could be taken of ACARS, which today sends out periodic messages about aircraft performance and in-flight conditions like turbulence readings.

The airlines could better utilize ACARS, so that "if something was to happen to an airplane," this system "would start churning more and more messages to be sent out upon whatever was happening inside the airplane close to real time basis, rather than doing it let's say once an hour or at specified intervals," he states.

Cassidy takes issue with Levine's proposed Safelander concept, saying that turning a commercial jetliner into a remotely piloted aircraft — RPA — is not as simple as "hooking up a box" to an aircraft. "That's underestimating some of the technical challenges to the extreme. The airplane has to be certified by the FAA and by the manufacturer to perform as an RPA, not just to have the airline have some kind of a box plugged in," he says.

The logistics of the proposed live data streaming and remote aircraft operations would require a significant financial investment by the airlines. The pilots think airlines should instead focus their financial resources on things like worldwide satellite-based aircraft surveillance, or black box locators with longer life spans.

"We have an extremely safe transportation system; unfortunately what happened in the wake of this latest accident [is] all these people out there who are marketing technologies, who are trying to suggest that they know what the solution is to prevent what happened there without even knowing the underlying facts of what led to this airplane disappearing. We have to figure out what happened with this plane first; and based on those lessons learned then make informed decisions on what we should do next," says Cassidy.

— Natalia Mironova

(Continued from page 25)

you'll see all the instruments. That's what the flight recorder's doing, getting all instruments [readings], among other things — things that the pilot can't even see. You can even have a more elaborate cockpit if you like on the ground, and you could have it so he can manually fly it, or send the signal to the autopilot. Either way. There may be a case either way.

There was the case where the Iranians allegedly hacked the super secret drone link. How do you prevent something like that?

That's always been the case. You know, we have nuclear bomb things going on all the time, and if you have a really good secure network — the Air Force makes a ton of them, and so does the Navy; that's what's driving these subs — you don't hack them. That's not really viable. The idea of taking over something like that is bad, but if the data is ciphered, they can't do it. And we have the ability to cipher. They don't take over many drones. Now maybe that one drone came down. I don't know enough about it. But [we've] got lots of drones.

What does ciphered mean?

Ciphered means that, in addition to being able to send a radio signal, you have to have special codes, a code of the day. That's how we arm nuclear weapons.

Not many people have this many patents of this much significance. Why do you focus on patents?

I have 15, but I'm going to be 80 soon. I didn't have any before the Pan Am [inertial navigation system] one, and since it was going to be commercial, the people from Sperry said we ought to patent it. Now the last two — Safelander in China and the United States, and RAFT — I own. And the reason for that was real simple. I felt that if the airlines owned it, they could suppress it. By my owning it, I could get it out.

Why are you patenting things in China, and doesn't that raise a lot of eyebrows here at home?

China has its own politics, and I don't know how to reach them too well, but China has the capability of doing it. They have the satellite capability. They're getting their own nav satellites. They're growing in the aviation industry. In the United States, there's so much politics to say the digital flight data recorder information is private. And they won.

When you're patenting things in China, is the message, "Hey United States, if you won't do it, I'm going to go work with China?"

I hope they will. That's exactly it. How do I get this thing through?

How did you react professionally to the death of your colleague Dave Garber in the Aliquippa crash?

I'll tell you, I was [a contractor] aboard the Ethan Allen [submarine], but I never had anybody really die. I'm lucky I wasn't on the Thresher, because I had requested to go there when I went on the Ethan Allen. I decided I want to look into [air safety] a little bit. Northrop decided to close the electronics division. The B-2 was still going to be worked in Palmdale, but it's not development any more; it's more like maintenance and manufacturing. That's not my shtick. Then they said, "a buy-out." I decided to take it, because what that would do is give time to look into Dave Garber's death a little more, and look into commercial aviation. So when I left Northrop, that's when I started doing this remote pilot thing.

Have any of your patents paid off financially for you?

No, not really much. In this sense, I had big jobs and I got big salaries. What happens is when you work for a big company you sign over the rights.

On the flight and voice data, after there's an accident, it's not private. You go down and get it and listen to it.

You shouldn't wait for an accident. It should be available to you before the accident, even to prevent an accident. The key is to prevent crashes. An example: Once you contacted the planes on 9/11, and you weren't getting good responses, the trajectories, the tracks show them going into harm's way, at that time, you should just take them over, period. That's it.

Is it too far a reach to international regulatory clearance?

Crashes occur occasionally. That leads people to say, "hey, why bother?" In another month or so, the amount of things going on for MH-370 are going to be down to zero in the newspapers. That's what happened with Air France. There's a real problem. Nobody wants to pay for anything. The reason we got GPS in commercial airliners is because the Air Force put the satellites up and they control the satellites. The airlines have nothing to do with it. ARINC [Aeronautical Radio, Inc., owned by Rockwell Collins] has nothing to do with it. There's no reason why you don't have a high bandwidth system just like the military. In my opinion, the communication system should be put in by the Air Force. They have the proven capability. INS came out of the military, GPS came out of the military. This requires [investment by] a country, and I wish it was the United States. Part of the reason [the military is] better able to do it is they got a mission to accomplish, and money's not the issue. And politics are not the issue: You never hear a military pilot saying data is private.

How much of the data should get recorded?

Once the data goes to the ground, they have massive storage for very little money. Air traffic control data, that's somehow escaped private things, and that's recorded for days. Once a month, now it may be every two months, they erase the tapes. But [after] a crash they can retrieve all the voice to the air traffic control system. It's real cheap. It's not much data. I estimated the amount of data for days is less than a PC, for all the planes.

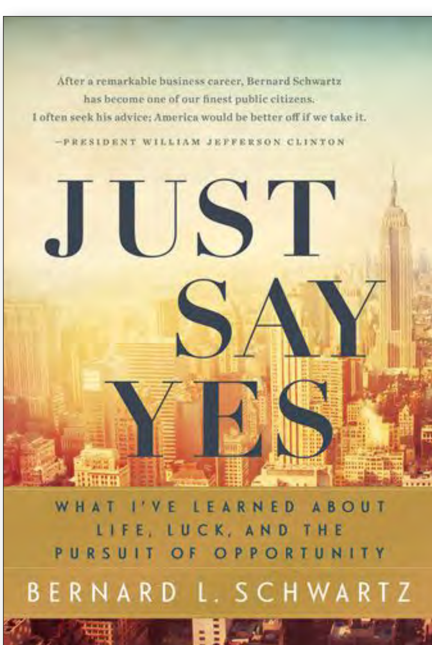
Lessons from an American success story

"Just Say Yes: What I've Learned About Life, Luck, and the Pursuit of Opportunity," by Bernard L. Schwartz

Reviewed by Ben Iannotta

Young aerospace readers could find inspiration in Bernard Schwartz's memoir. Professionals later in their careers might be a bit deflated by the tales of dinners with Saudi princes, visits to sprawling country estates and weekends watching football with Bill Clinton. For those willing to wade through the hobnobbing, this is a memoir providing genuine insight about Schwartz's business philosophy, strategy and relationships with other executives, including former Lockheed Martin chief Norm Augustine (good friends), and Augustine's successor, Dan Tellep (not so much).

Schwartz, 88, put together a career and life that will be difficult for anyone in this or any era to match. He is part of the generation of American men who returned from World War II ready to take on the world through business.



Schwartz races through his years growing up in a middle-class family in Brooklyn. He touches on his pedigree as an outspoken Democrat and his service as a pilot-in-training during World War II. He then plunges into a rich narrative of his rise from an accountant to the purchaser of a Bronx-based defense company called Loral, which was losing money during the Vietnam War, a time "when defense contractors could be expected to prosper."

Schwartz tells us how he managed to take Loral from the brink of bankruptcy in 1972 to one of America's most successful defense and space companies. He sheds light on the one blemish in his career — the financial straits of the Globalstar satellite communications enterprise and the ensuing bankruptcy reorganization of Loral Space & Communications, the company he headed after selling most of Loral to Lockheed Martin in 1996.

This is a story of wealth, yes, but it's also fascinating to hear about the vaunted "Loral culture" from the man who created it. Million-dollar deals were made with handshakes. Momentous internal decisions were reached after hallway encounters or short meetings in Schwartz's office. When Schwartz made a decision, it was final, hence the book title, "Just Say Yes."

Though short on technology details, this memoir could have some readers racing to drop Gandhi from their email signatures in favor of quotes like: "Forward is always a better direction" or "Be biased toward action" or "Any fool can have a vision. The question is, 'Is your vision any good?'"

For the engineering readers, the memoir is a valuable window into how Schwartz interacted with the experts on his staff. But these readers won't find detailed accounts of deliberations over design or technology choices. This is a book largely about money and mergers, and as the sub-title suggests: life and luck.

Schwartz tells us about an era when relationships and instinct counted more than balance sheets or lawyering. We learn about his sometimes stubborn efforts to hang onto those post-World War II ideals. He tells us about the steps he took to keep jobs in the Bronx — "this wasn't silicon valley — it was Fort Apache" — and about putting up millions of dollars to help displaced employees.

He portrays himself as a big-hearted guy, but Schwartz makes no bones that his primary professional motivation was to make money. He didn't arrive at Loral with grandiose plans to serve "the warfighter." He was lured by the excitement of owning an endeavor and seeing how far he could take it. He took it very far.

One has to wonder if this memoir will prompt today's generation of business leaders to borrow a bit of the Loral culture and pay it forward.

The Bernard L. Schwartz Center

Schwartz places a call from the bottom of the Grand Canyon using a Globastar satellite phone.

"The variety of information presented, from the higher-level plenaries down through the technical sessions; there was something for everyone."

– AVIATION 2013 attendee

WHAT MAKES AVIATION 2014 DIFFERENT?

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

WHY ATTEND

- Expand your knowledge, as expert engineers and scientists share their latest research and development findings.
- Find out what lies ahead, as senior leaders in industry and government discuss their programs and business challenges during plenary and interactive panel sessions.
- Network, discuss challenges, and share ideas during technical sessions, luncheons, networking breaks, and social activities.

RESERVE YOUR SPONSORSHIP AND EXPOSITION SPACE TODAY!

Contact Merrie Scott at merries@aiaa.org or Chris Grady at chrisg@aiaa.org

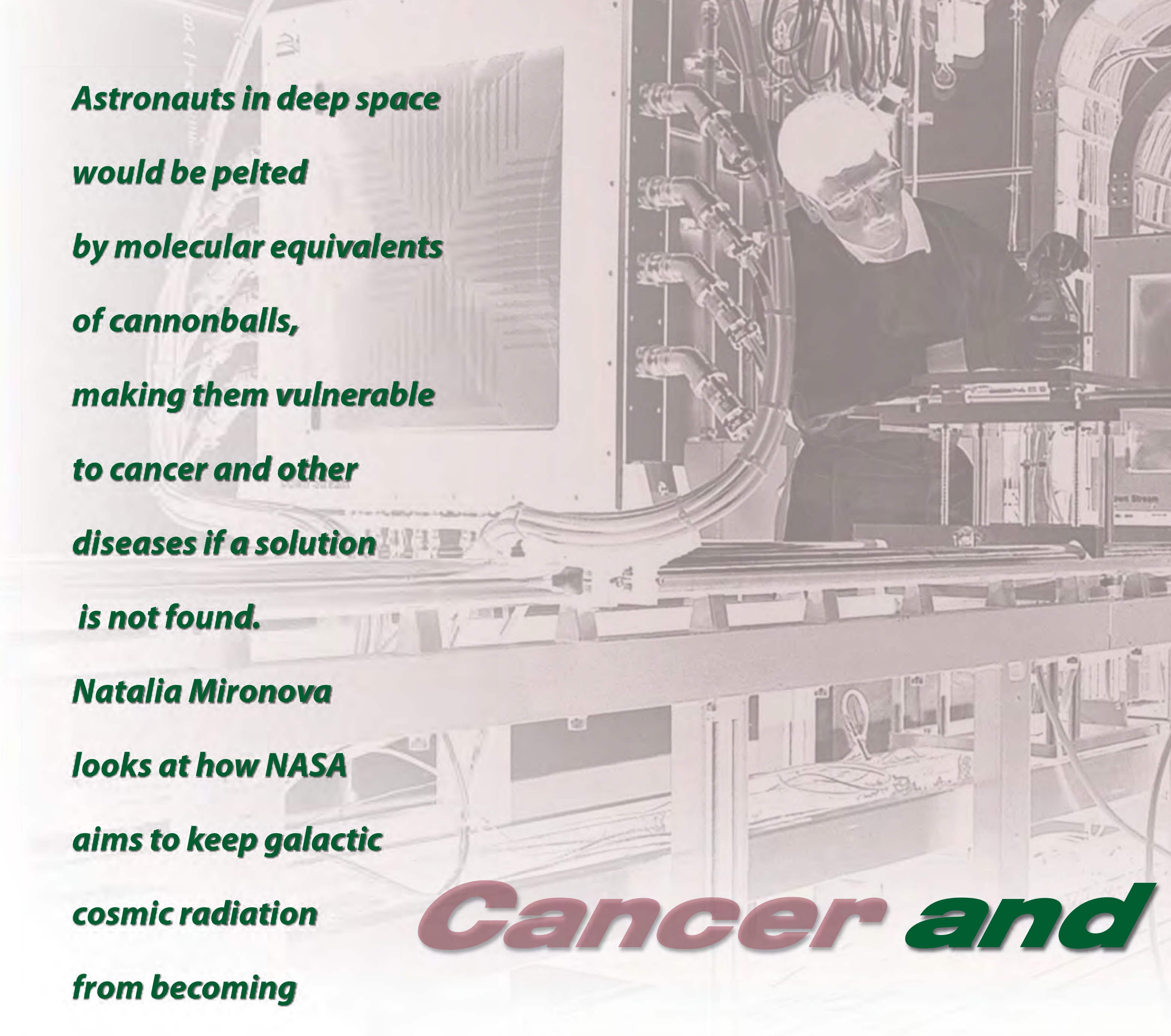
KEY TOPICS

- The implementation of new air traffic management capabilities.
- A rethinking of traditional commercial aviation operational models.
- The integration and utilization of unmanned platforms to enhance our existing fleets.
- An evolving financial landscape for both commercial and military aviation system acquisition.
- Increasingly connected and networked aviation platforms.
- The implications of policy decisions on how we define, design, and field new operational systems.

THE LOCATION

Georgia is home to more than 500 aerospace companies operating in a business climate where half a billion dollars is spent annually on engineering research and development. The official forum hotel, Hyatt Regency Atlanta, is just 11 miles from the Hartsfield-Jackson International Airport (ATL). A block of rooms is available for AIAA AVIATION 2014 registrants. Room rates are $139 for single or double occupancy plus applicable taxes. These rooms will be held for AIAA until 23 May 2014.

Book Your Room | **Government Employees Rooms**



Cancer and

Astronauts in deep space would be pelted by molecular equivalents of cannonballs, making them vulnerable to cancer and other diseases if a solution is not found. Natalia Mironova looks at how NASA aims to keep galactic cosmic radiation from becoming a showstopper.

by Natalia Mironova

A boxy, unassuming piece of equipment sits in a climate- and humidity-controlled room in a basement at Georgetown University Medical Center in Washington, D.C. It's a million-dollar device that researchers are using to analyze tissue samples taken from mice irradiated at a NASA lab on Long Island. Washington is a long way from the astronaut training facilities at the Johnson Space Center in Houston, but the work performed here at Georgetown's Lombardi Cancer Center may help shape the future of human spaceflight. Dr. Albert Fornace Jr. and his team have been working to determine how galactic cosmic radiation affects mice tissue. He hopes the findings will help gauge the risks of certain cancers and point NASA toward strategies for coping with those risks.

Whether in mice or men, radiation can short circuit cellular metabolism, damage the DNA code that governs how long cells live and how fast they reproduce, which can lead to cancer. So far, there is no evidence that astronauts run a higher risk of developing cancer than the general population. But exposure to galactic cosmic radiation has been limited by the relatively short duration of missions and the fact that astronauts in low Earth orbit are protected by Earth's magnetosphere, which deflects

The NASA Space Radiation Lab

spaceflight

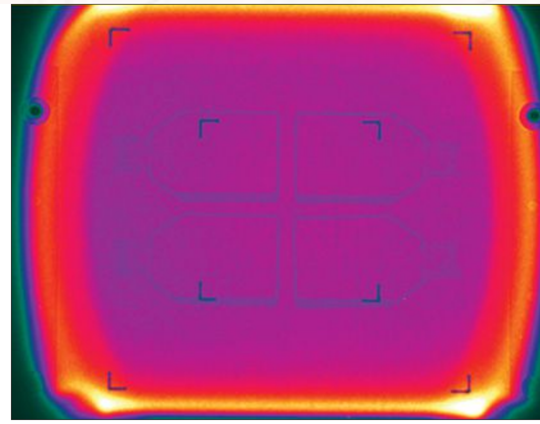
most of the cosmic radiation. With Mars being touted as the new frontier, NASA is worried about the length of the trip through a radiation environment much harsher than Earth's. Early findings from the research at Georgetown suggest those worries are valid. There are proposed medical solutions, but experts say a lot more work should be done before a crew bound for Mars heads to the launch pad.

NEW RADIATION ENVIRONMENT

A long-term, deep space mission would expose astronauts to galactic cosmic radiation on levels never experienced by humans. In deep space, astronauts would have to worry about two types of radiation — solar particle events, or SPEs, which are primarily streams of high-energy protons belched by the sun, and galactic cosmic radiation, or GCR, which consists mainly of higher energy ions plus some protons and gamma rays, which are the small-wavelength, high-energy rays emanating from the hottest region of the universe.

SPE radiation levels vary based on solar activity — they are lower during "solar minimums" and peak

> *"If we think of gamma rays and X-rays… as maybe a BB, then these heavy ions when they hit the cell are like a cannonball."*
>
> **— Dr. Albert Fornace Jr., Georgetown University**



Brookhaven National Laboratory

Mimicking deep space: Live mice were exposed to heavy ion radiation by placing them in the beam line at Brookhaven National Laboratory, home to the NASA Space Radiation Lab. This researcher is working with unspecified cells, not mice.

Perfect beam: The purple, right, indicates evenly distributed radiation across specimen flasks.

during "solar maximums." A mission could be scheduled during the solar minimum period to lessen the exposure to SPE. But the galactic cosmic radiation is a constant presence in deep space. Dr. Fornace likens the effect of the heavy ions to heavy artillery: "If we think of gamma rays and X-rays which we have here on Earth — and we have good risk estimates — as maybe a BB, then these heavy ions when they hit the cell are like a cannonball. And they are going very fast," he says.

Fornace and his team set out to find out just what kind of damage such a "cannonball" can do to live tissue. For the past four years, they have been using NASA funds to study the effects of space-based radiation on colorectal tumor development. Fornace chose to focus on this particular type of cancer for two reasons: Having been affiliated with NASA since the 1990s, he was aware of the agency's efforts to fund studies on leukemia, breast and lung cancer, and he felt not having any studies of intestinal tumors was a gap in the program. Secondly, he says, "We know that colorectal cancer is increased by radiation. And if radiation caused a modest increase, that could be very bad since it's already the third most common kind of tumor. Whereas if you increase a risk for a rare tumor, two times rare is still rare; two times this would be a big problem."

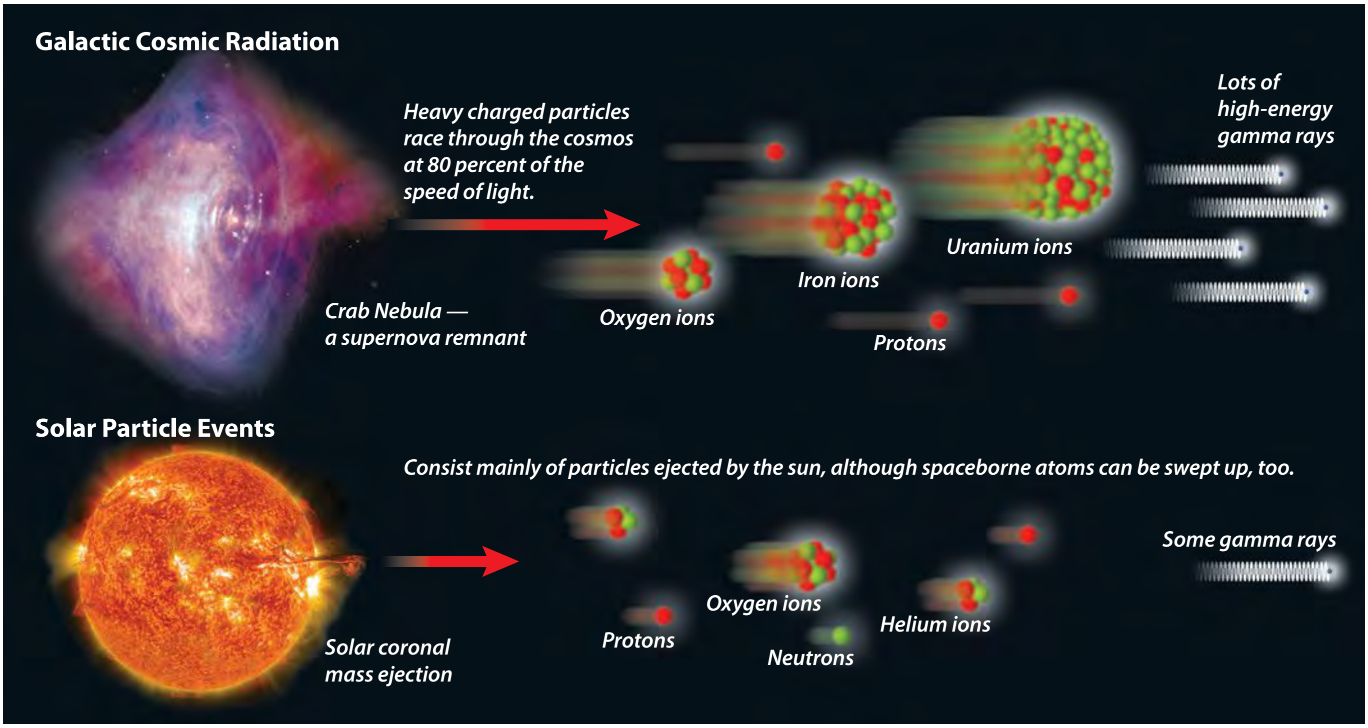
In 2013 Fornace and his colleagues, Dr. Kamal Datta and Dr. Shubhankar Suman, published a paper detailing how cosmic radiation increases colorectal cancer in mice. The team used specialized mutant mice predisposed to colorectal tumors; the mice were irradiated with both gamma radiation and heavy ion radiation. Sending research mice to deep space is an expensive and complex proposition; so the Georgetown team found a way to expose them to heavy ion radiation here on Earth, at NASA's Space Radiation Lab on the grounds of Brookhaven National Laboratory. A large apparatus called the cyclotron can strip any atom down to the nucleus, and then with magnets spin it around, getting it close to the speed of light; magnets then direct the particles down the pipe that leads to the research laboratory where lab mice are treated.

"These mice are well studied. This mouse model has been used to study colorectal cancer before. Once we expose these mice to different types of radiation, we do a quantitative as well as qualitative analysis — count the tumors and grade the tumors," says Datta.

What the researchers found was concerning. The tumors found in mice treated with heavy ion radiation were not only more numerous, the tumors were also higher grade, meaning they were malignant rather than benign. "All our studies show there is more risk for colorectal cancer," says Datta. There are, of course, still the unknown factors that the Georgetown researchers mention when talking about their results: There is the question of dosage — the radiation dose administered to the mice in hours or days would be spread out over several months for the astronauts. The study can't measure any effects of microgravity or the psychological stress of being on a long space mission. On top of that, there is the species difference. Mice are, after all, not people, but Fornace says they proved to be a good model in previous colorectal cancer studies not related to space radiation. The results, they believe, are telling: "I think we can say with confidence that the risk is not going to be lower than what we know for gamma rays," says Fornace. He views cancer as one of the potential "major hang-ups" in planning deep space missions.

Deep space dangers

Mars explorers will need protection from galactic cosmic radiation, which researchers say would plow into cells like molecular artillery.



Sources: NASA SOHO solar observatory, NASA Hubble and Chandra images

Graphic by John Bretschneider

DEFINING ACCEPTABLE RISK

Currently, NASA limits its astronauts to receiving 3 percent of the estimated fatal lifetime radiation exposure. This is based on science that says exposure to 1 sievert of radiation increases a person's risk for fatal cancer by 5 percent. How many "safe days" in space that translates to depends on the individual astronaut's "age, gender, prior exposure, solar cycle and mission location," according to Dr. Rich Williams, NASA's chief health and medical officer. In an e-mail he says, "For crew with no prior exposure, the number of estimated safe days can range from 180 to 1,600 days, for young females on deep space missions and older males on ISS missions respectively."

This policy limits the number of individuals who would qualify for a long-term deep space mission, like one to Mars. "You don't want to send a total rookie, you want somebody who's been in space and knows what they are doing, that means probably that person already has significant exposure. If you already had exposure in space then you're getting up to where your limit is," says Dr. Dorit Donoviel, deputy chief scientist at the National Biomedical Research Institute in Houston, Texas, a nonprofit institute established by NASA in 1997 to address health-related issues of long-term spaceflight. Donoviel points out that this 3 percent policy would preclude women from going on a lot more missions, because women reach their maximal safe days in space sooner than men. That's because women already have higher incidents of radiation-induced cancers, and on average they live five years longer than men, which gives more time to develop cancer.

Donoviel says one of the measures to take to protect the crew from galactic cosmic radiation would be to make the trip shorter. But so far, new propulsion technologies that would achieve that, or techniques to shield the spacecraft from galactic cosmic radiation, remain the stuff of science fiction: "Right now there are no lightweight solutions, in fact no ways to shield from galactic cosmic rays," says Donoviel. The best solution, she says, may lie with pharmaceuticals.

Besides colorectal cancer risk, the Georgetown researchers looked at the

Most days in space

Humans have spent the equivalent of more than two years in Earth orbit with no evidence of higher cancer rates. A Mars mission would instantly propel crew members into the record books and expose them to harsher cosmic radiation.

Soviet Union | Russia | Ukraine | United States

Men

1 Sergei Krikalev
803 days
6 flights

2 Alexandr Kaleri
769 days
5 flights

3 Sergei Avdeyev
747 days
3 flights

4 Gennady Padalka
710 days
4 flights

5 Valeriy Polyakov
678 days
2 flights

6 Anatoly Solovyev
651 days
5 flights

7 Yuri Malenchenko
641 days
5 flights

8 Viktor Afanasyev
555 days
4 flights

9 Yury Usachev
553 days
4 flights

10 Pavel Vinogradov
546 days
3 flights

SOURCES: NASA, Korolev Special Design Center, Gagarin cosmonaut training center, Roscosmos

long-term effects of heavy ion radiation on healthy cells, and what they found was equally worrisome. They've discovered what Fornace calls "the field effect" of heavy ion radiation. A year after radiation exposure, the researchers looked at the metabolism inside exposed cells and found that the mitochondria — the cell's powerhouse, where oxygen is metabolized — were generating unusually high amounts of toxic byproducts, or free radicals.

"Basically a year later we're finding that normal metabolism has been perturbed, normal mitochondrial function has been perturbed so it's generating more of these toxic byproducts, and they can damage DNA. So we're seeing increased DNA damage. And this is not due to radiation per se, the radiation is long gone. But the signaling pathways have been perturbed, and we are getting these long-term events," says Fornace. The extra toxins could lead not just to cancer but to diabetes and heart disease, for instance.

The research is providing time to find solutions: "I think it's concerning that we're having these long-term changes, but it gives us potential druggable targets that could be used to lessen the chance of cancer and the like," says Fornace. That is exactly what Donoviel and the scientists at the biomedical institute are working on, developing ways to prevent and treat effects of galactic cosmic radiation.

One of the suggested ways to approach the problem is to create a genetic profile of each astronaut and then personalize the drugs. Donoviel described the way the proposed process would go: "You've been selected for flight, and now we're going to [genetically] profile you because we want to understand what kinds of medicines we need to send along with you. If you are more susceptible to let's say de-

Radiation *and risk*

Radiation exposure and subsequent risk of developing cancer have long been on the list of health concerns for those who go to space. Even on a short mission to the International Space Station, astronauts risk exposure from solar flares or from crossing through the South Atlantic Anomaly — the area where the Van Allen radiation belt comes close to the Earth and intersects with the flight path of some spacecraft, sometimes knocking out electronics. So naturally, NASA is keeping a close eye on its astronaut corps.

Since 1989, NASA's Johnson Space Center has been running a Longitudinal Study of Astronaut Health, or LSAH, which in 2010 was renamed the Lifetime Surveillance of Astronaut Health. According to Dr. Rich Williams, NASA's chief health and medical officer until mid-2010, it "was primarily a research study designed to compare the astronauts to a healthy cohort of civil servants." The study found that astronauts do not have a higher total cancer incident rate compared to the U.S. "terrestrial population." But Williams and others point out that the study's data is not very reliable: It's limited by the small number of subjects (fewer than 400, according to Williams) and skewed by the fact that astronauts tend to be healthy individuals who don't smoke, exercise regularly and have access to top-notch medical care. "It is very difficult to determine with certainty if there is an occupational health risk increase in the astronauts due to their spaceflight experience. Further analysis and investigation is needed for specific cancers," said Williams by email.

Graphic by John Bretschneider

veloping atherosclerosis or heart disease, we're going to put you on preventative measures. If you have a mutation that makes you more predisposed to cancer, we're going to give you a higher dose of anti-oxidants than the guy next to you who doesn't have that. So it becomes a personalized way to prevent and treat."

The idea of genetic screening is a controversial one. According to Donoviel, the astronaut corps is very resistant to the idea of such testing. One can understand why an astronaut who spent years training for a space mission would not want to be excluded based on a genetic test revealing a mutation that may increase his or her risk for a certain type of cancer. Donoviel says that's not what her institute is proposing: "I think the idea is not to use genetics screenings to pre-select people, but really to understand the susceptibilities of the individuals that are selected. And then to apply personalized preventative measures and therapies en route in case something develops."

NASA's Williams says by email that it's entirely too early to broach the subject: "It will take many more years of development by the medical research community and pharmaceutical industry to robustly and reliably determine which genes indicate increased cancer risk, the biological mechanisms involved, and effective pharmaceuticals or life style changes to prevent or mitigate a person's susceptibility to a specific cancer caused by radiation damage. In summary, it is very premature to discuss screening of astronauts based on their genome, because of the current limited understanding and uncertainties involved."

Brookhaven National Laboratory

Cell room: A researcher prepares samples for irradiation as part of NASA's work to assess the biological effects of heavy ions.

The experts seem to agree on two things: One is that more research is needed both in the fields of spacecraft technology and on the medical side before a deep space mission becomes reality; the second is — despite the potential danger — human space exploration is worth the risk and the effort. When asked why we should send humans to space in light of his very worrisome findings, Georgetown's Fornace quoted then-NASA Administrator Michael Griffin in a 2005 interview with the Washington Post: "In the long run, a single planet species will not survive."

Lockheed Martin

The Apache AH-64E: The Army plans to pair the helicopters with unmanned Gray Eagles during combat operations in Afghanistan.

Pairing the crews of piloted craft with unmanned planes is ready to be tried in combat in Afghanistan. Keith Button explains the technology and the concept that could change the shape of Army combat.

Manned-unmanned teaming

When U.S. Army pilots in World War II tried steering remotely controlled drones into German targets, only one of the old bombers laden with explosives scored a hit. Consequences included the death of a famed U.S. pilot, Joe Kennedy, the future president's older brother, says Tom Crouch, aeronautics curator at the Smithsonian Institution.

Seven decades after Operation Aphrodite, the Army says it's time to try again, albeit with an entirely different mission and concept of operations.

The crews of Apache attack helicopters now arriving in Afghanistan could become the first crews in the history of combat to directly control and fire weapons flown on unmanned planes, experts say.

The first squadron of new Apaches — pilots, crews and 24 helicopters — began deploying in March, says Lt. Col. Steven Van Riper, the Army's product manager for Apache Sensors. Whether and when the crew members of the new AH-64E Apaches make use of their new lethality will depend on the commander's intent and the rules of engagement for each specific mission, he says.

General Atomics

Apache crews are training to control and fire weapons flown on Army Gray Eagles.

by Keith Button

"As we begin to use this system in actual combat operations, the tactics, techniques and procedures will evolve quickly," Van Riper says. "It really is mission dependent for what the Apaches can and can't do."

The Afghanistan deployment gives the Army a chance to apply tactics that could amount to the way of the future: the direct pairing of piloted aircraft with armed, unmanned aircraft. The planes in this case will be Gray Eagles made by General Atomics Aeronautical Systems. The operations could be short-lived, though, if the U.S. doesn't reach a force agreement with Afghanistan permitting some American troops, perhaps including helicopter crews, to stay beyond 2014.

Either way, the Army expects to learn a lot in the coming months. Exactly how Apache crews should use their companion Gray Eagles will be clearer "after we've had some use of the systems in an actual theater of operations," says Van Riper.

The newest Apaches are part of a $1.16-billion contract awarded by the Army to Boeing in March. Under the contract, Boeing will produce 82 of the Apache Echo models, so named because of their formal AH-64E designation and less commonly called Guardian Apaches. Of the total, 10 will be newly built with new airframes and 72 will be rebuilds — AH-64D Longbow Apaches that are torn down and "remanufactured" into AH-64Es.

Many of the D model Apaches are themselves rebuilds, from Apache A models. The Army retired the last A model in July 2012, when it was rebuilt into a D model.

Above the rotor blades is the donut-shaped radome. It houses either data-link hardware or the fire-control radar that spots targets.

U.S. Army

Faster, higher, better

The changes don't all have to do with staying connected to unmanned companion planes. The new Apaches provide the same engine power as their predecessors, but they make more of that power available to the pilot through an improved drive system, with a transmission that can convert the engine power into better flight performance, says Travis Williams, an Apache production manager at Boeing. Also, the new helicopters have a composite main rotor blade that gives the Apache more lift and better flight characteristics, so the aircraft can fly higher and faster.

The Echo Apaches are the first Army attack helicopters with the ability to fly at 6,000 feet with a full mission payload, and they have a combat speed of around 164 knots — about 20 knots faster than other Apaches. The Echo Apaches can also make tighter and faster turns.

In addition, the Echo Apaches have mission computer hardware that is more consolidated and lighter than that of their predecessors. The new computers also have more processing capacity.

The Army has taken a cautious approach to the unmanned aircraft pairing. First, some of the model D Apaches were retrofitted with communication links and controls to allow the Apache crews to control just the sensors on an unmanned aircraft. With the Echo version, crew members can control the unmanned plane's flight path, sensors and weapons.

Not all of the Apache E versions have the high-bandwidth data link hardware, built by a partnership of Lockheed Martin

U.S. Navy

Sea legs: An Army helicopter, the Apache has long been a staple of military operations in other services too. Here an AH-64 takes off from the flight deck of the Navy amphibious transport dock ship USS New Orleans during deck landing qualifications.

and Northrop Grumman, that allows for control of the unmanned aircraft.

The radome, or donut-shaped object above the rotor blades on the Apache, houses either the data link hardware or a fire control radar that identifies and prioritizes targets.

Beyond the Gray Eagle

For now, the Apaches are paired with Gray Eagles, but the Army eventually wants the crews to be able to control any kind of Army unmanned aircraft, says Sofia Bledsoe, an Army spokeswoman. Apache Echoes can receive sensor information from all Army unmanned aircraft already, but Gray Eagles are the only unmanned planes they can control.

In adding unmanned aircraft control, the Army also modified the cockpit displays and control grips in the new Apaches. Control of the sensors and weapons on the unmanned aircraft works through the grips of the co-pilot gunner, or "front-seater," in the two-person cockpit. The crew members have different pages available for view on their displays: for navigation, for performance and for video feeds, for example, and one for the unmanned aircraft.

The two cockpits for the front- and back-seaters are designed to allow the pilot or co-pilot to fly the helicopter and perform each other's tasks, the exception being unmanned aircraft control, which always goes to the co-pilot gunner.

To fly the unmanned plane, the co-pilot must have both hands on the control grips, which makes it nearly impossible to also pilot the helicopter, Van Riper says.

"Unless there's some extraordinary circumstances, typically that co-pilot gunner when he or she is involved with controlling the [unmanned plane] will not be flying the helicopter," Van Riper says.

The co-pilot gunner can control the flight path of the Gray Eagle, direct its sensors and weapons, and fire the weapons. The only thing missing from the Apache's control is the ability to take off and land the unmanned aircraft, Williams says. The unmanned plane's flight path is directed by setting waypoints or loiter patterns.

Overload issue

When manned-unmanned pairing was first proposed for the Apache, the idea raised concerns about potentially overloading the pilot and co-pilot with the tasks of flying two aircraft — and the difficulty of managing to think about them separately, including their flight paths, sensors and weapons.

Keven Gambold, who is chief operations officer of the Unmanned Experts consultancy firm and not affiliated with the Apache program, says it is important to note that the Apache pilot is not responsible for flying the unmanned aircraft.

"The key, I think, is that the con-ops [concept of operations] for it will go to the co-pilot gunner," says Gambold, who as an officer in the Royal Air Force once commanded a Combined Joint Predator Task Force squadron at Tallil Air Base, Iraq, flying unmanned aircraft combat missions. "That's an important distinction to make."

Gambold, who earlier in his career also flew in the two-man Tornados for the Royal Air Force, says the crew concept as applied to the Apache manned-unmanned pairing is "hugely undervalued."

With proper crew resource management, the whole is greater than the sum of the parts, he says. "If you are used to crew resource management — you say 'you do this; I do that' — then a UAV [unmanned aerial vehicle] is just another member of the crew.

"You can't get in a combat cockpit and not be constantly communicating, especially in a crew environment," Gambold says. "There is probably no silence; the job is constant talk. And surely when you're getting to this level, with a squad of Apaches, you've got to be thinking wingmen."

Show, don't tell

While the commonly held belief may be that adding unmanned aircraft responsibilities to the Apache crew creates a heavier workload, testing by the Army's Aviation Flight Test Directorate in Redstone Arsenal, Ala., and Mesa, Ariz., showed that the opposite was true.

According to the directorate, testing showed that unmanned aircraft interoperability would help increase situational awareness and decrease the overall workload for the Apache crews, in most cases. And in a presentation on manned-unmanned teaming, a speaker used the analogy of trying to talk one's spouse through directions for using the TV remote control.

It's far easier to just do it than to tell somebody to do it, says Gambold.

The manned-unmanned teaming is meant to improve on a targeting process that Gambold says has traditionally gone like this:

"You are a long-loiter, ISTAR [intelligence, surveillance, target acquisition and reconnaissance] asset…And you might be following one white truck for six hours. But there's a lot of white trucks out there.

"Finally, they do all of their due diligence and go through all of the rules of engagement, and say: 'OK; this a bad truck. We're going to kill it.' Now, the drama is talking somebody" — the person controlling weapons on another aircraft – onto that truck. You go: 'Do you see a building?' 'Yes.' 'Do you see the crossroads?' 'Yes.' 'Do you see the white truck?' 'Yes.' 'Aha — that's it' And then a minute later, a different white truck blows up." Mistakes can happen because of this chatter.

From a co-pilot gunner's point of view, if the unmanned plane is being flown by somebody else and they've found the correct target, then it's still easier to pick up control of the aircraft than to talk to another operator about how to attack the target, says Gambold.

Balancing the burden

Williams, the Apache production manager at Boeing, says the Apache crew's workload was an important consideration in designing the displays and tools for handling tasks in the cockpit.

"What the Army and Boeing were concerned about was that as you brought this capability in to an AH-64E, you did not want to have crew overload," he says. "You want aviators flying the Apache to be heads-up…you want them to play in the game; you don't want them so focused on all of these technologies and screens that they're not paying attention to their world.

"As part of the development process, there were intense human factors engineering studies done; intense crew station working group meetings that involved the user, where all that was fully planned for and vetted out," says Williams.

Van Riper says the manned-unmanned teaming does add to what the Apache crews have to think about.

"But as material developers, I believe we've done our level best to make that burden manageable," he says. New avionics and flight software help balance the burden by taking away some of the workload in other areas, performing tasks automatically that formerly had to be done by the crews.

"We've also designed training to make sure the air crews know how to prioritize their cockpit tasks," Van Riper says.

Another precaution built into the operation was for the on-the-ground controllers to always have "snatch back" capability, meaning that if they see something that en-dangers friendly forces or civilians, they can take control of the unmanned plane from the Apache, Van Riper says. Also, the Apache crew and ground controllers always want to have positive communication via data or voice during the handover of control.

Besides the advantages of controlling weapons beyond the horizon with an unmanned plane, the Apache crew's situational awareness is much higher, Van Riper says.

While waiting to depart on a mission from a forward arming and refueling point, for example, the Apache air crew members can look at video feeds from an unmanned plane circling over a potential target, and use that plane's weapons on the target, if required, he said.

"They can step up their different levels of interoperability as the mission requires, but really it's about giving that air crew situational awareness while waiting to depart on a mission, or when they're en route to an objective," Van Riper says.

Boeing's new contract also calls for the company to provide six crew trainers, spare parts and possible engineering studies, as needed. The helicopter manufacturing and rebuilding will take place in Mesa, Ariz., with estimated completion by June 30, 2016.

The money for the contract comes out of the fiscal year 2013 and 2014 budgets. For the 2014 calendar year, Boeing is expected to deliver 37 rebuilt Echo Apaches and 10 new aircraft, with 35 rebuilt Echos coming in 2015.

Boeing built the first Echo Apache in October 2010, and under a "low-rate initial production" contract produced 51 of the helicopters. Under the new contract, the company moves into full-rate production mode, and has churned out nine of the aircraft so far. Except for some minor production changes and updated software, the Echo Apaches produced under the new contract will be essentially the same as those built under the initial one, Williams says.

The Army's long-range plan is to eventually buy a total of 690 new Apaches, including 56 rebuilds and 634 newly built aircraft. Their lifespan is projected to at least 2040.

Out of the

25 Years Ago, May 1989

May 4-8 The Space Shuttle Atlantis is launched and 6 hours later uses the solid-fuel inertial upper stage to boost the Magellan Venus radar mapper into space. This is the first U.S. interplanetary mission in 11 years and the first time an interplanetary probe has been fired from the shuttle. Magellan is to orbit Venus by August 1990 and map the Venusian surface extensively by radar. NASA, Astronautics and Aeronautics, 1986-90, Page 215.

May 10 President George H.W. Bush bestows the name Endeavour on the space shuttle that replaces the lost orbiter Challenger. Chosen in a nationwide competition among school children, Endeavour was the name of famed British Explorer Capt. James Cook's first ship sent to the South Pacific in 1768 with astronomers aboard to observe the transit of Venus across the Sun. The new orbiter is scheduled to fly in March 1992. NASA, Astronautics and Aeronautics, 1986-90, Page 215.

50 Years Ago, May 1964

May 1 At the annual May Day parade in Moscow, the Soviet Union unveils its new anti-aircraft missile, later identified as the SA-4 Ganef. The long-range, ramjet-powered missile has four solid-propellant boosters. It is carried into combat on tracked vehicles and provides anti-aircraft defense against targets at all speeds and altitudes. The SA-4 becomes standard for Soviet ground forces and is later issued to other Warsaw Pact nations, starting with East Germany and Czechoslovakia. Aviation Week, May 11, 1964, Page 27; B. Gunston, Illustrated Encyclopedia of the World's Rockets & Missiles, Page 159.

May 1 Britain's Type 221 research aircraft, to be used in the Concorde supersonic transport development, makes its inaugural flight at Filton, near Bristol, England. The Type 221 is a redesigned Fairey FD-2 with a wing of the same general contour as the future Concorde. Fitted with a Rolls-Royce Avon engine, the research aircraft will enable aerodynamic studies of slender delta wings, from subsonic to supersonic speeds up to Mach 1.6. Aviation Week, May 11, 1964, Page 37.

May 2 Pan American World Airways inaugurates non-stop, 4,000-mile service from California to Tahiti using a Boeing 707-320B. The weekly service originates in San Francisco with a stop-over in Los Angeles. Aviation Week, March 30, 1964, Page 60.

May 7 The Vickers Super VC-10 jet airliner makes its inaugural flight from Wisley Airfield near Weybridge, England. Powering the aircraft are four Rolls-Royce Conway 43D turbofan engines of 22,500 pounds thrust each. Thirty of the planes are to be delivered to British Overseas Airways for transatlantic service beginning the following year. Aviation Week, May 25, 1964, Page 34.

May 11 Famed U.S. pilot Jacqueline Cochran, an Air Force Reserve officer, claims a new world's speed record for women. Flying an Air Force Lockheed F-104G Starfighter single-engine, high-performance supersonic interceptor aircraft at Edwards Air Force Base, Calif., she reaches Mach 2.2 — 1,429 mph — and an altitude of 37,100 feet. Washington Post, May 19, 1964.

May 11 North American Aviation unveils the large, six-engined 2,000-mph inter-continental XB-70 Valkyrie Number 1 supersonic aircraft at the Palmdale, Calif., plant where the plane was developed. The aircraft is the prototype version of the proposed B-70 nuclear-armed deep penetration strategic bomber for the Air Force. Aviation Week, May 18, 1964, Pages 26-30; New York Times, May 12, 1964.

May 13 In a test of the Project Apollo escape system, a boilerplate model of the Apollo Command Service Module spacecraft with the escape system attached is boosted up to 17,000 feet by the Little Joe 2 solid-propellant test vehicle. The escape system rockets ignite and take up the boilerplate capsule to a maximum of 24,000 feet before the drogue parachute opens and helps lower the capsule back to Earth. The first parachute breaks loose from the spacecraft, but the other chutes are sufficient to land the craft safely at a speed of 30 feet per second. Aviation Week, May 18, 1964, Page 32; New York Times, May 14, 1964, Page 18.

May 21 The first two-way telephone call between the U.S. and Japan takes place via the U.S. Relay 2 communications satellite, which is stationed 4,000 miles above the Pacific Ocean. NASA News Release 64-122.

May 28 In a test flight from Cape Kennedy, Fla., the huge Saturn 1 SA-6 two-stage launch vehicle boosts a dummy Apollo spacecraft, attached to the S-4 second stage, into a 140-mile apogee by 123.9-mile perigee orbit. Three days later, after 50 orbits of the Earth, this temporary "satellite" reenters the atmosphere. This is

Past

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

the sixth consecutive flight for the Saturn 1 and the first with an active guidance system to inject the upper stage and Apollo spacecraft into orbit. Eight on-board movie cameras photograph the propulsion and propellant operations and are later recovered. Missiles & Rockets, May 8, 1964, Page 10. Aviation Week, June 1, 1964, Page 25.

75 Years Ago, May 1939

May 4 The "traffic research and goodwill flight" of a German Junkers Ju-52 Luft Hansa airliner from Berlin to Tokyo arrives safely. The plane carries C.A. von Gablenz, a Luft Hansa director, who is surveying the German route to the Far East. Interavia, April 25, 1939, Page 8, and May 5, 1939, Page 7.

May 7 The Soviet Union's Petlyakov VI-100 prototype airplane makes its inaugural flight. Later named the Pe-2, it becomes the primary tactical bomber on the eastern front during World War II. Altogether, some 11,427 Pe-2s are produced. B. Gunston, The Encyclopedia of Russian Aircraft: 1875-1995, Pages 282-283.

May 10 The Post Office begins airmail pickup service using Stinson Reliant planes over routes covering 1,040 miles in Pennsylvania, West Virginia, Ohio and Delaware. The one-year contract goes to All American Aviation of Wilmington, Del. Aircraft Year Book, 1940, Page 432.

May 15 The Navy orders a contract for the Curtiss-Wright XSB2C dive bomber. Known as the Helldiver during World War II, it will become the main carrier dive bomber by the end of the war. E. Emme, ed., Aeronautics and Astronautics 1915-60, Page 38.

May 19 A new sailplane soaring record of 30,200 feet is set by Peter Glockner of the German Research Institute for Soaring. The old record was 22,434 feet, set in Germany in November 1938. Interavia, May 23, 1939, Page 8.

May 20 Pan American Airways starts the first North Atlantic airmail service on its southern route to the Azores, Portugal, and Marseilles, France, from Port Washington, N.Y. The Boeing 314 flying boat Yankee Clipper, commanded by Capt. Arthur E. La Porte, inaugurates the service, which carries 1,804 pounds of mail. Aircraft Year Book, 1940, Page 432.

May 20 The first large-scale aerial battles between Soviet and Japanese aircraft take place near the Khalkhin-Gol River, Outer Mongolia. This engagement also marks the first use of Soviet operational air-to-air rockets, 82-mm caliber missiles mounted on I-16 fighter planes. The solid-fuel, smokeless powder rockets were developed from 1928 to 1933 by the Gas Dynamics Lab and, in modified form, became the famous surface-to-surface Katyushas. A. Slukhai, "Russian Rocketry: A Historical Survey (NASA TT F-426)," Page 28; F. Durant III and G. James, eds., "First Steps Toward Space (Smithsonian Annals of Flight No. 10)," Page 91.

May 24 Famed Mexican aviator Francisco Sarabia sets a new non-stop flight record in a Gee Bee racer, flying from Mexico City to Floyd Bennett Field in Brooklyn, N.Y., a distance of 2,350 miles, in 10 hours 45 minutes. He beats the old record of 14 hours 19 minutes, set by Amelia Earhart on May 8, 1935. However, Sarabia is killed in a crash while taking off for a return trip on June 7 from Washington, D.C. Aircraft Year Book, 1940, Page 432.

100 Years Ago, May 1914

May 28 Glenn H. Curtiss makes a brief flight over the lake at Hammondsport, N.Y., in the original machine of Samuel P. Langley, who failed in two attempts to fly it in 1903 just before the Wright brothers' first flight. The Smithsonian Institution, where Langley was secretary from 1886 to 1906, permitted Curtiss to borrow the Langley plane. Curtiss has replaced some of the original ribs, which were broken, and made some modifications and improvements. He also has added floats instead of using a catapult launching. Flight, June 5, 1914, Page 601, and June 12, 1914, Pages 630-631.

AIAA Bulletin

Team New York in front of the east side of the Capitol on 12 March at Congressional Visits Day (CVD). AIAA's CVD program brings aerospace engineers and scientists to Washington, DC, each year for a day of meetings and advocacy on behalf of aerospace engineering and science with lawmakers on Capitol Hill. See the full story on page **B6**.

MAY 2014

AIAA Meeting Schedule	B2
AIAA News	B5
SPACE 2014 Event Preview	B14
AIAA Courses and Training Program	B19

AIAA Directory

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

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

Other Important Numbers: ***Aerospace America*** / Greg Wilson, ext. **7596*** • ***AIAA Bulletin*** / Christine Williams, ext. **7500*** • **AIAA Foundation** / Karen Thomas, ext. **7520*** • **Book Sales** / **800.682.AIAA** or **703.661.1595**, Dept. 415 • **Corporate Members** / Merrie Scott, ext. **7530*** • **International Affairs** / Betty Guillie, ext. **7573***; Emily Springer, ext. **7533*** • **Editorial, Books and Journals** / Heather Brennan, ext. **7568*** • **Honors and Awards** / Carol Stewart, ext. **7623*** • **Journal Subscriptions, Member** / **800.639.AIAA** • **Exhibits / Journal Subscriptions, Institutional / Online Archive Subscriptions** / Michele Dominiak, ext. **7531*** • **Continuing Education** / Chris Brown, ext. **7504*** • **Public Policy** / Steve Howell, ext. **7625*** • **Section Activities** / Chris Jessee, ext. **3848*** • **Standards, Domestic** / Amy Barrett, ext. **7546*** • **Standards, International** / Nick Tongson, ext. **7515*** • **Student Programs** / Stephen Brock, ext. **7536*** • **Technical Committees** / Betty Guillie, ext. **7573***

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

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

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

Event & Course Schedule

DATE	MEETING (Issue of *AIAA Bulletin* in which program appears)	LOCATION	ABSTRACT DEADLINE
2014			
5–9 May	SpaceOps 2014: 13th International Conference on Space Operations	Pasadena, CA	5 Aug 13
9–10 May†	20th Annual Improving Space Operations Workshop	Pasadena, CA (Contact: Larry Bryant, 818.298.0581; aiaa.sostc@gmail.com; https://info.aiaa.org/tac/SMG/SOSTC)	
14–19 May†	International Space Development Conference (ISDC)	Los Angeles, CA (Contact: 202.429.1600, pat.montoure@nss.org, http://isdc.nss.org/2014)	
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)	
26–29 May†	6th International Conference on Research in Air Transportation (ICRAT 2014)	Istanbul, Turkey (Contact: Andres Zellweger, 301.330.5514, dres.z@comcast.net, http://www.icrat.org/	
2–4 Jun†	Global Space Applications Conference	Paris, France (Contact: Lisa Antoniadis, +33 1 45 67 68 46, lisa.antoniadis@iafastro.org)	
5 Jun	Aerospace Today ... and Tomorrow: An Executive Symposium	Williamsburg, VA	
14–15 Jun	Third AIAA Workshop on Benchmark Problems for Airframe Noise Computations (BANC-III)	Atlanta, GA	
14–15 Jun	Business Management for Engineers	Atlanta, GA	
14–15 Jun	Optimal Design in Multidisciplinary Systems	Atlanta, GA	
16–20 Jun	AIAA AVIATION 2014 (AIAA Aviation and Aeronautics Forum and Exposition) Featuring: 20th AIAA/CEAS Aeroacoustics Conference 30th AIAA Aerodynamic Measurement Technology and Ground Testing 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 AIAA Flight Testing Conference 7th AIAA Flow Control Conference 44th AIAA Fluid Dynamics Conference 19th AIAA International Space Planes and Hypersonic Systems and Technologies Conference 11th AIAA/ASME Joint Thermophysics and Heat Transfer 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 7th AIAA Theoretical Fluid Mechanics Conference	Atlanta, GA	14 Nov 13
22–27 Jun†	12th International Probabilistic Safety Assessment and Management Conference	Honolulu, HI (Contact: Todd Paulos, 949.809.8283, secretariat@psam12.org, www.psam12.org)	
13–17 Jul†	International Conference on Environmental Systems	Tucson, AZ (Contact: Andrew Jackson, 806.742.2801 x230, Andrew.jackson@ttu.edu, http://www.depts.ttu.edu/ceweb/ices/)	
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	AIAA Propulsion and Energy 2014 (AIAA Propulsion and Energy Forum and Exposition) Featuring: 50th AIAA/ASME/SAE/ASEE Joint Propulsion Conference 12th International Energy Conversion Engineering Conference	Cleveland, OH	14 Jan 14
31 Jul–1 Aug	2nd AIAA Propulsion Aerodynamics Workshop	Cleveland, OH	
31 Jul–1 Aug	Hybrid Rocket Propulsion	Cleveland, OH	
31 Jul–1 Aug	Missile Propulsion Design, Technologies, and System Engineering	Cleveland, OH	

DATE	MEETING (Issue of *AIAA Bulletin* in which program appears)	LOCATION	ABSTRACT DEADLINE
31 Jul–1 Aug	**Application of Green Propulsion for Future Space**	Cleveland, OH	
2–10 Aug†	**40th Scientific Assembly of the Committee on Space Research (COSPAR) and Associated Events**	Moscow, Russia http://cospar2014moscow.com/	**14 Feb 14**
3–4 Aug	**Decision Analysis**	San Diego, CA	
4–7 Aug	**AIAA SPACE 2014 (AIAA Space and Astronautics Forum and Exposition)** **Featuring:** **AIAA/AAS Astrodynamics Specialist Conference** **AIAA Complex Aerospace Systems Exchange** **32nd AIAA International Communications Satellite Systems Conference** **AIAA SPACE Conference**	San Diego, CA	**21 Jan 14**
7–12 Sept†	**29th Congress of the International Council of the Aeronautical Sciences (ICAS)**	St. Petersburg, Russia (Contact: www.icas2014.com)	**15 Jul 13**
25 Sept†	**Acoustic Testing and Upgrade of the LLF—A Symposium Dedicated to Aero-Acoustic Testing on the Occasion of the Finalization of the Acoustic Upgrade of the DNW-LLF**	Marknesse, The Netherlands (Contact: Siggi Pokörn, +31 610 279 923; siggi.pokoern@dnw.aero, www.dnw.aero)	
29 Sep–3 Oct†	**65th International Astronautical Congress**	Toronto, Canada (Contact: http://www.iac2014.org/)	
5–10 Oct†	**33rd Digital Avionics Systems Conference**	Colorado Springs, CO (Contact: Denise Ponchak, 216.433.3465, denise.s.ponchak@nasa.gov, www.dasconline.org)	
22–26 Oct†	**30th Annual Meeting of the American Society for Gravitational and Space Research**	Pasadena, CA (Contact Cindy Martin-Brennan, 703.392.0272, executive_director@asgsr.org, www.asgsr.org)	
3–6 Nov†	**28th Space Simulation Conference**	Baltimore, MD (Contact: Andrew Webb, 443.778.5115, Andrew.webb@jhuapl.edu, http://spacesimcon.org/)	
2015			
5–9 Jan	**AIAA SciTech 2015 (AIAA Science and Technology Forum and Exposition 2015)** **Featuring:** **23rd AIAA/ASME/AHS Adaptive Structures Conference** **53rd AIAA Aerospace Sciences Meeting** **AIAA Atmospheric Flight Mechanics Conference** **AIAA Infotech@Aerospace Conference** **AIAA Spacecraft Structures Conference (formerly the AIAA Gossamer Systems Forum)** **AIAA Guidance, Navigation, and Control Conference** **AIAA Modeling and Simulation Technologies Conference** **17th AIAA Non-Deterministic Approaches Conference** **56th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference** **8th Symposium on Space Resource Utilization** **33rd ASME Wind Energy Symposium**	Kissimmee, FL	
11–15 Jan†	**25th AAS/AIAA Space Flight Mechanics Meeting**	Williamsburg, VA (Contact: AAS—Roberto Furfaro, 520.312.7440; AIAA—Stefano Casotto, Stefano.casotto@unipd.it; http://space-flight.org/docs/2015_winter/2015_winter.html)	
26–29 Jan†	**61st Annual Reliability & Maintainability Symposium (RAMS 2015)**	Palm Harbor, FL (Contact: Julio Pulido, 952 270 1630, julio.e.pulido@gmail.com, www.rams.org)	
7–14 Mar†	**2015 IEEE Aerospace Conference**	Big Sky, MT (Contact: Erik Nilsen, 818.354.4441, erik.n.nilsen@jpl.nasa.gov, www.aeroconf.org)	
25–27 Mar†	**3rd Int. Conference on Buckling and Postbuckling Behaviour of Composite Laminated Shell Structures with DESICOS Workshop**	Braunschweig, Germany (Contact: Richard Degenhardt, +49 531 295 3059, Richard.degenhardt@dlr.de, www.desicos.eu	
30 Mar–2 Apr	**23rd AIAA Aerodynamic Decelerator Systems Technology Conference and Seminar**	Daytona Beach, FL	**30 Sep 14**
13–15 Apr†	**EuroGNC 2015, 3rd CEAS Specialist Conference on Guidance, Navigation and Control**	Toulouse, France (Contact: Daniel Alazard, +33 (0)5 61 33 80 94, alazard@isae.fr, w3.onera.fr/eurognc2015)	
25–27 May†	**22nd St. Petersburg International Conference on Integrated Navigation Systems**	St. Petersburg, Russia, (Contact: Prof. V. G. Peshekhonov, 7 812 238 8210, icins@eprib.ru, www. Elektropribor.spb.ru)	

DATE	MEETING (Issue of *AIAA Bulletin* in which program appears)	LOCATION	ABSTRACT DEADLINE
22–26 Jun	**AIAA AVIATION 2015** **(AIAA Aviation and Aeronautics Forum and Exposition)** **Featuring:** **21st AIAA/CEAS Aeroacoustics Conference** **31st AIAA Aerodynamic Measurement Technology and Ground Testing Conference** **33rd AIAA Applied Aerodynamics Conference** **AIAA Atmospheric Flight Mechanics Conference** **7th AIAA Atmospheric and Space Environments Conference** **15th AIAA Aviation Technology, Integration, and Operations Conference** **AIAA Balloon Systems Conference** **AIAA Flight Testing Conference** **8th AIAA Flow Control Conference** **45th AIAA Fluid Dynamics Conference** **22nd AIAA Lighter-Than-Air Systems Technology Conference** **16th AIAA/ISSMO Multidisciplinary Analysis and Optimization Conference** **AIAA Modeling and Simulation Technologies Conference** **46th AIAA Plasmadynamics and Lasers Conference** **8th AIAA Theoretical Fluid Mechanics Conference** **45th AIAA Thermophysics Conference**	Dallas, TX	
27–29 Jul	**AIAA Propulsion and Energy 2015** **(AIAA Propulsion and Energy Forum and Exposition)** **Featuring:** **51st AIAA/ASME/SAE/ASEE Joint Propulsion Conference** **13th International Energy Conversion Engineering Conference**	Orlando, FL	
31 Aug–2 Sep	**AIAA SPACE 2015** **(AIAA Space and Astronautics Forum and Exposition)** **Featuring:** **AIAA SPACE Conference**	Pasadena, CA	

For more information on meetings listed above, visit our website at www.aiaa.org/calendar or call 800.639.AIAA or 703.264.7500 (outside U.S.).

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

AIAA Continuing Education courses.

From the Corner Office

WHAT'S IN A NAME?

Sandy H. Magnus, Executive Director

I was reading through the feedback we received from SciTech 2014 (and thank you to those who took time to respond!!) and a comment caught my eye. It was a comment about terminology. The author was unhappy about Institute leadership using the term "Aerospace Professional" instead of "Aerospace Engineer" to describe AIAA members. The thought being expressed was that not referring to AIAA members as "Aerospace Engineers" was somehow demeaning.

I thought I would take a moment to discuss this point because language is important. It defines who we are and brings clarity to our identities and to the purpose of our organization.

AIAA is unique among professional societies in that at the undergraduate and graduate level our student members primarily are drawn from Aerospace (or Mechanical with an Aerospace emphasis) engineering departments. This follows the parallel that the IEEE draws from Electrical Engineering departments, ASCE from Civil, ASME from Mechanical, and so on. But at the professional level, our members are from a much broader background than any of the other professional societies. For example, I am a member of AIAA, but I am not an "Aerospace Engineer." I am a member because I am an "engineer who has worked in Aerospace." For that matter I am not just an "engineer who has worked in Aerospace" but also an "operator" and a "manager" who has worked in the Aerospace industry. Even though I was not working as an "engineer" for the whole of the twenty-plus years of my career, I have certainly been contributing to the Aerospace industry and supporting our engineering efforts.

So the term "Aerospace Professional" describes me much better than "Aerospace Engineer." Do I feel that AIAA is my home professional organization even though I am not an "Aerospace Engineer"? Yes, definitely. As you know the Aerospace industry is broad and multidisciplinary. Even though my educational background is in physics, electrical engineering, and materials, I have always worked with applications in the Aerospace field. It is at AIAA where I can identify most and find the people who share the passions and interests that I share. And I am not alone.

Our membership is spread between government, academia, and industry. While a large portion of our membership continue to get to do the fun stuff—hands-on engineering and daily technical problem solving, some of us have to serve elsewhere. Many talented engineers and scientists are called to support the Aerospace industry in areas other than the direct technical work. Department chairs and deans, line managers, branch chiefs, logistical experts, operators, vice presidents, and company heads are some of the directions we get pulled into. The term "Aerospace Engineer" can no longer be applied to this group of people although they are also part of the AIAA community.

Are those of us that are no longer at the nuts and bolts of solving engineering problems not welcome? Can AIAA not find a place to discuss the issues that this community has to face as well? It might not be discussions on the latest techniques of CFD but rather the latest trends in acquisition processes or supply chain management, or the impact of additive manufacturing on design and certification of flight critical parts. All of these topics, while not specifically hard engineering and science, affect the Aerospace industry differently and can affect how our community of scientists, engineers, and technologists can work effectively and efficiently.

AIAA needs to be able to meet the needs of all of these various communities; communities that are bonded together by the passion and enthusiasm we have for things that fly. We cannot and will not abandon our roots—the technical core from aviation and rocketry that brought us together—but we have to ensure that we are inclusive enough to support engineers and scientists as we move in different directions during our careers in the Aerospace industry. We all want the industry to succeed and prosper.

So what's in a name? A lot, it seems—the weight of a whole enthusiastic group of people daring to dream and achieve great things! While many (or most) of us are engineers, we are all "Aerospace Professionals." We shape the future of Aerospace.

2014 BOARD OF DIRECTORS ELECTION RESULTS

AIAA is pleased to announce the results of its 2014 Board of Directors election. The newly elected officers and directors are:

Vice President-Elect, Finance—Laura McGill, Raytheon Corporation

Vice President-Elect, International Activities—John Evans, Lockheed Martin Corporation

Vice President-Elect, Publications—Frank Lu, University of Texas at Arlington

Vice President-Elect, Standards—Allen Arrington, Sierra Lobo Inc.

Director–Technical, Aircraft and Atmospheric Systems Group—Dimitri Mavris, Georgia Institute of Technology

Director–Technical, Engineering and Technology Management Group—Nancy Andersen, G & N Corporation

Director–Technical, Space and Missiles Groups—Peter Montgomery, Jacobs Engineering

Director–Region 1—Ferdinand Grosveld, Northrop Grumman Corporation

Director–At-Large, International—Scott Eberhardt, Aerospace Consultant

Director–At-Large—Basil Hassan, Sandia National Laboratories

"I congratulate and look forward to working with each of the newly elected board members," said AIAA President-Elect, Jim Albaugh. "Election to the Board of Directors is an acknowledgment by your peers of your commitment to AIAA. It carries with it a responsibility to ensure that AIAA stays a strong, vital organization, committed to shaping the future of aerospace."

The newly elected board members will begin their terms of office on **1 May 2014**.

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.

CONGRESSIONAL VISITS DAY 2014

Duane Hyland

On 12 March, 119 AIAA members walked around Capitol Hill, engaging lawmakers in a day of conversation about needed policy changes critical to the future of aerospace. Program participants came from all six of AIAA's domestic regions, representing 34 local sections and 20 states.

The day began with a breakfast for all participants in the Rayburn House Office Building where AIAA Executive Director Sandra Magnus spoke about the importance of public policy advocacy to the Institute and to the community. Magnus reminded participants that the type of advocacy that goes on during CVD is important because lawmakers have to see the "human" side of aerospace, and the only way to do that is through conversations with their constituents. She explained, "CVD is just the first step in establishing relationships with policymakers, these visits are really about building relationships with the lawmakers, and laying the groundwork for continued discussions during the summer when the decision maker is home on recess." Magnus concluded her remarks by stating that "she looked forward to hearing about the results of the visits, and seeing what types of activities are done over the summer to keep the engagement, and the conversations, going." AIAA Vice President of Public Policy, Mary Snitch, also spoke to the group, reminding them that citizen advocacy is a cherished American tradition, and urging everyone to "make the conversations count!"

Participants then ventured out for their meetings, completing 191 of them by day's end. Issues discussed at this year's CVD were the growing threat of orbital debris, access for unmanned aerial vehicles in the national aerospace system, the development of a seamless national cybersecurity policy, and assuring the viability of the U.S. aerospace and defense industrial base. For a complete list, please visit AIAA 2014 Key Issues at www.aiaa.org/SecondaryTwoColumn.aspx?id=21773.

The productive meetings have brought about several follow-up requests from congressional staff, ranging from AIAA writing model legislations (making it easier for lawmakers to meet our needs) to providing technical help with specific pieces of legislation, including House Resolution 3625, which mandates better cybersecurity across federal computing platforms.

Despite changes to the CVD program, including elimination of the event's training day, the 17th CVD program delivered a lean, focused slate of engagement with lawmakers—firmly cementing ongoing relationships with decision makers, while laying the framework necessary for firm partnerships with the Hill going forward. We hope that all members will continue to support the CVD program, and we invite each of you to join us here in Washington, DC, on 11 March 2015, when we go back to the Hill for another round of discussions aimed at furthering federal support for aerospace!

Team Maryland with Senator Mikulski's staff.

Team New England with Representative Michaud's staff

Above: Team Delaware with Senator Caper's staff. Below: Team Michigan with staff from Representative Bentivolio's Office.

Team Kansas with Representative Yoder.

FUTURE CITY SPECIAL AWARD

Bruce Cranford, AIAA-NCS Liaison to DiscoverE Week

The AIAA National Capital Section (AIAA-NCS) presented a Special Award for the Best Use of Aerospace Technology as part of the Future City's program to the team from the Aiken Area, South Carolina Home Educators. The future city name was Veloreno and team members were Jordan Lewis, Rosemarie Pousset, and Sophie King; Jill Potvin (teacher); and Larry Morris (engineer mentor). The AIAA-NCS congratulates the team for their outstanding efforts. The support of the Future City's program is part of the National Capital's Section commitment to STEM.

The award, presented by Dr. Supriya Banerjee, Chair, AIAA-NCS and Bruce Cranford, AIAA-NCS liaison to the DiscoverE week, consisted of a savings bond and a plague for each student team member. The AIAA-NCS also wishes to thank the NCS judges: Sri Ayyalasomayajula (Research Scientist at Intelligent Automation, Inc.), Ben Jimenez (Army Research Laboratory), and Dr. Ananthakrishna Sarma (Senior Scientist, Technical Fellow, Center for Atmospheric Physics, Leidos Inc.).

Teams from 37 middle schools nationwide, winners of regional competitions in January, participated in the Future City National Finals, 15–18 February, in Washington, DC. All regional winning teams received an all-expense-paid trip to the National Finals. Future City is sponsored in part by Engineers Week, a consortium of more than 100 engineering societies and major corporations. For more information and a list of all the winners, visit http://www.futurecity.org/

Dr. Supriya Banerjee, Chair, AIAA-NCS (right) with The Aiken area, South Carolina Home Educators team and their future city project. (*Photograph by Bruce Cranford*)

Future City, in its 22nd year, asks middle school students to create cities of the future, first on a computer and then in large tabletop models. Working in teams with a teacher and volunteer engineer mentor, students create their cities using the SimCity 3000 TM video game donated to all participating schools by Electronic Arts, Inc. of Redwood City, CA. They write a city abstract and an essay on using engineering to solve an important social challenge. They present and defend their cities before engineer judges at the competition. More than 40,000 students from more than 1,350 schools participated in 2013–2014.

The students created detailed—often fantastic—cities of tomorrow that give intriguing insight into how young minds envision their future. At the same time, their bold designs and innovative concepts provide a refreshingly optimistic appreciation of how our nation can realistically deal with the many challenges facing its cities, including environmental disasters, crime, urban decay, transportation and urban sprawl.

2014 AIAA NCS judges. (*Photograph by Bruce Cranford*)

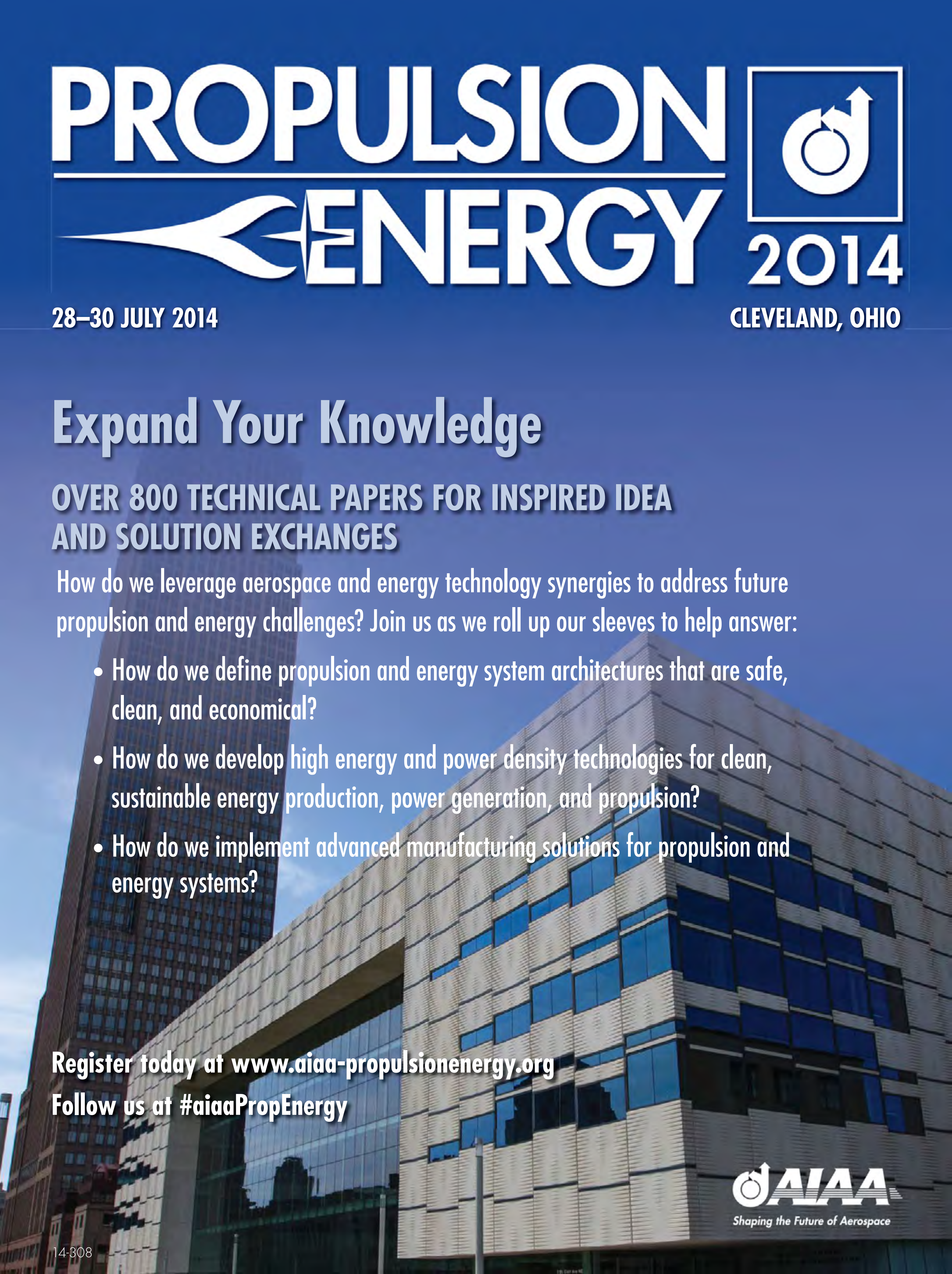
FREITAG SR. SCHOLARSHIP PRESENTED TO GABLENZ

The AIAA Joseph Freitag Sr. Scholarship Prize was given to 20-year-old **Sven Gablenz** on 10 September 2013, at the Daimler Training Institute, Stuttgart, Germany. Mr. Gablenz graduated as an industrial engineer and was selected to receive this 7th annual award of the scholarship by the instructors at the institute based on the criteria that is contained in the AIAA award certificate.

In addition to having an outstanding academic record and team leader, the awardee has to have been accepted into an engineering college or university to pursue a bachelor of engineering degree. Mr. Gablenz was admitted to the Esslingen Hochschule (College) to pursue studies leading to a degree in mechanical engineering. The ceremony followed the graduation of over 100 students from the Daimler Training Institute, most of whom will be offered jobs at Daimler in one of the Mercedes facilities or other factories that are part of Daimler.

The award was created by John and Joseph Freitag Jr., the sons of Joseph Freitag Sr. Mr. Freitag Sr. graduated from the Daimler Training Institute in 1924 and came to the United States, where he had an outstanding career as a designer at the Sperry Gyroscope Company. Among other work, he was the designer of the Sperry Bombsight that became the basis of automatic flight control. Mr. Freitag Sr. is honored on the Smithsonian Walk of Fame near Dulles Airport.

Mr. Gablenz receiving the award. From left to right, Marion Pietsch (Director of the Training Institute), Joe Freitag Jr, Sven Gablenz, John and Denise Freitag.


PROPULSION ENERGY 2014
28–30 JULY 2014
CLEVELAND, OHIO
Expand Your Knowledge
OVER 800 TECHNICAL PAPERS FOR INSPIRED IDEA AND SOLUTION EXCHANGES
How do we leverage aerospace and energy technology synergies to address future propulsion and energy challenges? Join us as we roll up our sleeves to help answer:
• How do we define propulsion and energy system architectures that are safe, clean, and economical?
• How do we develop high energy and power density technologies for clean, sustainable energy production, power generation, and propulsion?
• How do we implement advanced manufacturing solutions for propulsion and energy systems?
Register today at www.aiaa-propulsionenergy.org
Follow us at #aiaaPropEnergy
AIAA
Shaping the Future of Aerospace
14-308

LEEDS ELEMENTARY SCHOOL PARTICIPATES IN NASA'S EXPLORATION DESIGN CHALLENGE

On 25 February, kindergarten students at Leeds Elementary School in Elkton, MD, participated in the NASA Exploration Design Challenge, which was facilitated by AIAA Delaware Section Public Policy Officer Tim Dominick. As part of the challenge, students learned about the effects of radiation on human space travelers and analyzed different materials that simulate space radiation shielding for NASA's Orion spacecraft.

The students were also introduced to the scientific method and how to apply that process for their study, and Astronaut Suni Williams provided a recorded message from her time on the International Space Station that encouraged the students to think like a NASA engineer while participating in the challenge. All the kindergarten students at Leeds Elementary will be joining participants from around the world to celebrate the Exploration Flight Test-1 (EFT-1) of Orion by having their names flown on board as virtual crew members. EFT-1 has recently been rescheduled to launch from Kennedy Space Center aboard a Delta IV Heavy in December 2014.

Leeds Elementary kindergarten students testing different radiation shielding materials.

HAMPTON ROADS SECTION PARTICIPATED AT TIDEWATER SCIENCE & ENGINEERING FAIR

On 15 March, eight members of the Hampton Roads Section (HRS) participated as judges for the Tidewater Science and Engineering Fair's AIAA HRS Awards at Old Dominion University. First and second place awards were given in both the senior and junior categories for projects devoted to the progress of engineering and science in aviation and space. All winners received certificates and will be invited to our awards dinner. First place winners received $100 and second place winners received $50. The sponsoring teachers for each first or second place winner received $50 or $25, respectively (AIAA HRS was one of only two groups to recognize the teachers for their hard work as well as the student participants).

The winners for the AIAA HRS Awards were:

- *Senior Division 1st Place*: Gerrold Walker, "The Effect of Car Spoiler on Aerodynamic Performance," Ocean Lakes High School, Virginia Beach Public Schools, sponsoring teacher was Heather Green
- *Senior Division 2nd Place*: George Wenn III, "Solar Heater," Heritage High School, Newport News Public Schools, sponsoring teacher was Tysha Sanford.
- *Junior Division 1st Place*: Jenna Davidson, "The Effect of Fuel Density on Bottle Rocket Height," Tabb Middle School, York County Public Schools, sponsoring teacher was Theresa Guthrie.
- *Junior Division 2nd Place*: Kylee Baines, "Where Did All the Stars Go," Gildersleeve Middle School, Newport News Public Schools, sponsoring teacher was Tim Criner.

This year's AIAA HRS Award judges were Karen Arnett, Karen Berger, Brad Crawford, Robert Dillman, Frank Dixon, Robert Norcross, Joe Posey, and Bruce Powers. AIAA HRS K–12 Outreach Co-Chair Karen Berger presented the awards.

AIAA HRS Educator Associate Karen Arnett judging a Tidewater Science and Engineering Fair Junior Category participant.

AIAA HRS judge Bruce Powers with a Tidewater Science and Engineering Fair Junior Category participant.

Important Announcement: New Editor-in-Chief Sought for the *Journal of Thermophysics and Heat Transfer*

AIAA is seeking an outstanding candidate with an international reputation for this position to assume the responsibilities of Editor-in-Chief of the *Journal of Thermophysics and Heat Transfer*. The chosen candidate will assume the editorship at an exciting time as new features and functionality intended to enhance journal content are added to Aerospace Research Central, AIAA's platform for electronic publications.

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

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

Heather Brennan, Director, Publications
American Institute of Aeronautics and Astronautics
1801 Alexander Bell Drive, Suite 500
Reston, VA 20191-4344
Fax: 703/264-7551
E-mail: heatherb@aiaa.org

A minimum of two letters of recommendation also are required. The recommendations should be sent by the parties writing the letters directly to Ms. Brennan at the above address, fax number, or e-mail. **To receive full consideration, applications and all required materials must be received at AIAA Headquarters by 15 May 2014, but applications will be accepted until the position is filled.**

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

Important Announcement: New Editor-in-Chief Sought for the *Journal of Spacecraft and Rockets*

AIAA is seeking an outstanding candidate with an international reputation for this position to assume the responsibilities of Editor-in-Chief of the *Journal of Spacecraft and Rockets*. The chosen candidate will assume the editorship at an exciting time as new features and functionality intended to enhance journal content are added to Aerospace Research Central, AIAA's platform for electronic publications.

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

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

Heather Brennan, Director, Publications
American Institute of Aeronautics and Astronautics
1801 Alexander Bell Drive, Suite 500
Reston, VA 20191-4344
Fax: 703/264-7551
E-mail: heatherb@aiaa.org

A minimum of two letters of recommendation also are required. The recommendations should be sent by the parties writing the letters directly to Ms. Brennan at the above address, fax number, or e-mail. **To receive full consideration, applications and all required materials must be received at AIAA Headquarters by 15 May 2014, but applications will be accepted until the position is filled.**

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

AHMADIAN NAMED DAN PLETTA PROFESSOR AT VIRGINIA TECH

Mehdi Ahmadian, professor of mechanical engineering in the College of Engineering at Virginia Tech, was recently named the Dan Pletta Professor by the Virginia Tech Board of Visitors. The Dan Pletta Professorship in the College of Engineering is named for a former department head and professor of engineering science and mechanics who served the university from 1932 to 1972 and died in 1996. The recipient of the professorship holds it for a five-year term.

A member of the Virginia Tech community since 1995, Ahmadian has received international recognition for his research, publication record, and leadership in the field of vibration, and vehicle dynamics and control. Before joining Virginia Tech, Ahmadian held engineering and managerial positions with the Lord Corp. and the General Electric Co. At Virginia Tech, he is the founding director of the Center for Vehicle Systems and Safety and the Railway Technologies Laboratory. He was the founding director of the Virginia Institute for Performance Engineering and Research and the Advanced Vehicle Dynamics Laboratory.

He has authored more than 120 peer-reviewed journal publications and more than 250 conference publications. He has made more than 300 technical presentations in topics related to advanced technologies for ground vehicles, including four keynote lectures and more than 50 invited colloquiums. He holds eight U.S. and international patents, and he has edited six technical volumes. Ahmadian has worked with other faculty on research programs totaling $17.5 million and has been personally responsible for $14.3 million in research funding.

He currently serves as editor for the *International Journal of Vehicle System Dynamics*, editor-in-chief of *Shock and Vibration*, editor-in-chief for *Advances in Automobile Engineering*, and senior editor of *Journal of Vibration and Control*. He also serves on the editorial board of the journal *Smart Materials Research* and *Advances in Mechanical Engineering*. In the past, he has served as associate editor for the American Society of Mechanical Engineers' *Journal of Vibration and Acoustics*, the *AIAA Journal*, and *Shock and Vibration*.

Ahmadian is a Fellow of ASME and SAE International and an AIAA Associate Fellow. He is the recipient of the 2008 Society of Automotive Engineers Forest R. McFarland Award and the 2014 SAE International L. Ray Buckendale Award that includes a plenary lecture on "Integrating Electromechanical Systems in Commercial Vehicles for Improved Handling, Safety, and Comfort."

Ahmadian regularly teaches undergraduate and graduate courses in vehicle dynamics, vibrations, control, and mechanical design; leads senior undergraduate design teams; and supervises undergraduate research programs. He has advised 20 doctoral degree and 45 master's degree students to completion.

Ahmadian received his bachelor's degree, master's degree, and doctoral degree from the State University of New York at Buffalo.

OBITUARY

AIAA Fellow Harwell Died in April

Dr. Kenneth E. Harwell died on 4 April at the age of 77.

Dr. Harwell received a congressional appointment to the U.S. Army Military Academy at West Point (which he declined) and instead he joined the U.S. Army Reserve, advancing to sergeant first class. He earned a Bachelor of Science degree in aeronautical engineering from the University of Alabama in 1959. He went on to further his education at The California Institute of Technology by completing his Masters and PhD in Aeronautics.

From 1963 to 1976, Dr. Harwell, then professor at Auburn University, was instrumental in developing graduate programs in Aerospace Engineering. His most significant accomplishment while at Auburn was the design and implementation of the doctoral program in Aerospace Engineering.

From there, he went on to the University of Tennessee Space Institute as a professor, ultimately being appointed Dean from 1982 to 1989. While at UTSI, Dr. Harwell helped found the Center for Excellence for Laser Applications, the NASA Center for Advanced Propulsion, and the University of Tennessee Calspan Center for Aerospace Research, among other initiatives.

In 1989, Dr. Harwell was named Senior Vice President for Research and Associate Provost for the University of Alabama in Huntsville. He led the university to become one of the top leaders in research in the country. While at UAH, Harwell contributed to the formation of the Global Hydrology and Climate Center, the Space Science and Technology Alliance, and supervised over 15 research centers and institutes.

Following his retirement from UAH, Dr. Harwell was appointed the first Chief Scientist of the Air Force Research Laboratory organization where he served for two years leading the establishment of future national investments of the U.S. Air Force. Harwell also served as Director of Defense Laboratory Programs in the Office of the Secretary of Defense continuing his contributions to national investments in research, engineering, and science. Harwell also had consulted with Auburn University's College of Engineering in recent years.

Dr. Harwell was a registered professional engineer in Alabama and a Distinguished Engineering Fellow at the University of Alabama. He was recognized with the 1981 General H.H. Arnold Award from the AIAA Tennessee Section and the 1991 Holger Toftoy Award and 1997 Professional of the Year Award from the AIAA Alabama/Mississippi Section. He was the author of numerous research publications and held two patents. Dr. Harwell served on the AIAA Board of Directors as Director–At Large from 2007 to 2010. His involvement in AIAA included working with the STEM K–12 Outreach Committee, as well as the Electric Propulsion and Plasmadynamics and Lasers Technical Committees, among others.

Dr. Harwell's legacy will continue to live through the numerous groundbreaking programs he established and students he touched over the many years of service to the academic world.

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 otherwise indicated. However AIAA accepts nominations year-round and applies them to the appropriate year.

Any AIAA member in good standing may serve as a nominator and are urged to read award guidelines to view nominee eligibility, page limits, and letters of endorsement instructions. All nominations, whether submitted online or in hard copy, must comply with the limit of 7 pages for the nomination package; see details on the webpage (**https://www.aiaa.org/secondary.aspx?id=230**).

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

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

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

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

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

Dr. John Ruth Digital Avionics Award presented to recognize 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)

Faculty Advisor Award 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 presented for the best original contribution to the field of aeronautical or astronautical historical non-fiction literature published in the last five years dealing with the science, technology, and/or impact of aeronautics and astronautics on society.

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

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

Call for Nominations for the Excellence in Aerospace Standardization Award due 1 July

Recognize the achievements of your standards colleagues by nominating them for the Excellence in Aerospace Standardization Award! This biennial award honors contributions by individuals who advance the health of the aerospace community by enabling cooperation, competition, and growth through the standardization process. Such individuals may have been committee chairs, project leaders, or industry executives; the award is intended to recognize substantive accomplishment.

Any AIAA member in good standing may be a nominator; please review the award guidelines for nominee eligibility, letters of endorsement, and page limits here. AIAA members may submit nominations online after logging in with their username and password, where you will be guided step-by-step through the process. Paper entries are also acceptable. For more information, please contact Carol Stewart, Manager, AIAA Honors and Awards, at carols@aiaa.org.

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

Lawrence Sperry Award 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 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 presented for an outstanding contribution or contributions to aeronautical and astronautical literature in the relatively recent past.

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

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

Summerfield Book Award 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 presented to recognize 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, contact Carol Stewart, Manager, AIAA Honors and Awards at carols@aiaa.org or 703.264.7623.

SPACE 2014

AIAA Space and Astronautics Forum and Exposition

Connecting, Protecting, and Enhancing a Global Society

4–7 August 2014
Manchester Grand Hyatt
San Diego, California

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

www.aiaa-space.org
#aiaaSpace

Premier Sponsor

LOCKHEED MARTIN

Sponsors

a.i. solutions — Smarter approaches. Better results.℠

BOEING®

DUNMORE®

SSL™

Media Sponsors

AEROSPACE AMERICA

SPACENEWS®

Executive Steering Committee
James H. Crocker, Lockheed Martin Space Systems
Lt Gen (Ret) Larry D. James, NASA Jet Propulsion Laboratory
Gregory Jones, Orbital Sciences
David King, Dynetics, Inc.
Christopher Scolese, NASA Goddard Spaceflight Center
Lt Gen (Ret) John T. “Tom” Sheridan, The SI Organization, Inc.

AIAA Programs

Conference Overview

AIAA SPACE 2014 will examine the impacts of space activity on society. The forum will convene a global conversation around the important role our community plays in enabling a connected culture, monitoring our planet, expanding our boundaries beyond Earth, and advancing technology and innovation to address worldwide opportunities.

The forum's general sessions, plenary speakers, and panelists will address these key issues:

Facilitating Global Connections
• What sorts of new opportunities and capabilities do space-based assets and technologies enable in terms of connecting society?
• What capabilities are missing?
• What do complimentary industries need from the space community to make their businesses more successful?

Monitoring the Planet
• What new EO systems are being developed?
• What innovative uses of climate and weather data will we see in the near, mid, and long term?
• Are our on-orbit systems sufficient and sustainable to provide the data and services needed in an emergency?

Expanding Boundaries
• What is the current status of major exploration programs?
• How do non-governmental initiatives fit with governmental plans?
• How do we sustain exploration in a constantly changing policy and budget environment?
• How do we communicate the importance and benefits of exploration to those outside of our community?

Advancing Technology
• How are space technologies used to increase the efficiency and effectiveness of common processes?
• What new technology spin offs are providing opportunities for new businesses?

Technical Program

A strong technical program, featuring the industry leaders and original thinkers, will keep you at the cutting edge of new thinking, best practices, and stimulating idea exchanges. The program includes:

Communications Systems (ICSSC)
Astrodynamics Specialist
National Security Space
Space and Earth Science
Space Exploration
Space Operations & Logistics
Space Resources & Colonization
Space History, Society, and Policy
Space Systems
Space Transportation and Launch
Space Robotics and Space Architecture
Space Systems Engineering and Economics
Reinventing Space

Speakers

Speakers for AIAA SPACE 2014 will be announced on our website: **www.aiaa-space.org**, as they are confirmed. Check back for updates.

Recognition

Join us in Pasadena as we recognize the very best in our industry: those individuals and teams who have taken aerospace technology to the next level…who have advanced the quality and depth of the aerospace profession…who have leveraged their aerospace knowledge for the benefit of society. Their achievements have inspired us to dream and to explore new frontiers.

AIAA SPACE 2014 will present the following technical awards:

Aerospace Communications Award
George M. Low Space Transportation Award
Haley Space Flight Award
Space Sciences Award
Space Systems Award
von Braun Award for Excellence in Space Program Management

Networking

AIAA SPACE 2014 is expected to draw more than 800 participants from across all facets of the aerospace enterprise who are shaping the future of flight. Whether it's lunch in the exhibit hall, evening receptions, B2B matchmaking, awards ceremonies, lectureships, or simply talking with the person next to you at a technical paper presentation, you'll find many opportunities to meet new colleagues and build new relationships.

Continuing Education

Stay at the top of your game with continuing education courses from AIAA. AIAA SPACE 2014 will offer the following course on 3–4 August:

Decision Analysis*

Decision Analysis (aka Trade Study) is a subject of the systems engineering process. Decision needs to be made from conceptual development to verification, manufacturing and disposal; from system-level down to component/subcomponent levels. It can be applied to any areas and subjects including your personal life. This course will introduce the trade study role and process as part of the overall systems engineering process.

•Schedule subject to change

ISCCS Colloquium

Monday, 4 August, 0800–1730 hrs

The Technical Committee on Communications Systems will present a separate, full-day colloquium exploring the special topic of "Next Generation Broadband Satcom." Whether to support direct broadcast to homes, access to the Internet, or evolving military communications, the need for increased satellite communication capacity and capabilities subject to stringent quality of service requirements is ubiquitous. The colloquium will address this topic from several perspectives. Enabling the next generation of broadband communications will be advances in a variety of technologies.

ICSSC Colloquium requires a separate registration

Business-to-Business (B2B) Match Making

Tuesday, 5 August, 1000–1400 hrs

Participate in B2B matchmaking activities at AIAA SPACE 2014 to find out how your capabilities match with the needs of major government R&D agencies and aerospace corporations. Learn about the latest technology opportunities, form new alliances and partnerships, and 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. Cost to attend is $200 and includes lunch.

Opening Reception and Poster Session

Tuesday, 5 August, 1830–2000 hrs, Exhibition Hall

William H. Pickering Lecture

Wednesday, 6 August, 1830–2000 hrs, Grand Hall at the Manchester Grand Hyatt

The William H. Pickering Lecture is named for the former NASA Jet Propulsion Laboratory Director to honor his initiation and leadership of America's unmanned scientific space program, from Explorer I in 1958 through the development of the Viking orbiters and Voyager outer planet and interstellar missions. The lecture is open to all attendees and the general public.

Rising Leaders in Aerospace Forum

AIAA's Rising Leaders in Aerospace Forum provides a forum for young aerospace leaders, age 35 and under, to learn from and engage with others. The multidimensional program will feature networking and professional development activities. More information coming soon.

Complex Aerospace Systems Exchange (CASE)

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. Over the course of three days, CASE will examine the following topics:

- Complex Systems Development
- Integration, Test, and Verification of Complex Systems
- Program Management to Achieve Robust and Resilient Systems

Sponsorship and Exposition

In today's dynamic business environment, effective outreach and customer interface are vital to successfully capturing new partnership opportunities. AIAA's sponsorship and exhibits programs can help you achieve your objectives. Contact Merrie Scott, merries@aiaa.org to secure your sponsorship, and Christopher Grady at chrisg@aiaa.org to book your exhibit space today.

Hotel Information

AIAA has made arrangements for a block of rooms at the hotel listed below.

Manchester Grand Hyatt San Diego
One Market Place
San Diego, California 92101
Tel: +1 619.232.1234

Room rates are $219 for a standard room. Applicable taxes will apply. Book your rooms early! These rooms will be held for AIAA until **11 July 2014** or until the room block is full, then released for use by the general public.

There are also a small number of federal government per diem rooms available. Please select "GOVERNMENT" under guest type. If you reserve a government room, you will need to present a government ID upon check-in.

If you have issues making reservations under one of the AIAA blocks, please contact Anna Kimmel (annak@aiaa.org), AIAA Event Manager.

Registration

Register and sign up for email alerts at **www.aiaa-space.org**.

Upcoming AIAA Continuing Education Courses

AIAA now offers live and on-demand Continuing Education webinars.
Viewers enjoy excellent tutorials for effective online learning at home or in the office.
For more information please visit https://www.aiaa.org/webinars.

14–15 June 2014
Workshop and Courses at AIAA Aviation and Aeronautics Forum and Exposition 2014 (AIAA AVIATION 2014)
www.aiaa-aviation.org

Third AIAA Workshop on Benchmark Problems for Airframe Noise Computations (BANC-III)

The major emphasis of this workshop will be coordinated computational, modeling, and measurement efforts based on collaborative definition of a hierarchical set of benchmark configurations representing major sources of airframe noise; joint development of datasets that would eventually achieve benchmark quality.

Business Management for Engineers (Instructor: Alan Tribble)

This course is intended to provide an overview of basic business principles used to manage a company. In particular, this course will help individuals with a strong technical background in science or engineering prepare for the transition from a role as a technical contributor to a business leader.

Key topics
- Capitalism and free markets
- Business finance
- Business structure and functions
- The relationship between systems engineering and program management
- Communicating for business impact versus technical
- Globalization

Optimal Design in Multidisciplinary Systems (Instructors: Joaquim R. R. A. Martins & Jaroslaw Sobieski)

Design engineers and technical managers involved with preliminary or detailed design of aerospace, mechanical, and other multidisciplinary engineering systems will find this material applicable in their work environment. Advanced research students and research scholars in academia and in research laboratories will also benefit from the topics covered in this course. They would use this material as an entry point into possible areas of further research.

Key Topics
- Multidisciplinary design—components, challenges, and opportunities
- Optimization methods
- Sensitivity analysis
- Decomposition architectures in multidisciplinary design
- Surrogate modeling in design
- Soft computing methods in optimal design

31 July–1 August 2014
Workshop and Courses at AIAA Propulsion and Energy Forum and Exposition 2014 (AIAA Propulsion and Energy 2014)
www.aiaa-propulsionenergy.org

2nd AIAA Propulsion Aerodynamics Workshop

This workshop is being held so that various groups from industry and academia can look at a given set of Propulsion Aerodynamic problems and come up with an agreed set of solutions to the problems.

Hybrid Rocket Propulsion (Instructor: Joe Majdalani)

This course is essential for all professionals specializing in chemical propulsion. The mechanisms associated with hybrid combustion and propulsion are diverse and affect our abilities to successfully advance and sustain the development of hybrid technology. It is our ultimate goal to promote the science of hybrid rocketry that is safe enough to be used in both academia and the private sector. A historical demonstration of hybrid rocket capability is the 2004 X Prize winner SpaceShipOne. This technology can also be used in outreach activities when used in conjunction with hands-on design projects and payload launches that involve student teams. Interest in hybrid rocketry can be translated into increased awareness in science and technology, helping to alleviate the persistent attrition in our technical workforce. This course reviews the fundamentals of hybrid rocket propulsion with special emphasis on application-based design and system integration, propellant selection, flow field and regression rate modeling, solid fuel pyrolysis, scaling effects, transient behavior, and combustion instability. Advantages and disadvantages of conventional and unconventional vortex hybrid configurations are examined and discussed.

Key Topics
- Introduction, classification, challenges, and advantages of hybrids
- Similarity and scaling effects in hybrid rocket motors

- Flowfield modeling of classical and non-classical hybrid rockets
- Solid fuel pyrolysis phenomena and regression rate: mechanisms & measurement techniques
- Combustion instability and transient behavior in hybrid rocket motors
- Metals, other energetic additives, and special binders used in solid fuels for hybrid rocket applications

Who Should Attend

This short-course is aimed at bringing together professionals with mutual interest in chemical combustion and propulsion, including modern techniques for measuring hybrid rocket performance, flame and flow field modeling, testing, and stability analysis. The purpose is to present and discuss fundamental theory alongside research findings with emphasis on unsolved problems, open questions, and benchmark tests. The course will provide a platform for learning and exchanging hybrid rocket experiences in the hope of stimulating further interactions and future collaborations.

Missile Propulsion Design, Technologies, and System Engineering (Instructor: Eugene L. Fleeman)

A system-level, integrated method is provided for missile propulsion design, technologies, development, analysis, and system engineering activities in addressing requirements such as cost, performance, risk, and launch platform integration. The methods presented are 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.

Key Topics

- Key drivers in the missile propulsion design and system engineering process
- Critical tradeoffs, methods,, and technologies in propulsion system sizing to meet flight performance and other requirements
- Launch platform-missile integration
- Sizing examples for missile propulsion
- Missile propulsion system and technology development process

Application of Green Propulsion for Future Space

Liquid propulsion systems are critical to launch vehicle and spacecraft performance, and mission success. This two-day course, taught by a team of international experts, will focus on the movement to green propulsion for a range of spacecraft applications. Topics include a brief history of hypergols; what is considered green and what is driving the green propulsion movement; figures of merit and lessons learned in the development of green propellants; flight experience and applications for the various classes of satellites; and challenges for current and future green thrusters and systems.

Key Topics

- History of storables
- What is green and what is driving the green movement
- Green propellants
- Green flight experience
- Applications of green propulsion

3–4 August 2014
Course at AIAA Space and Astronautics Forum and Exposition 2014 (AIAA SPACE 2014)
www.aiaa-space.org

Decision Analysis (Instructor: John Hsu)

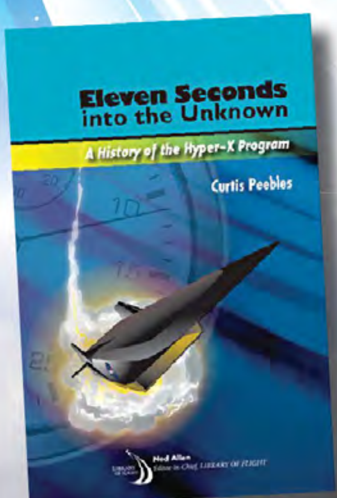
Decision analysis is an important part of system life cycle development throughout all phases and system hierarchical levels. This course presents the trade study process as part of the systems engineering process and introduces different decision analysis methods including the traditional trade study methods, trade space for Cost as Independent Variable (CAIV), Analytic Hierarchy Process (AHV) as part of the Analytic Network Process (ANP), Weighted Sum Model (WSM), Potentially All Pairwise Rankings of All Possible Alternatives (PAPRIKA), and Decision Analysis with Uncertain information/data. The highlights are: evaluation criteria weights assignment methods including objective determination via QFD methodology; how to down-select too many alternatives; various scoring methods for evaluation criteria; how to develop decision trees; mathematical eigenvector calculations to assist the AHP analysis; how to handle billions pairwise combinations and rankings for PAPRIKA; and five methods to reach decisions with uncertain information/data, and more. Several ways of writing credible and thorough trade study report are introduced.

Key Topics

- Understand the trade study process and role in the overall systems engineering process.
- Learn the traditional trade study methods: Defining selection criteria, Identifying weights, Identifying alternatives, Defining scoring criteria, Scoring alternatives, Calculating ratings for alternatives, and Performing sensitivity analysis.
- Learn how to develop decision trees as hierarchical guidance for different levels of trade studies.
- Learn the trade study role and contribution to Cost as Independent Variable (CAIV).
- Learn how to use and apply decision analysis methods including Analytic Hierarchy Process (AHV) as part of the Analytic Network Process (ANP), Weighted Sum Model (WSM), Potentially All Pairwise Rankings of All Possible Alternatives (PAPRIKA), and Decision Analysis with Uncertain information/data.
- Learn how to write a credible, organized, structured and thorough trade study report.

LIBRARY OF FLIGHT

Suitable for all reading levels, the Library of Flight series encompasses a wide variety of general-interest and reference books, including case studies. Appropriate subjects include the history and economics of aerospace as well as design, development, and management of aircraft and space programs.



FEATURED TITLES

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

Curtis Peebles
342 pages

This is the highly-anticipated sequel to Peebles' first book on the X-43A/Hyper-X project, *Road to Mach 10: Lessons Learned from the X-43A Flight Research Program.* A central theme of the Hyper-X story is how disparate groups and organizations became a unified team working toward a common goal.

ISBN: 978-1-60086-776-7
List Price: $39.95
AIAA Member Price: $29.95

"Perfect for those interested in high-speed flight, aerospace history, the organization and management of technological projects, and the future of spaceflight."

Skycrane: Igor Sikorsky's Last Vision

John A. McKenna
136 pages

The Skycrane was the last creation of aircraft design pioneer Igor Sikorsky. In *SKYCRANE: Igor Sikorsky's Last Vision*, former Sikorsky Aircraft Executive Vice President John A. McKenna traces the development of this remarkable helicopter from original concept and early sketches to standout performer for the military and private industry.

ISBN: 978-1-60086-756-9
List Price: $39.95
AIAA Member Price: $29.95

"An inside look at the continual innovation and perseverance required for the creation and development of one of the world's most unusual helicopters."

– Michael J. Hirschberg, Managing Editor, Vertiflite magazine

12-0168_update3

Find these books and many more at **arc.aiaa.org**

AIAA

AIAA's #1 Selling Book

Aircraft Design: A Conceptual Approach, Fifth Edition

Daniel P. Raymer

July 2012, 800 pages, Hardback

ISBN: 978-1-60086-911-2

List Price: $109.95

AIAA Member Price: $84.95

This best-selling textbook presents the entire process of aircraft conceptual design—from requirements definition to initial sizing, configuration layout, analysis, sizing, optimization, and trade studies. Widely used in industry and government aircraft design groups, *Aircraft Design: A Conceptual Approach* is also the design text at major universities around the world. A virtual encyclopedia of aerospace engineering, it is known for its completeness, easy-to-read style, and real-world approach to the process of design.

Special Features and Concepts Discussed:

- More than 900 pages of design methods, illustrations, tips, explanations, and equations
- Overviews of lofting, subsystems, maintainability, producibility, vulnerability, and stealth
- Concepts and calculation methods for aerodynamics, stability and control, propulsion, structures, weights, performance, and cost
- Coverage of conventional and unconventional design methods, including UAV, canard, tandem wing, C-wing, oblique wing, asymmetrical, multi-fuselage, wing-in-ground-effect, and more
- VTOL, helicopter, spacecraft, launch vehicle, hypersonic, and airship design
- Advice on how to become an aircraft designer
- Electric aircraft, batteries, fuel cells, and solar cells
- Green airplanes, including biofuels, GTL, hydrogen, methane, and nuclear
- Active aeroelastic wing and advanced tailless concepts

RDS^{win} Student: Software for Aircraft Design, Sizing, and Performance, Enhanced and Enlarged, Version 6.0

CD-ROM

ISBN: 978-1-60086-920-4

List Price: $109.95

AIAA Member Price: $84.95

The companion RDS^{win} Student aircraft design software is a valuable complement to the text. RDS^{win} Student incorporates the design and analysis methods of the book in menu-driven, easy-to-use modules. An extensive user's manual is provided with the software, along with the complete data files used for the Lightweight Supercruise Fighter design example in the back of the book. **Now runs on the Windows operating system.**

Buy Both and Save!

Aircraft Design Fifth Edition Textbook and RDS^{win} Student software

ISBN: 978-1-60086-921-1

List Price: $159.95

AIAA Member Price: $124.95

AIAA EDUCATION SERIES

Order 24 hours a Day at arc.aiaa.org

12-0170-3d