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Triton Systems Stellar-J

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Contents

Cover: Wes Kelly's Stellar-J climbs to altitude on turbine power, carrying an upper stage with payload piggyback. Concept art by Jon Berndt, using POV-Ray (www.povray.org), Terragen (www.planetside.co.uk/terragen/), and Moray (www.stmuc.com/moray/).

From the Editor The *Santa Maria* was Rented

JON S. BERNDT

In the midst of the recovery from hurricane Katrina and the birth of hurricane Rita, NASA released the results of the Exploration Systems Architecture Study (ESAS). The combination of the three events proved to be an opportune target for a number of editorial writers. I lost count of how many times I read, "*Can we really afford to spend over $100 billion on something we've essentially already done, in the same way we've already done it … now?*" [Rarely mentioned is that the cost given is spread out over many years.] I could not help but think of a poster I had seen, a parody of the motivational messages seen in the workplace: "*The tallest blade of grass is the first to be cut by the lawnmower.*"

Frankly, the nation *is* facing some huge abnormal and unexpected expenses. The cost/benefit question is a valid one to ask. In an email discussion I had with several people, a couple of relevant points were raised:

Going to the Moon and later, Mars will cost the American middle class taxpaying family of four as much per year as they spend on one pizza.

All NASA knowledge is in the public domain and thus may constitute the greatest single growing source of intellectual capital available to the citizens of the United States.

Perhaps one of the best endorsements for human spaceflight comes from China. With the insight gained from observing decades of U.S. and Russian human spaceflight endeavors, that country is convinced of the worth of the effort – perhaps asking themselves not if they could afford to pursue it, but if they could afford *not* to.

The *Why* is not in question. It's the *How*, and the *Who* – at least if you ask the new space entrepreneurs.

Within the editorial *noise*, amidst the denigrating references to "Apollo v2.0", there is an interesting *signal*: a set of intelligent points and questions being raised not necessarily regarding the Vision for Space Exploration (VSE), but the implementation of it (ESAS). Some would like to see more commercial opportunity associated with the VSE — not just the same "lip service" that has been given literally for two decades up to this point. Wes Kelly, designer of a potential Earth-to-orbit workhorse called Stellar-J (see article this issue), says: "*If NASA wants to go to Mars, it will be able to only if commercial people (not just the big guys) know how to get to orbit, have the facilities, the contracts, and do it routinely. Not the other way around.*" The point is that, while NASA has the technical capability to go to the Moon, or Mars, etc., it will only be able to *afford* to do so if there is a more established infrastructure that it can leverage. For example, imagine if Antarctic research expedition teams had to design, manufacture, and operate C-130 aircraft, helicopters, and ship transports to perform their mission.

Rick Tumlinson, Co-Founder of the Space Frontier Foundation, expressed disappointment in the ESAS plan in early October:

"The public sector has to understand its role is to enable the private sector – not to do it for us. This is critical. NASA can't expand civilization into space any more than the FBI can. They are a federal agency. Their job is to help the public, not be the public. NASA can be a lean, mean, exploration machine if they want to be - though they don't for all kinds of reasons, which add up to this disaster of a plan. They feel the need to own everything, to run it all, to keep their rice bowls filled and those of their constituents ...

NASA is faced with how to do this on a budget. In the example of the vehicles, the agency has decided to go build yet another mega ship, to its own specs and design. What would have happened if the agency had had the incredible, daring, concept of saying we will pay X number of dollars for X number of pounds delivered to X location per year? Some say that we can't put the "NewSpace" companies or such newfangled ideas as pay-for-delivery in the critical path. After all, they are unproven. As I said in my Space News piece, the one thing we have actual evidence for is that the traditional solutions and players have blown it almost 100% of the time when it comes to delivering on the sales pitch. But my idea of offering payments etc. wouldn't even shut out the traditionals. They would just have to get creative again."

In announcing the results of the ESAS, NASA Administrator Mike Griffin expressed strong support for prudent use of commercial services:

"*We are baselining in the out years past the retirement of the shuttle, … commercial service to the station. That is the only known and knowable – at this point – market for those entrepreneurs that I have to give. We … will be providing this fall a new procurement to try to stimulate that market. ... I can provide the incentive and I can provide the market that I have and commercial providers will either emerge or not. It is not acceptable for a publicly funded program not to have a way of meeting its mission requirements in the event that commercial operators do or don't materialize. So, the architecture that we have advanced allows NASA to meet its mission requirements, but also allows NASA to concentrate its resources on other more advanced activities if commercial providers can emerge in the next five to seven years. That is exactly our intent. Our fondest desire would be to keep NASA on the very frontier of space activity, letting commercial providers fill in for those activities which are not frontier activities. We will be putting some money where our mouth is.*"

The Administrator's comments sound quite promising, and the JSC solicitation published 10/28 for Commercial Orbital Transportation Service demonstrations raises hopes that we will see the leveraging of an engine that is more powerful than the SSME, F1, or SRB: American entrepreneurial spirit - the engine of our ingenuity.

> *"… imagine if Antarctic research expedition teams had to design, manufacture, and operate C-130 aircraft, helicopter, and ship transports to perform their mission."*

Chair's Corner

STEVE KING, AIAA HOUSTON CHAIR

"Technical Competence" in our world of human space flight is a major tenet allowing missions to be performed successfully and their crews returned safely home. It will also be required to meet the known and unforeseen challenges in implementing the President's Vision for Space Exploration and exploiting untold opportunities that will likely follow.

Over the years I have seen less importance placed within many organizations on keeping one's technical skills sharp. In-house training courses, conference paper presentation, or working on an advanced degree after hours fell by the wayside. This can be attributed to many factors such as budget pressures, contract changes, workforce reductions, or limited thought put into career planning. Our new NASA Administrator, Dr. Mike Griffin, brings to NASA's top leadership a renewed sense of technical excellence. He places a great value on technical competence. I personally feel we are going to see a renewed emphasis placed on ensuring our workforce is adequately trained and that their skills remain honed.

AIAA and its Houston Section are poised to respond to these needs. At the National level, AIAA provides a wide variety of conferences throughout the year, conducts both resident and online continuing education technical courses, and is an excellent means of having your work published. The Houston Section is averaging two technical Lunch n' Learns a month with growing attendance. This is principally due to the dedication and thorough planning of Executive Council members Tim Propp, Douglas Yazell, and Ellen Gillespie. We have already started planning for our next Annual Technical Symposium, which will be held May 19, 2006. Well over 200 attendees are expected. In addition, Professional Engineers attending our technical seminars and discussions may earn credit towards their annual continuing education requirements. Whether as a student, lecturer, or interested party, we welcome your participation in all that the Houston Section has to offer.

Let's continue the journey…

—SK

Letters to the editor@aiaa-houston.org

AIAA HOUSTON

[Regarding the editorial coverage of STS-114]

To the Editor:

I am appalled at the coverage that surrounded the return to flight of Discovery. The media blasted what was basically a flawless flight. Maybe we have too much coverage of the amount of technology that is now available to us to view what happens during launch and on ... Never before has a flight been so photographed. Which of these photographs are of value? How much damage has been logged on previous flights when the shuttle has returned? Are we comparing the visual inspections from previous flights to this last one, STS-114.

I feel that we can always improve; have we improved since Columbia? You bet we have. I would like to have seen just one positive report from the new media that was positive about STS-114. We all as a team did a spectacular job to get the shuttle to the point of flying again. All of us should be commended for the hard work and effort that went into this flight along with many other flights. When you sign up for a job like ours there are inherent risks. We all know that. Would we do anything else given the choice? Most of us would say no. Space exploration is in your blood. It is what makes you passionate. So, we take the risks and we persevere.

My hat is off to all my teammates within the NASA community, both NASA and all the subcontractors that have made the space program so successful.

We need to send a message to the media that they wouldn't have the capability to even broadcast their narrow minded view if it wasn't for the space program and the people that pour their heart and souls into this work.

I look forward to the next flight and the years to come of successful human flight. Yes, there may be some loss of life, tragic as it is, everyone working on these programs respects and reacts to this real risk. We have a passion. I don't think that passion and fire can be easily doused.

Leesa Beier

Horizons invites readers to comment on articles presented here. Please send correspondence to the editor at:

editor@aiaa-houston.org

Please make a note in your letter if you would prefer to remain anonymous if your letter is printed in *Horizons*.

The Stellar-J Launch Vehicle and Commercial Space Development

Feature Story

WES KELLY, TRITON SYSTEMS

Triton Systems needs to describe its chief project to two principal audiences:

1. Engineers interested in technical details and

2. Venture backers interested in customers, markets, and return on investment.

Despite the fact that AIAA is largely a community of engineers, this article will address both views. To illustrate the difference in perspectives, we will begin with an "engineering" description.

The Stellar-J is a winged first stage vehicle built around kerosene liquid rocket engines and air breathing propulsion. Conventional jet engines power the Stellar-J to stratospheric, subsonic, cruise followed by rocket ignition and continued climb. This first stage ascent is performed with a pull-up terminating in staging conditions similar to existing vertical launchers. Descent follows a profile similar to the X-15, X-34 or the Space Shuttle at high angle of attack until reaching subsonic speeds in which jet cruise or glide descent to an airfield are options. Like a fighter aircraft that carries a range of different ordinance on wing pylons, the Stellar-J carries upper stages or modules within a payload envelope. Triton Systems LLC, a small aerospace startup is pursuing its design.

Commercial aviation stands as proof of routine jet-powered stratospheric, subsonic flight. Unless designing for around-the-world cruise, mass fractions of aircraft seldom approach those of ballistic rockets, but state of the art intermediate values make this flight regime attractive as the start of first stage flight. If one third of the delta velocity required for orbital flight (~30Kfps) is obtained in first stage, 1500 fps can be derived from jet cruise speed at altitude. After first stage rocket burn (adding ~8500 fps ideal velocity), upper stages can be released for continuation to orbital missions. The scalability of the concept parallels commercial jet aircraft: takeoff weights from 35 to 350 tons. In the course of designing Stellar-J vehicles around multiples of available engines, we have developed design, trajectory, mission, and performance data for 35, 70, and 350-ton configurations. At 350 tons the larger Stellar J configurations compare in mass to jumbo jets - or the Soyuz launch vehicle. As a result of discussions with potential customers, we include designs for recoverable orbiters for manned and unmanned sortie flights or rendezvous with space platforms and space stations.

That's the aerospace engineer's capsule description. Now the "elevator (sales) pitch":

The small satellite user community needs a cheap, reliable, launch system that can:

1. Turn around fast.

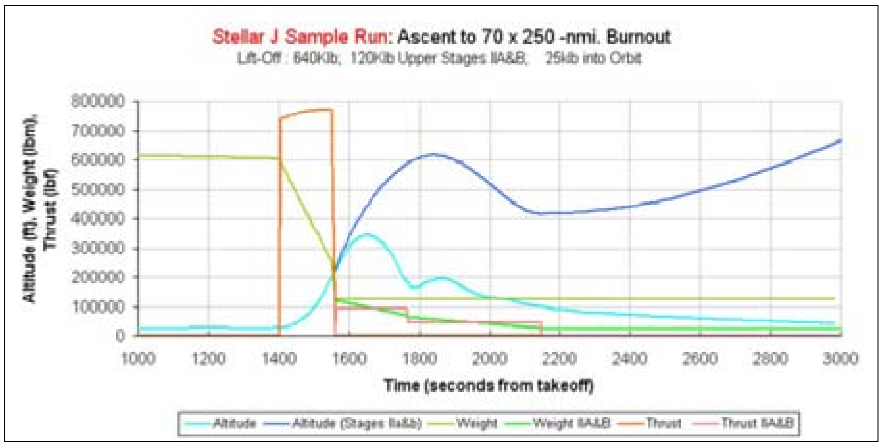
2. Grow with user needs.

3. Cultivate capabilities mutually beneficial - e.g., rendezvous and return cargo.

The size of customer community is large:

- small companies
- civil and military offices
- private research institutes
- universities and related research consortia
- domestic and foreign.

Our approach: Horizontal take-off and landing first stage with wings and jet engines. Rocket burn from airline cruise to typical booster rocket staging.



Most of the system is reusable many times. Where recent X-prize events are similar to 1920's barnstorming, this is the Ford Tri-Motor concept. Completion of the 35-ton system for 1000-lb payloads is a $100 million development project over three years with initial funding sought for a demonstrator vehicle.

As can be seen, both engineering and business presentations convey knowledge essential to both parties, but with different emphasis; and both cases are essential for commercial space development. Commercial space has obtained increased legitimacy in recent years, perhaps first from DARPA and USAF. Now even NASA is allocating parts of its manifest to launchers from start-up companies. Yet for many the startups have come in under the radar. Large-scale government programs condition lead many of us to think of requirement-laden RFPs as the conventional approach to business. Since other booming sectors of the economy with vast sums for

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R&D do not do business this way, one can imagine an aerospace engineer's scramble to develop an open market mode of operation. An elevator pitch is but an iceberg tip of a process of study and getting acquainted with new (for aerospace) resources; in Houston, the MIT Enterprise Forum, the Houston Technology Center and Bay Area Houston Economic Partnership provide an introduction to the financial and venture capital community; nationally, the Space Frontier Foundation, the Space Studies Institute and the Space Access Society provide forums for the commercial space effort. Besides these organizations, it is also difficult to summarize many years of "zero-budget" development, acknowledging much valued and tacit assist from supporters with both engineering and business acumen.

Commercial rules of engagement differ in other ways. A "successful" presentation could provoke a listener to jump from his seat and announce, "Good heavens, they're right!" It is initial discretion that prevents an audience stampede toward the presentation goal – to the exclusion of the originators. For this reason we apologize in advance for some reticence about many technical and commercial details.

Despite discretion, we can resolve the question: "Why the name?" Quite simply: "All the well-known stars and monstrosities of antiquity were already taken." We flirted with Space Utility Vehicle and other automotive tie-ins, but car repair recollections restrained us. What's more, we wanted to tie both winged flight and the stars together – i.e., "aerospace" flight. On the west coast there is a large blue bird known as Steller's jay. We see no copyright infringement in that bird's activities... The Stellar-J solves space access problems.

When the term "aerospace" became common after Sputnik while I was in grade school, science fiction space travel stories initially described its potential. When near objectives in space were actually achieved, government-sponsored commissions charted futures dependent on accepted recommendations and expenditures. The 1969 post-Apollo recommendations of the Agnew-led commission[1] charting solar system exploration did not fare well, save for development of a Space Shuttle. Subsequent guidepost-setting studies encountered similar cool receptions, though the 1990 Augustine commission[2] convinced many of the need for "Alternate Access" to space after Challenger's loss in 1986. Since 1991, more time has elapsed than from Apollo's inception and landing without "alternate access" achievement from numerous civil programs. At this writing the Shuttle is steering toward retirement and "alternate" has morphed into replacement as an objective, replacement with the re-invention of Apollo techniques. "Alternate" is a banner that by default has been passed to private enterprise.

Historians often ponder why nations did not exploit opportunities afforded them. In Ptolemaic Egypt the steam turbine was discovered, only to remain a classical world curiosity. Before Columbus, Norsemen ventured to North America, as perhaps did the Chinese. It was the United States that developed the winged reusable rocket plane with a reusable engine. After several decades of infatuation with the X-15 and the Space Shuttle, America is about to shelve the concept, allowing historians to mull its fate as well, unless foreign programs or private industry give winged launch vehicles a new lease on life.

Has winged flight with re-usable vehicles proved a dead end by Columbia's crash? Though capsules on ballistic vehicles address some immediate concerns, there are many winged configurations, applications and operational trades. Our reading on this phenomenon is that the process associated with large government projects such as moon rockets and shuttles, from KSC facilities to budgets, is not flexible enough to support both types of flight. Spaceflight in the United States remains a special operation at limited national facilities with flight costs comparable to major league stadium construction, but the remedy lies in efforts to create a grass-roots infrastructure in this country based on small systems using the skills developed in those 50 years since "aerospace" engineering began. Which small private sector aerospace companies will provide the exit from this situation? As enthusiastic as we are about Stellar-J, we suspect that the race is still too early to judge, much as described by Ecclesiastes 9:11 with many twists ahead.

Discussing alternate access, winged vs. ballistic launch vehicles and spacecraft, the real concern is infrastructure: its flexibility and viability. Like four years before, space systems and facilities seem vulnerable once again. Our previous concern was terrorists crashing planes into population centers and national assets; at this time, the concern is deadly hurricanes. National infrastructure should adapt to these new realities (along with older realities like international competition); by taking technologies learned in government crash programs and spinning them off into smaller, distributed processes and applications. While we see Stellar-J as a piece of that response, we do not see it as a commission finding itself, but rather one of many possible avenues that free enterprise allows Americans to fulfill their vision for a space future. Stellar-J or one of its worthy rivals (i.e., not in violation of laws of physics or economics) will prove itself not because it was vetted by a commission, but because engineers and backers surmount all the unexpected difficulties ahead in getting the product to market.

Whether generally acknowledged or not, several families of staged-combustion rocket engines developed by the United States (the SSME) and the Soviet Union (RD-170, -180, NK-33, -43 etc.) have operating lifetimes of an hour or more – especially with overhaul. Since a typical ascent to orbit requires ten minutes or less, use of such engines in expendable launch vehicles (ELVs) wastes resources, validating a circular argument of space flight costliness. The full
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advantage of staged combustion engines is in the early phases of flight, however, the first 2-3 minutes of burn where high thrust to weight and chamber pressures are crucial. This atmospheric flight phase runs from after take-off to altitudes of 30 nautical miles or more and mach numbers of 4 to 7.

Both American and Russian engineers devised retrieval schemes for such booster engines and stages: recover like the Shuttle SRBs by parachute in the ocean (1980s Shuttle Liquid Rocket Booster studies[3]); retrofire and soft land the boosters near the launch site (Kistler); flyback with wings under jet power (1990s Shuttle Liquid Fly-Back Booster and RKK Energia studies). The problems and virtues of these approaches deserve separate treatment, but we can imagine the groans of Shuttle analysts contemplating two more sets of wings with their loads, plus geometries suitable for exiting the Vertical Assembly Building. These were issues of Shuttle integration and the Procrustean bed of KSC facilities for vertical launch. We believe design for horizontal takeoff avoids many of these difficulties as well as providing benefits for flight-testing, servicing, launch windows, recovery and deployment.

While the arguments for meeting civil requirements are compelling, it is clear that the NASA procurement process is defined for meeting narrow, but changing objectives of the agency – and Congress. Many of the mainstays of its own infrastructure (e.g., the Delta II and Atlas II) were provided by external sources: the air force seeking "alternate access" to space after the Challenger's loss. In both cases USAF offered exclusive contracts to launch a dozen or more satellites without specifying the launch vehicle in the contract. Production overcapacity of these systems since 1986 has passed for what is America's commercial launch capability. In a 1997 paper given to the Space Studies Institute[4], we suggested a similar procedure to provide alternate access to the International Space Station with the corresponding overcapacity providing commercial services. We did not anticipate many events, however, including the possibility we would be so actively engaged in obtaining this capability.

The Stellar-J business plan is just as important as the engineering data book. And one important segment is the section devoted to sources of revenue. In constructing that plan we identified a number of potential missions or markets for the vehicle and identified the potential customers. In Table 1, sources of revenue are shown for four vehicles of different capability plus the subscale demonstrator. To determine which markets were the best targets we developed eight attributes with which we scored each activity. Though the quantitative scoring is not included here, intercontinental package delivery and large geostationary satellites were eliminated in the tables because we saw the Stellar J as not well suited to these markets. Interestingly enough, some market re-combinations looked more attractive than when first presented, but follow up survey data will be essential.

In developing our business case, we are reminded of the role of aircraft developers and operators in the 1920s and 30s and their relation with NACA. NACA was an advisor to these developers; not the customer. Designers and flyers sold hardware or services to the Post Office or other government agencies, (e.g., Agriculture, War Department) and more and more to a public at large. For many reasons, NASA mission support should be a transitional, but beneficial role to develop commercial infrastructure, but not an end in itself. Parcel package delivery per se will not loom large in orbital traffic, but the space agency's immediate needs for orbital delivery when purchased in blocs of a dozen launches could serve as an engine for commercial development. In the long term, however, the community of satellite developers and operators external to NASA is the market of greatest potential.

As indicated above, the commercial formative process differs from that of the civil space program. Though each is indeed concerned with budgets, the venture capital perspective emphasizes return on investment. Those of us who have participated in the design and architecture studies associated with commission reports described above are only partly prepared for the elaborations on business plans required by venture capitalists, commercial partners and investment bankers. In other sections of the country, entrepreneurs have had a headstart over the Houston aerospace community, but our contacts with the financial community have advised us to capitalize on our advantages: In Houston, we are an aerospace community with strong professional ties and exceptional knowledge. We are used to working together. A strong commercial entry coming from Houston is not such a long shot.

— WDK

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		Vehicle Types and Configurations				
		Demo	A: 35-ton	B: 70-ton	C: 350-ton	D: + Orbiter
Mission Model for Revenue						
1.	Sounding Rockets	x	x			
2.	Sub-Orbital Tourism	x	x	x		
3.	Micro-Satellites	x	x			
4.	Low Earth Orbit Satellite Constellations			x		
5.	LEO Space Platforms				x	
6.	Rendezvous Payloads		x	x	x	x
7.	Sortie and Return Payloads		x	x	x	x
8.	Rescue Standby		x	x	x	x
9.	Sale and Use of Stellar-J Vehicle		x	x	x	x

Table 1. Potential Sources of Revenue

Feature Story

New York to Paris. Earth to Orbit. What's the Difference?

ADVENT LAUNCH SYSTEMS, INC.

The Advent launch system is an "engineered" concept for delivery to Earth Orbit and return. The term "engineered" is understood in many ways these days. The Advent team defines it as "providing the desired effect with minimum cost." In addition, the cost includes everything involved; design, development, fabrication, operation, taxes, reliability/safety, and insurance.

ALSI rocket launch from the ocean. (rendition of ALSI concept by Jon Berndt)

The Advent team utilizes a math model to help quantify each system cost to support the overall engineering process. The math model is very similar to that used in the petrochemical refining industry to calculate the cost of each product being generated. The analysis includes the cost of products from adjacent systems. The analytical process requires simultaneous solution of the equations that describe the input and output of each system. Modern computers can solve the equations in a matter of seconds. Alternative system concepts can be easily evaluated. Engineering a system for delivery to Earth Orbit involves many interfaces. The results indicate the feasibility of a very significant reduction in cost. Today's cost is in the range of $2000 to $6000 per pound delivered. Cost in the range of $100 or less is possible. However, many of the system features are not typically accepted as "politically correct."

The term "politically correct" – like the term "engineered" – can have a wide variety of interpretations. The Advent team quickly concluded that the cost of launch and landing facilities could be a lot more than the cost of developing the vehicle itself. We recalled Von Braun's idea of launching out of the ocean. We quickly learned why. We also quickly learned why he never was able to make it happen. It's not a "politically correct" idea. Ocean operations are considered by most people to be very expensive and unsafe. There are people that think that starting a rocket engine under water will harm the sea creatures. It has also been considered expensive to deliver payloads to the launch site especially when the payloads will likely be very sensitive to the wet and salty ocean environment.

We began to look into these arguments and enter our findings into the System Accounting Model. The results are very interesting. The safety issue was the first consideration. The ocean itself is not particularly "unsafe" unless the weather is very severe. The solution to that problem is to use larger anchors. Weather can be just as severe on land. We decided that it would be wise to use ocean-going equipment that is built for bad weather (as most of that kind of equipment is) and that the extra cost is minimal.

We quickly discovered that the delivery of propellant to an ocean operation would be much less expensive and much safer than delivery on land – especially the delivery of rocket propellants, liquid methane and liquid oxygen. Procurement of the propellants can be from the world market. We will likely invest in the equipment to produce liquid oxygen and use boil off from the methane storage tank to fuel the equipment.

Starting a rocket engine under water is a problem if turbopumps are involved but a pressure-fed engine will start under water like a cutting torch. The rocket engine will simply blow a BIG bubble under water. The water is pushed aside by the bubble, about 30 feet in diameter in about 2 seconds. The most traumatic part of the rocket take-off will be the collapse of the bubble and the generation of a circular wave. Our analysis indicates that we could have divers under the vehicle during take off and they would simply get a real "thrill" out of their ride on the wave.

The vehicle is to be made of titanium and titanium is compatible with seawater. Avionics have to be "sealed" to endure normal humidity so that was not a problem. The delivery of payloads to the launch site was determined to be potentially less for the ocean launch because the vehicle can be launched relatively close to the payload source. In addition, the launch site can be in a place to provide minimal energy for getting to the desired orbit: at the equator for equatorial orbit and closer to the North or South Pole for polar orbit. Deciding the "best" launch site is another engineering problem. As it works out, a rocket is a lot more like a submarine than most people think. Ocean launches can be very cost-effective.

The Advent system is the product of many *lively* discussions among similarly lively engineers. Many alternatives have been evaluated using the System Accounting Model. The result is a very simple system with features that are contrary to most of the institutional standards today.

The use of a pressure-fed propulsion system instead of using tur-

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bopumps is a typical example. The idea of a pressure-fed system was proposed many years ago (the Big Dumb Booster). Regarding the engine itself, the comment was, "if you want to build a good rocket then you must have a good engine, and a good engine uses hydrogen and has a turbopump for minimizing size and weight." When asked about the cost implications, the engine expert recommended talking to the program office about cost. The primary focus on technology has compromised the engineering effort in our space program.

The Advent vehicle uses a relatively simple pressure-fed engine with inexpensive methane and oxygen for propellant. Having a rectangular nozzle outlet provides the capability of using two planar surfaces to vary the area ratio and to direct the thrust vector in one plane. Having multiple engines across the aft edge of the wing structure facilitates vehicle control in the roll and pitch direction. The movable nozzle surfaces can support vehicle deceleration and then provide elevon control for landing.

The engine itself is of tube-wall construction, with all the propellant, fuel, and oxygen, passing through the tubes. The high inertia of the fluids in the tubes is anticipated to assure steady flow, allowing the thrust to be throttled to about half without experiencing the typical combustion instability. This feature allows the pressurization system to provide only about half the required high sea level pressure at burnout. The pressurization system can be about half that typically required. In addition, the improved combustion stability may offer the opportunity to use saturated liquid propellants that pressurize themselves. Analysis indicates that both propellants will have about half their initial pressure when the tank empties. On-orbit propulsion is to use a portion of the pressurant gases. Any remaining pressurant will provide additional stability for the tanks as they land on the ocean. These two primary features of the Advent concept are being patented, the control surfaces with four functions and the tube wall engine that is expected to be efficiently throttleable.

The planform loading of the Advent vehicles will be in the range of 10 to 20 pounds per square foot, providing a landing velocity in the range of 80 to 100 miles per hour. The landings will likely be with a crosswind to avoid direct wave impingement. There is a concern regarding the possibility of the forward end of the vehicle having enough hydrodynamic drag to causing tumbling. The classic problem with *slapdown* is also a characteristic that needs analysis.

Having two stages minimizes vehicle size. Three stages can further reduce size but increases complexity. Using the same basic design for both stages minimizes development cost. Adjustments in thermal protection and/or engine thrust level may be required for the transition from a booster to an orbiter, but the design can be tailored to facilitate the required changes with minimal cost. Each feature of the system has been evaluated with the System Accounting Model.

Advent has a development plan with four basic steps to the first payload delivery. Completion of the engine tune-up runs is the first step. The second step is to build and fly the first upper stage for our system. It will be a lot like our Xprize vehicle and will be tested with suborbital flights. Then the third step is to build and fly another system like the vehicle of the second step but about twice the size. With both vehicles verified we can connect the two vehicles and make our first trip to orbit (step 4).

Advent is planning to make an orbit delivery before spending five million dollars. Granted, that sounds very optimistic, but the Advent team has found that being *optimistic* is almost as productive as being *persistent*. We have looked into various forms of funding but retirement pay has been sufficient to this point. We hope that NASA will continue to pursue its interest in methane-fueled equipment and verify our engine prototype in the process of early check out of their methane equipment. With the engine verified, we are hoping to gather a larger group of retirees and other participants to help with completing step two. With step two completed, we are hoping to get some prospective customers to help with the financing of steps three and four to provide orbit deliveries for 1000 pound payloads. Profit from the 1000-pound payload deliveries is expected to fund the effort to deliver 10,000 pound payloads.

Advent plans to continue the development program and build the next larger booster for 100,000 pound payloads. As the cash flows in, construction of the booster for 1,000,000-pound payloads will begin. Each step is for the construction of a new vehicle of the same basic design but about twice as big. Each time, the booster from the previous system can be used as the orbiter, or an additional new booster will be fabricated for the new system. When five new vehicles have been constructed, the payload capability will be 1,000,000 pounds. The cost for operating the largest system will differ from the cost for operating the smallest system only because of increased propellant requirement and the increased cost of the larger operational equipment. The operational crew will be essentially the same. As once predicted by Werner Von Braun, it is expected that the cost for orbital delivery will be about the same cost as delivery from New York to Paris in an airplane. The only difference will be the time: ten minutes instead of ten hours. The Advent engineering effort supported by the System Accounting Model confirms Von Braun's prediction.

ALSI rocket engine.
(photo courtesy of ALSI)

Advent Launch Systems, Inc.
Friendswood, Texas
281-488-1493
281-787-0735
Contact: Jim Akkerman
jimakkerman@houston.rr.com

www.adventlaunchservices.com

Feature Story

Next Generation Rocket Scientists in Fredericksburg

BRETT WILLIAMS, AEROSCIENCES/DRAFTING INSTRUCTOR, FREDERICKSBURG HIGH SCHOOL

Fuel grain R&D team with RB10-H fuel grain

Forty-years have passed since a ‘wave’ of space engineers were hired for the race to the moon. The baby boomers are retiring. Over the past twenty-years the number of engineering degree seekers has steadily fallen to be woefully shy of replacing the industry’s retirees. Half of today’s degree seekers are foreign and nearly half of them will return to their homelands to work. Industry memos, bulletins, magazines, conferences, as well as company initiatives, have discussed this for years – with no real change.

Industry is looking to academia to produce more engineers. However, academia declares public education is not producing students that can be developed into tomorrow’s engineers and innovators – and they are, for the most part, correct. Public education is trying. President Bush’s No Child Left Behind is attempting to prepare 100% of America’s youth for college – a monumental task. Never before has a country tried to prepare all its youth for college; and there are some concerns with the effort. Hands-on vocational programs are being reduced to support funding for core academics and advanced placement programs. Vocational application does not correspond with college preparation. How is public education going to deliver on preparing tomorrow’s engineers, innovators, and the technically skilled workforce to support the 21st century’s industry needs when less than 6% of the students being prepared for college are showing any interest in engineering[1] and when technically skilled labor force development is being ignored?

In a small rural town in central Texas, a public high school has been working for the past ten years to find the answers to today’s educational dilemma concerning tomorrow’s problems. In the ‘96-97 school year Fredericksburg High School in Fredericksburg, Texas initiated a Principals of Technology program that would become the catalyst to help create a new program where today students learn how to solve engineering problems, design, develop, test and analyze, do collaborative research with universities and industry – and 80% of the students in the program head into engineering.

The initiative behind the program’s design is to raise critical thinking and analysis skills by using a problem/project based format requiring high level problem-solving and the application of the knowledge bases they have been provided during their public education careers. The program, called the Fredericksburg High School Aeroscience Program (FHSAP), is based on the aerospace industry. The program is a two-year, junior-senior program where students in the first year design and develop ROV’s and UAV’s for research or work application. This year the students in the first year of the program are developing an ROV for the central Texas law enforcement agencies to use in hazardous scenarios. Capable of operating without an umbilical the 160-lb ROV will possess two video downlinks, one with infrared capability, and a dual track propulsion system allowing the vehicle a designed velocity of 5mph and the capability to climb stairs. It will also possess two-way audio and a forward ‘fork-lift like’ armature for close-in inspection or the capture of a package.

Second year students design sounding rockets capable of lofting 35-lb university research packages to altitudes of 100,000-feet. The 500-lb vehicles are tested at the Army’s White Sands Missile Range. Students are responsible for developing the numbers for the velocity needed for the university research package to reach the desired altitude and from this the students develop the preliminary numbers for the initial mass of the vehicle and the fuel and oxidizer masses for the hybrid propulsion system. This then allows for the students to group into component teams, nose cone to nozzle, for ‘concurrent’ development of components – much like the Atlas ICBM. [Note: the first six weeks of the second year introduces the history of America’s space program by teaching from the Sung dynasty to today and capturing the major players and events: Tsiolkovsky, Oberth, Goddard, GIRD, VfR, ARS/AIAA, Korolev/Glushko, von Braun/Molina, V2, WAC, Hermes program, Aerobee, Viking, Navaho, Redstone, Sputnik, Explorer/Vanguard, MX774, Russian R-series, Vostok, Voskhod, Soyuz, Atlas, Titan, Saturn, Mercury, Gemini, Apollo, Shuttle, CEV. This serves to develop within the students an interest and respect for the aerospace industry and an understanding for the theory, design, development, and testing of new vehicles.] Once the vehicle’s components are designed by the students, and critical decisions are made concerning appropriate materials to fabricate from, the students undergo a critical design review (CDR) by peers and by presenting their design calculations to professionals in the aerospace industry; no suggestions by professionals are given – only discovery of mistakes. Since most of the materials for vehicle development are donated to the project, the CDR is done to prevent extreme errors or waste of materials from occurring – the students know there is one chance with the project to be successful and the best way to be successful is to make sure it is correct before proceeding. After revising the design, and/or passing the CDR, the students are required to work directly with machining and fabrication businesses to develop the needed component. While this is occurring, the student is required to stay within planned schedules and constantly stay in communication with other teams working on the project. It is imperative the students learn good teamwork and communication skills. For the project to be suc-

References in this article:

1. Richard J. Noeth et al., Maintaining a Strong Engineering Workforce: ACT Policy Report (Iowa City: ACT, Inc., 2003)

Above: Redbird10-H R&D team

(continued from page 10)
cessful, all teams must complete their responsibilities. If any team does not complete the design and development, does not communicate with other teams, or develops a component in error, the project will fail. *Failure is an option in this program*. For it is the potential failure that helps drive the students toward success. Once the students have completed the development of their components, all teams will then join for the final assembly of the project and the Flight Readiness Review. This will occur within a time factor to allow for simple modifications where needed. The vehicle is then ready to be 'all up' tested.

There are several facets to the aeroscience program. First, life skills are developed by the students. Students learn problem-solving, design and development, machining and fabrication, budgets and purchasing, testing and analysis, documentation and reporting, time management, teamwork, public relations, and communication skills to name a few. In addition, through an educational agreement developed in 1998 with the Army's White Sands Missile Range, FHSAP is able to provide flight opportunities to universities at frugal costs – especially with the design and development costs being in-kind by the students. Because of this, students are introduced to, and given the opportunity to experience, university level research, and R&D within the engineering industries. Exposing the students to post-secondary education and industry work stimulates interest and passions that develop a value for the education they are receiving in the classroom.

A non-profit 501C3, the Fredericksburg Education Initiative (FEI), has been developed to support FHSAP and the Fredericksburg Independent School District (FISD) to aid with vertical and horizontal alignments of grades, from the head start program to the high school, to promote career pathways, workforce development and educational interest and value. FHSAP and FEI support the notion that a student that understands why they are being educated, have a value for their education, and recognize the pathway through public education, can be educated to a greater degree. In addition, FEI is helping to promote integrated classes or teaming, to support teamwork and application of class lessons for a project throughout all educational departments. Also, FEI is helping to establish a value of vocational classes by helping to upgrade the FHS vocational department. An example is FEI helping to bring machining equipment into the vocational department through donations and funding support. This allows students to gain experience by machining components on their own. Therefore, they develop needed components for school projects and also develop the skills, internship, and employment opportunities with the local machining industry. FHSAP and FEI feel that a technically skilled labor force does need to consider post-secondary education, but public education cannot ignore the value of hands-on education concerning workforce development. To assist this, FEI led the development of the Texas Partnership of Aeroscience Education (TPAE). TPAE is a 2+2+2 vertical alignment from high school (FISD) to two-year institutions (Midland College) to a four-year university (Texas Tech) to industry (WestTex Space Port) that has created a replicable template for workforce development pathways from high school to industry. This includes technical skills certificates available for graduating students to use for employment or concurrent credit that will be accepted at a two-year institution – supporting the student's desire for continued education. TPAE is presently working on concurrency of the course to the four-year institutions.

There is proof that these applied philosophies of education are successful in supporting workforce development and today's workforce needs – especially for the

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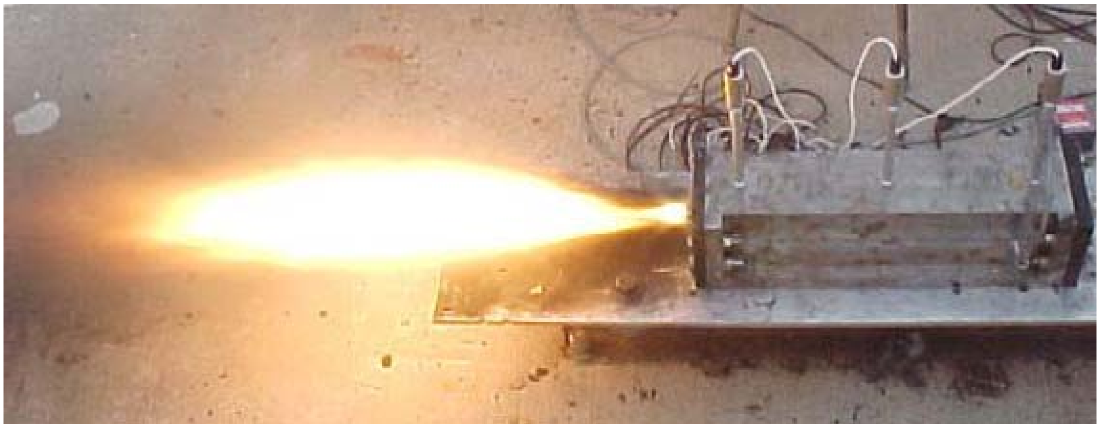
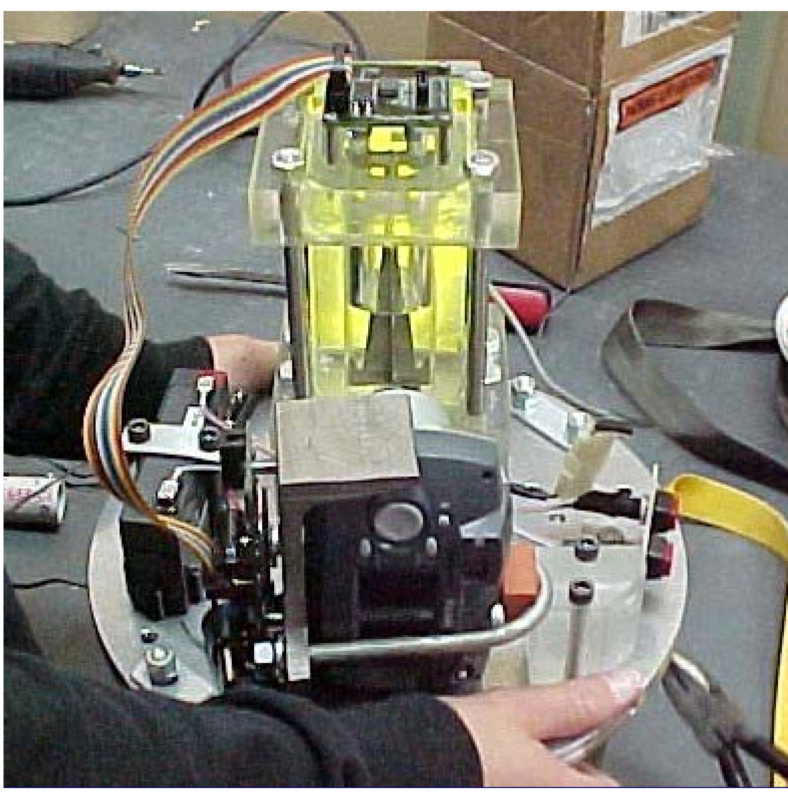
aerospace industry. As mentioned previously, 80% of students in FHSAP become engineering degree seekers. Average SAT scores across all students at FHS have increased by 150-points since the inception of the FHSAP in 1996. Students are interning with companies like Microcosm, Ball Aerospace, NASA Stennis, and JSC centers, USA, Pratt and Whitney and others. In addition, students are entering universities outside the FHSAP region – being accepted to Purdue, Tulane, Rice, Michigan, University of Arizona, University of Illinois, MIT, Stanford University, and every year at least one student in the program receives a military academy appointment. There are students now employed at United Space Alliance, NASA's Stennis Space Center working on the SSME's, the Institute of Advanced Technologies working on hypervelocity projectiles, and with SpaceX working on the Falcon's propulsion system. And FHSAP has even had some early spin-offs: the Student Launch Initiative at NASA's Marshall Space Flight Center has been having great success with the program in northern Alabama and has been working with the Aerospace Industry Association for the Team America competition held annually.



(Above) 150-lbf test cell at the Humble-Bowden Propulsion Research Center

(Below) Purdue University research package to fly on RB10-H in Spring 2006



These successes are directly related to the FHSAP's and FEI's philosophies concerning public education and the curriculum, titled the Suborbital Aeroscience Studies curriculum, used in the FHSAP. Currently, the SAS curriculum is being prepared for publication with the support of the Universities Space Research Association, so FHSAP and TPAE can begin teacher-training workshops and begin replication of the program. The first teacher-training workshop is scheduled for June 2006 in Fredericksburg, TX where five schools across Texas will come to be given the curriculum, the support documents, and the information needed for the school and the district to be successful with the implementation of the SAS program. This will be further accomplished by the three-step program development plan TPAE has created to help with the establishment of the program. First year schools at the workshop will be given the curriculum for the first step in developing their program's high altitude research capabilities. This first step will include the information needed for the teacher/program to facilitate the students with their design and development of a stable sounding rocket capable of lofting a quarter-pound research package to an altitude of one-mile. This first step, termed the Oberth step, develops the programs ability to teach the curriculum, locate and acquire needed items on a timely manner, fabricate needed parts, teamwork, communicate, develop public relations, manage funding and schedules, and most importantly – to develop the capability of stable flight by understanding stable flight. If successful, for an unsuccessful first year requires the school to repeat the failed year, the school would return to the second year workshop and be given the curriculum and the support information to accomplish transonic flight. Again, this step – the Tsiolkovsky step – would develop the programs ability to incorporate all the knowledge and experience from the first year; but, would also set a slightly stronger goal when it comes to the vehicles structural design and better understanding of mass fraction and aerodynamic loads. If successful with transonic flight, the school would then return for the third and final year, the Goddard year. Within this third step, the teacher training workshop supports the teacher/school as it attempts to provide flight time for a university research package.

The three-step program development plan is the same pathway that FHSAP experienced. The first year was stable flight (RB1), the second year transonic flight (RB5 – 833.68 mph), and the third year tested the Redbird8-H to 16,000-ft at WSMR. Presently, the Fredericksburg High School Aeroscience Program is ready to test the RB10-H, a vehicle de-

(continued from page 12)
signed to loft a fluid research package for Purdue University, and is finishing development of the RB11-H to get a Stanford University optical/telemetry research package to altitude.

There have been two concerns with replicating the aeroscience program – fuel grain and nozzle development. The inert hybrid propulsion systems the students have been developing over the past eight years have been the same application of inert fuels and oxidizers as SpaceDev's Space Ship One – Hydroxyl-Terminated Polybutadiene (HTPB – or golden goo) and nitrous oxide. The performance parameters have usually specified approximately 1,500-lbf of thrust with about a 35-second burn time from the system. Because there is no real control on the materials being donated, unless purchased, the inner diameter of the engine case and oxidizer tank can vary from six-inches to twelve-inches. This causes students to have to expand the diameter of the cartridge load fuel grain, therefore shortening the circular center port, and go with occasionally complex multi-port fuel grains. Due to the fabrication inability of most public education facilities, for casting grains and pressing composites, for the past eight years FHSAP has relied on the support of NASA's Marshall Space Flight Center and Thiokol to develop the fuel grains and nozzles to student specifications. If replication of the program is to be successful there is the need to find inert, safe, easy to acquire, and easy to work with materials for fuel grain and nozzle development. NASA's Shuttle Program has been offering support lately as FHSAP has developed a 3,000-lbf static test facility, named the Humble-Bowden Propulsion Research Center, where material testing has been occurring for the past two-years. The facility, developed by the students at FHS, is supported by National Instruments LabVIEW for data acquisition and testing automation. The facility uses Eaton's transducers for measuring mass flow rates (the facility is capable of providing an oxidizer mass flow rate of five-lbs/sec) and pressure sensing in the pre-mixing and post-mixing regions as well as within the grain. The transducers also act to shutdown a test in the event of any anomalous spikes. Moog and Rocketdyne have provided valve support. All testing is also captured on eight video cameras for documentation of all test angles and security during testing. FHSAP is on schedule to provide the information needed when other high schools across the state of Texas, and across the country, will need to easily acquire a safe, inert, easy-to-work-with material to develop a fuel grain and/or nozzle while studying propulsion or developing a sounding vehicle to reach for research altitudes.

Presently, the Fredericksburg High School Aeroscience Program is finishing the earlier noted ROV and the Redbird 11-H: scheduling tests of the RB10-H and the RB11-H at WSMR this spring, continuing the fuel grain and nozzle R&D, and finishing the development of a 45-ft, transportable launch tower being designed and developed by Polaris out of California. The Fredericksburg Education Initiative is beginning a funding drive to help fund the educational initiatives listed above, and to help with the development of a new regional technology center that will be the new home for FHSAP and the management of the Suborbital Aeroscience Studies curriculum as it begins to replicate and disseminate. The Texas Partnership for Aeroscience Education (TPAE) is finalizing its 501C3 status to begin a funding search to help publish the SAS curriculum, and to offer the curriculum and program to interested schools. The TPAE is ready to announce the call for partners for its new advisory board to help support the TPAE as it supports aeroscience education, replicates and disseminates the SAS curriculum, and teaches the template of high-school-to-industry pathways in the context of academia and workforce development.

Above—First test at White Sands Missile Range, Redbird8-H.

Below—Team members recover Redbird8-H.

Section Awards

Houston Section Receives Several Awards from AIAA National

T. SOPHIA BRIGHT, PAST CHAIR

AIAA National recently released a news bulletin announcing the winners of the 2004/2005 Section Awards. The Section Awards honor particularly notable performances made by an AIAA section. The Houston Section falls into the Large Section category and competed against the likes of Albuquerque, Atlanta, Baltimore, Northern Ohio, Phoenix, St. Louis, and San Diego.

A total of 7 awards were presented by AIAA National. The Houston Section was recognized as follows:

· Outstanding Section – 1st Place

· Career Enhancement – 2nd Place
(Chair, Elizabeth ('Liz') Zapata)

· Communications – 1st Place
(Newsletter Editor, Jon S. Berndt)

· Membership – 1st Place
(Chair, Elizabeth Blome)

· Harry Staubs Precollege Outreach – 1st Place
(Chair, Joy Conrad King)

· Public Policy – Honorable Mention
(Chair, L. Nicole Smith)

· Young Professional Activity – 2nd Place
(Young Professional, Sarah Shull)

As the 2004/2005 Chair I want to congratulate the members of the Houston Section and, in particular, the members of the Executive Council. Without each and every one of you these awards would not have been possible. These awards are cash awards and are very important to the Houston Section as they represent the bread and butter by which the Houston Section can provide many of its services to its members.

Under the leadership of this year's Chair, Steve King, the 2005/2006 term will have another very successful year. I look forward to next year's news bulletin announcing the Houston Section with firsts in all the categories!

How can NASA claim this is a new spacecraft, it looks like an Apollo era capsule?

The shape of the spacecraft is a product of physics. The science of space flight hasn't changed since we started sending humans into space. This is a high tech design that combines the very best of Apollo and the space shuttle. Blunt-body, conical spacecraft simply provide the safest, most economical means of transporting crews to and from space.

- From the NASA Exploration FAQ

Staying Informed

COMPILED BY THE EDITOR

This column points out useful web sites, documents, policy papers, periodicals, etc.

NASA Hurricane Resources Page
www.nasa.gov/vision/earth/lookingatearth/hurricane_2005.html

2005 U.S. Commercial Space Transportation Developments and Concepts: Vehicles, Technologies, and Concepts
http://www.aia-aerospace.org/stats/resources/ast_rlv_05.pdf

A Better Rocket Engine
science.nasa.gov/headlines/y2005/14oct_betterrocket.htm

NASA Exploration FAQ
www.nasa.gov/missions/solarsystem/cev_faq.html

A Short List of Some Smaller and/or Newer Commercial Space Companies
Andrews Space: www.andrews-space.com
Armadillo Aerospace: www.armadilloaerospace.com
Bigelow Aerospace: www.bigelowaerospace.com
Blue Origin: www.blueorigin.com
Rocketplane: www.rocketplane.com
SpaceDev: www.spacedev.com
Space Exporation Technologies Corporation: www.spacex.com
t/Space: www.transformspace.com
Virgin Galactic: www.virgingalactic.com
XCOR: www.xcor.com

A Short List of Space Advocacy Groups
The Space Frontier Foundation: www.space-frontier.org
The Planetary Society: www.planetarysociety.org
The National Space Society: www.nss.org
The Mars Society: www.marssociety.org, and www.marshouston.org

New Members

ELIZABETH BLOME, MEMBERSHIP

The Houston Section has many new members. If you see one of these folks at the next section event, please welcome them:

Seema Ahuja
Luther Allen
Daniel Allgood
Lessie Alva
Srividhya Ammanur
Pamela Anderson
James Anderson
Lisa Andrews
Latasha Anthony
Jorge Arismendi
Jennifer Bertolimo
Eddie Bickham
Felicia Biggs
Gordon Blue
Khechara Bradford
Larry Bradshaw
Patti Breymeyer
Pamela Brown
Gayle Bull
Staci Callahan
Gemma Calvo
Andrew Carpenter
Cody Carruthers
Jerry Carter
Rebecca Cedillo
Adam Chisholm
Vergie Clark
David Coan
Sherri Colyer
Maureen Cullen
Rebecca Darling
Lillian Davila
Debra Davis
Tanya Davis
Lorena Del Rio Lohse
Johnston Dietz
Cashell Donahoe
Jennifer Donovan
Lary Dorrington
Eliz Dorsey
Kathy Duquesnay
Sandra Duran
Danille Dylinski
Matthre Ellis
Debbie Emerson
Rex Evans
Cheryl Faircloth
Justin Falck
Aimee Falcon
Susan Fontanilla
Aaron Ford
Elizabeth Friske
Brandy Fuller
Diasheena Gabriel
Robert Gilbert
Joan Gilliland
Rodney Goff
Alexander Graham
Jeanette Griffin
Melissa Grooters
Janet Grout
Arnold Guerrero
Consuelo Guerrero
Jordan Hahn
Shannon Hand
Jay Hensley
Edith Hillman
Marsha Hopes
Judith Horstman
Gloria Hudson
Denis Huebner
Elaine Hume
Marilyn Humphrey
April Hughes
Ziaul Huque
Michelle Huynh
Jennifer Johnson
Sandera Johnson
Lindi Juarez
Dawn Kale
Donna Kash
Robert Keiser
Aaron Kelley
Virginia Keown
Melanie Kern
Amy Kershner
Allison Kiker
Kelley Kimball
William Klimko
Yvonne Knight
Matthew Kuester
Justin Kulger
Kari Leedom
Astrid Lertora
Jesse Loudermilk
Megan Loudermilk
Cory Logan
Valerie Loving
Angel Lowe
Ronald Lum
Diane Lunsford
Margaret Luton
Andrew Lynch
Ramona Mateer
Cynthia Maurstad
Jonathan Maxwell
Benjamin May
Stephanie McClain
Jacqueline McCorkindale
Jessica McCraw
Melinda McDonald
Ronald McNeel
Chuck Miller
Mary Mejia
Jennifer Miller
Melinda Mills
Amy Moak
Catherine Modica
Jose Moreira
James Moughon
Kevin Moore
James Motejzik
Sarah Musselman
David Myrick
Anthony Natasi
Hanh Nguyen
Michael Osenar
Pamela Ossorio
Kim Ottosen
Donna Parker
Bonnie Patterson
Kristy Pavini
Patrick Peirce
Aaron Powell
Teresa Phillips
Andrea Plato
Todd Porter
Melba Prevot
Sandra Quandt
Raphael Randal
Chad Ressler
Marilee Reupke
Gable Rhodes
Michael Rhodes
Bernetta Ridgway
Danielle Rockenbaugh
Sandra Rocquin
Wilfredo Rodiguez
Marcello Romano
Lauren Rosenfeld
Carrie Sample
Rae Saxton
Kelly Schuler
Timothy Scudder
Susan Scurry
Beatriz Kelly Serrato
Juan Senent
Margaret Sheridan
Shanna Simmons
Pattijean Simpson
Kranti Singh
Charlene Smith
Jalanta Smith
Monique Smith
Dario Solis
Luke Sommons
Patrick Spaller
Jennifer Stamand
Aimee Stanton
Karen Stocco
Lisa Stone
Cory Thomsen
Erik Torguson
Sara Townsley
Jeanette Valore
Myla Van Duyn
Victoria Varga
Sue Vaugn
Jamie Walport
Kelly Ward
Sean Welch
Samuel Welsh
Dianne Wells
Pat White
Sheree Will
Sharon Williams
Tiffany Williamson
Donna Wilson
Jennifer Wischer
Olga Wunch
Catherine Zarate

Important notes:

- Not a member? See the end page.

Help AIAA Help You - Update Your Membership Records

ELIZABETH BLOME, MEMBERSHIP

We have no contact information for the following members. If you know where they are, please ask them to update their information on www.aiaa.org.

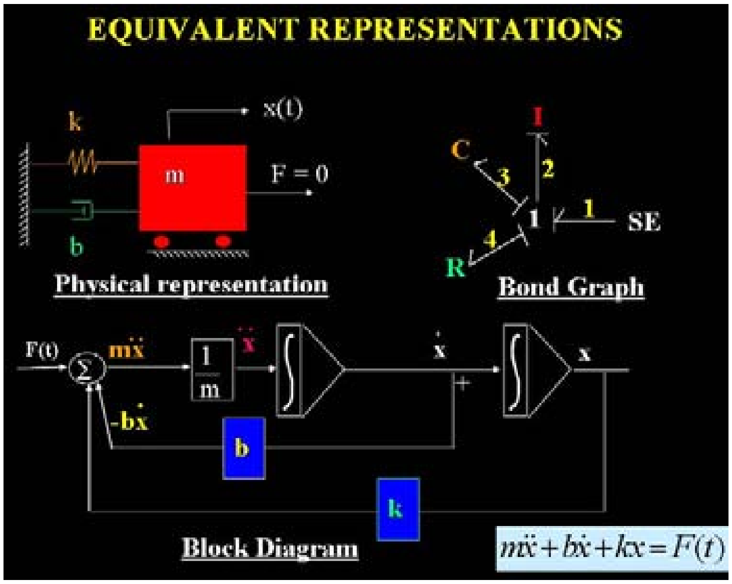
Robert Ambrose
Nick Baker
Paul Campbell
Justin Doyle
Jeff Donoughue
Henry Hoang
Jeffrey Marshall
Lena Norris
Ozden Ochoa
Keun Joo Park
Jeff Phillips
Alicia Rutledge
Matthew Scudder
Grant Threatt
Jaime Valverde
Luis Velasquez
James Watts
Bryan Witt
Pamela Workings

A Lunch and Learn Summary Report

Automating Modeling and Simulation of Dynamic and Control Systems Using the Bond Graph Method

TIM PROPP/VICE CHAIR-TECHNICAL

The AIAA Houston Section's Technical Committees hosted a Lunch and Learn seminar on August 11, 2005, in the JSC Building 30 Auditorium. Dr. Jose Granda, Professor of Mechanical Engineering at the California State University in Sacramento, California and a NASA Faculty Fellow, attracted a crowd of 27 to learn about the fundamentals of Bond Graph Modeling, a methodology originated by Professor Henry Paynter of the Massachusetts Institute of Technology. Modeling and integrating aerodynamic, biological, electrical, hydraulic, mechanical, and thermal dynamic systems (e.g., Mechatronics) plays a central role in the design of any complex system. A major challenge is to obtain the integrated model in the form of first order differential equations in symbolic form. A transfer function and the system state space matrices are the basis for time and frequency domain analysis. The Bond Graph Modeling methodology solves this problem in a unified manner, across engineering disciplines. A classical approach for modeling physical systems includes the following steps:



Step 1: develop an engineering model

Step 2: write differential equations

Step 3: determine a solution

Step 4: write a program

Using the Bond Graph Modeling methodology, the steps are revised as follows:

Step 1: develop a schematic

Step 2: draw a Bond Graph

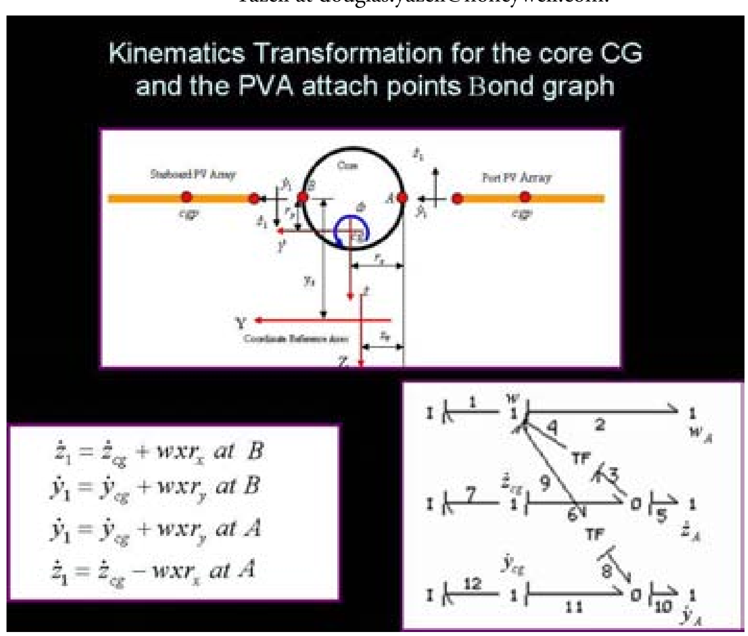
Step 3: obtain computer generated differential equations

Step 4: use Advanced Continuous Simulation Language (ASCL) or MATLAB-SIMULINK to analyze systems.

Once the Bond Graph has been drawn, it is entered into a Computer Aided Modeling Program (CAMP-G) to generate the MATLAB source files.

Tools based on the Bond Graph Modeling methodology are being developed throughout the world in industry, government, and universities. These tools are expected to play a premier role in modeling, simulation, and design of future systems. Users include Ford Motor Company, General Motors, Lockheed Martin, MIT, University of Texas, University of Arizona, and technology institutes in Indonesia, Korea, Switzerland, and Germany. The Bond Graph method has also been used to analyze rigid and flexible bodies for the International Space Station Russian Zvezda Module and Japanese Centrifuge.

If anyone is interested in obtaining a copy of the videotaped presentation, please contact Douglas Yazell at douglas.yazell@honeywell.com.



Bond Graph analysis for the Zvezda module.

When Smart People do Dumb Things: A Tech Fellow's Lessons Learned in Data Analysis

DOUGLAS SCHWAAB

A Lunch and Learn Summary Report

Dr. Tony Lin was the guest speaker for the Lunch n' Learn seminar on August 18th. Dr. Lin, a Technical Fellow and Statistical Expert at the Boeing Satellite Development Center, provided a very informative and humorous presentation on the common pitfalls in data analysis can consistently cause "smart" engineers and technical managers to make "dumb" decisions. Dr. Lin's talk included numerous examples that illustrated these common pitfalls from his experience in both academia and Boeing satellite programs.

Dr. Lin opened his presentation by quoting some famous aerospace predictions that were later proven wrong by history – such as "Heavier than air flying machines are an impossibility" (Lord Kelvin, 1895). What went wrong with these famous predictions was incorrect assumptions. Two key lessons are to: 1) distinguish FACTS from ASSUMPTIONS, and 2) know what ASSUMPTIONS you are making. As Will Rogers said, " It ain't so much the things we don't know that get us in trouble. It's the things we do know that ain't so…"

Dr Lin provided an outline of the common questions to ask during data analysis – as well as excellent examples -- that can help avoid incorrect assumptions:

- Are we solving the "right" problem?
- Do we have "good" data?
  - Are we looking at the right variables?
  - Are the data "representative" of the thing being studied?
  - Is the sample size "large enough" to be meaningful?
- What mathematical models are being used to describe the data? Are the models reasonable?
  - Are we assuming the data have a normal (bell-shaped) distribution?
  - Are we assuming the future data will follow a line?
- Before we jump to any conclusions – do we really know WHY the data came out the way they did?

Dr. Lin continues to seek more stories of these kinds of data analysis mistakes. You can share your dumb data analysis story with him at tony.h.lin@boeing.com.

Professional Engineering - Past, Present and Future

EDMUNDO R. GONZALEZ, JR., P.E., RPLS
EMERITUS BOARD MEMBER TO NCEES

Past

The beginning of human civilization as defined by Anthropologists was determined as the time that homosapiens were able to develop and use tools. That certainly must have been for hunting, fishing or farming. Of course, there was no minimum amount of education, examinations or experience required at that time. Very soon after that, there must have been some concern about the health, safety and welfare of their community.

Present

If you read any article about the perception by the public of the different professions, you will invariable find the profession of engineering at the top of the list or very close to the top. This has to be because we take our profession seriously and with pride. We have developed technology to accommodate our society and its needs. Housing, travel, food, cell phones - everywhere you turn you can see what the hands of engineers have done. We are able to harness our technology and abilities and continue our course to improve our quality of life.

Future

Where are we going? Only we as engineers can tell. Rest assured it will be an effort to the limit of our abilities. How can you participate in this? It is simple; apply your efforts to the fullest in your daily work, keep up to date with technology and participate in your technical and professional societies. Lead the way to where you think we should go.

(Reprinted from *Engineering Express*, published by the Texas Board of Professional Engineers, number 32, Summer 2005, page 14 (ref. www.tbpe.state.tx.us).

Local Industry News and Announcements

AIAA Associate Fellow Bonnie Dunbar Heads for Seattle

The Museum of Flight is pleased to announce the selection of NASA astronaut Dr. Bonnie Dunbar, Ph. D., as its new president and CEO. Dunbar will replace current president and CEO Ralph Bufano — who has led the Museum since 1991 — effective October 3, 2005. Her selection followed a yearlong national search process and was affirmed by a unanimous vote of the Executive Committee of the Museum's Board of Trustees yesterday.

Bonnie extends an open invitation to readers to visit the Museum when in Seattle. For more information see:
www.museumofflight.org

(Source: Ms. Bonnie Dunbar, and The Museum of Flight)

SPACEHAB Subsidiary Wins $4.9 Million Contract

Houston, Texas, September 29, 2005 – SPACEHAB, Incorporated (NASDAQ/NMS: SPAB), a leading provider of commercial space services, announced today that its Astrotech Space Operations subsidiary has been awarded a new contract by NASA/Kennedy Space Center to provide payload processing services from the Company's high-tech facilities in Titusville, Florida.

This indefinite-delivery, indefinite-quantity (ID/IQ) contract, valued at up to $4.9 million, is for spacecraft processing services in support of several NASA spacecraft anticipated for launch next year. Currently under contract are the STEREO observatory (http://stereo.gsfc.nasa.gov/index.shtml) and the Dawn mission (http://dawn.jpl.nasa.gov/). Also expected to be included in this contract is processing support to NASA's THEMIS spacecraft.

For more information, see www.spacehab.com.

(Source: SPACEHAB)

NASA/JSC and Commercial Orbital Transportation Services

NASA/JSC plans to solicit proposals from industry for Earth to orbit space flight demonstrations of any combination of the following mission capabilities:

Period 1
a) External unpressurized cargo delivery and disposal,
b) Internal pressurized cargo delivery and disposal,
c) Internal pressurized cargo delivery, return and recovery.

Option Period 2
d) Crew Transportation.

[…]

The objective of these space flight capability demonstrations is to stimulate commercial enterprises in space and lead to innovative, cost effective access to low-Earth orbit. It is anticipated that upon the successful demonstration of any one of the mission capabilities prior to 2010 timeframe, NASA may issue a request for proposals to competitively procure commercial orbital transportation services to resupply the International Space Station. NASA anticipates that these services will be needed through at least 2015.

(Source: NASA, http://prod.nais.nasa.gov/cgi-bin/eps/synopsis.cgi?acqid=118128).

A Lunch and Learn Summary Report

Small Business Innovative Research/Small Business Technology Transfer Programs

TIM PROPP, VICE CHAIR - TECHNICAL

For more information about NASA's SBIR STTR Programs, please visit http://sbir.nasa.gov.

About 40% of the completed Phase 1 projects receive funding for Phase 2 development. Two JSC/SBIR-developed technologies were inducted in the Space Technology Hall of Fame in 2004: Autonomous Technologies and Cybernet). Additionally, two JSC SBIR companies were chosen for the Space Technology Hall of Fame in 2005: Argonide Corporation and Triangle Research & Development Corporation.

Dr. Kumar Krishen, Chief Technologist for the NASA JSC Technology Transfer Office, attracted a crowd of 32 on 9/29 to hear the status and accomplishments of the JSC Small Business Innovative Research (SBIR) and Small Business Technology Transfer (STTR) Programs. The SBIR and STTR Programs provide opportunities for small, high technology companies and research institutions (RI) to participate in Government sponsored research and development (R&D) efforts in key technology areas. JSC currently has 18 million dollars worth of SBIR STTR contracts. The SBIR Program was established by the U.S. Congress in 1982 to provide increased opportunities for small businesses to participate in R&D, to increase employment, and to improve U.S. competitiveness. The program's specific objectives are to stimulate U.S. technological innovation, use small businesses to meet federal research and development needs, increase private-sector commercialization of innovations derived from federal R&D, and foster and encourage participation by socially disadvantaged businesses. Legislation enacted in 2000 extended and strengthened the SBIR program and increased its emphasis on pursuing commercial applications of SBIR project results. The STTR Program awards contracts to small business concerns for cooperative research and development with a non-profit RI, such as a university. The goal of the Congress in establishing the STTR program is to facilitate the transfer of technology developed by an RI through the entrepreneurship of a small business. The small business and its partnering institution are required to sign an agreement on how intellectual property will be shared between them. Modeled after the SBIR Program with the same basic requirements and phased funding structure described above, STTR is nevertheless a separate activity and is separately funded. The SBIR Phase 1 contracts last for 6 months with a maximum funding of $70,000, and Phase 2 contracts last for 24 months with a maximum funding of $600,000. The STTR Phase 1 contracts last for 12 months with a maximum funding of $100,000, and Phase 2 contracts last for 24 months with the maximum contract value of $600,000. Historically, the ratio of the number of Phase 1 proposals to awards for SBIR is 7:1 and for STTR 5:1.

More on Education and the Workforce: H.R. 758

Legislation

JON BERNDT, EDITOR

In the past months since our article on Education and the Future Workforce, the issue continues to be prominent in the news, and in the nation's capitol.

In the September 26 issue of the Houston Chronicle, employment correspondent Rebecca Maitland wrote: "For the last five years, those in engineering management around the country have been making it known that a new generation of engineers is needed. Roughly 50 percent of today's engineers are approaching retirement." The story discusses the High School for Engineering Professions (HSEP) — a magnet school program in HISD. You can read more about the HSEP at a team web site:

www.leopards57.com

Fredericksburg High School—as seen in this issue of Horizons — also has an active program to expose students to engineering and science.

The Aerospace Industries Association held a panel discussion this May about several issues of interest to the aerospace industry. One of those involved worforce issues. George Yohrling, President and CEO of Curtiss-Wright Corporation, described one of their solutions to the problem: "*Like everyone else, we're finding that our workforce is aging, particularly engineers. There have been many instances, fortunately, where our most talented engineers don't like full retirement and we've been able to bring them back on a contract to help train new, younger employees. We've also established scholarships at three engineering schools close to our major manufacturing sites. This is getting us exposure and a recruiting edge. We're looking at extending that to internships where students would come in and work hands-on with our senior people.*"

Bigelow Aerospace recently opened up an office in Houston. In an article in Space.com, a Bigelow representative said: "*One of the most difficult aspects of the aerospace field is quality people. It is difficult to identify, hire and find good engineers. The aerospace workforce is becoming a concern.*"

The problem is now being acted on with legislation. Bill H.R. 758 passed in the House on October 25 and has moved on to the Senate. The stated purpose of the bill is: "To establish an interagency aerospace revitalization task force to develop a national strategy for aerospace workforce recruitment, training, and cultivation.

The Findings of the bill are:

(1) The aerospace industry generates nearly 15 percent of the gross domestic product of the United States, supports approximately 11,000,000 jobs in the United States, and leads the United States economy in net exports.

(2) The aerospace industry contributes directly to the economic and national security of the United States through military, space, air transport, and in-formation technology applications.

(3) A skilled and educated workforce represents the most valuable asset of the United States economy.

(4) In 2004, total employment in the aerospace industry fell to its lowest point in 50 years.

(5) 27 percent of the aerospace manufacturing workforce will become eligible for retirement by 2008.

(6) Students in the United States rank near the bottom of the leading industrialized countries of the world in mathematics and science test performance.

(7) To ensure the stability of high-skilled jobs and the global competitiveness of the domestic aerospace industry, the United States requires coordinated Federal Government policies to sustain and expand the science, mathematics, engineering, and manufacturing workforce.

The Bill calls for the creation of an interagency task force , whose duties will be to:

"… develop a strategy for the Federal Government for aerospace workforce development, including strategies for--

(1) maximizing cooperation among departments and agencies of the Federal Government and the use of resources of the Federal Government in fulfilling demand for a skilled workforce across all vocational classifications;

(2) developing integrated Federal Government policies to promote and monitor public and private sector programs for science, engineering, technology, mathematics, and skilled trades education and training; and

(3) establishing partnerships with industry, organized labor, academia, and State and local governments to--
   - collect and disseminate information on occupational requirements and projected employment openings; and
   - coordinate appropriate agency resources, including grants, loans, and scholarships, for the advancement of workforce education, training, and certification programs."

For more information on this bill, another bill relevant to the aerospace industry, or any bill at all, a useful site is:

www.GovTrack.US

A Lunch and Learn Summary Report

Apollo EVA: Lessons Learned

BILL WEST, EVA TECHNICAL COMMITTEE CHAIR

The Houston AIAA EVA Technical Committee held a Lunch N' Learn on Thursday, October 20th, entitled "Lessons Learned from Apollo EVAs." Dr. Dean Eppler from Science Applications International Corporation discussed the results of interviews conducted in 1994 with eight of the Apollo astronauts that walked on the Moon. In the interviews the crewmembers discussed their EVA experiences, what worked and what didn't work, as well as viewed what was then new EVA hardware for both the ISS as well as the Space Exploration Initiative. The presentation by Dr. Eppler covered the results of these interviews and covered such topics as mission operations philosophy to suit and tool design. Dr. Eppler also briefly talked about his own experiences developing advanced EVA hardware and testing it during Desert RATS. Approximately 70 people attended the LnL.

The LnL presentation and a copy of the paper co-authored by Dr. Eppler are available at the AIAA-Houston website:

www.aiaa-houston.org

The web site for the Apollo Lunar Surface Journal is at: http://www.hq.nasa.gov/office/pao/History/alsj/. The site features a huge archive of information. The Apollo Lunar Surface Journal is a record of the lunar surface operations conducted by the six pairs of astronauts who landed on the Moon from 1969 through 1972.

Also featured at the ALSJ is a page about Dean Eppler, including images of newer space suit designs undergoing field tests:

www.hq.nasa.gov/office/pao/History/alsj/eppler.html

A Lunch and Learn Summary Report

Advent Launch System

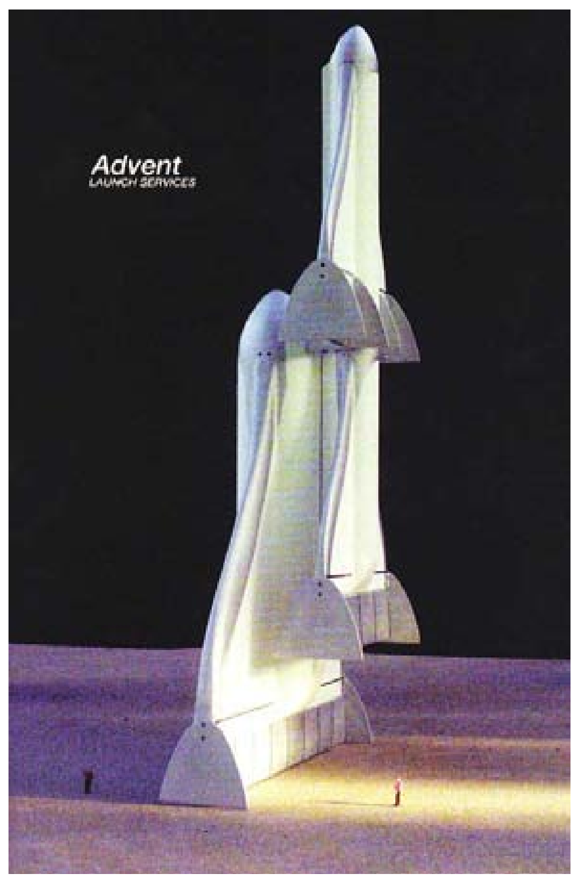
ANDY PETRO, PROPULSION AND POWER TECHNICAL COMMITTEE CHAIR

[See feature article this issue on Advent Launch Services]

The Propulsion and Power Systems Technical Committee co-hosted a Lunch and Learn seminar along with the JSC chapter of the NASA Alumni League on October 6, 2005. The topic was the Advent Launch System presented by James Akkerman and Glen Smith. Both presenters are retired NASA engineers with extensive experience in propulsion and aerospace system development. Among his many innovations, Mr. Akkerman is known for the left-ventricular assist device, an important contribution of NASA technology to the field of heart disease treatment.

In the presentation, Mr. Akkerman described the design, development plans and the long- term strategy of the Advent Launch Service organization. Working locally, with modest resources, they have developed a launch vehicle concept which employs a number of features which are intended to allow for frequent flights and rapid turnaround of the reusable vehicle resulting in radically lower operations cost. It is a multi-stage vehicle but stages of various sizes would be developed by scaling a common stage design. The concept could deliver payloads ranging from 1000 pounds to 100,000 pounds or more. The Advent team has performed ground testing of the engine and propellant tank assembly and an actual engine was on display at the presentation along with photographs of their testing activities.

About 40 people attended the presentation at the Gilruth Center.



Advent Launch System staging concept.

2005-2006 "Spirit of Apollo" College Scholarship Award

DOUGLAS SCHWAAB, SCHOLARSHIP

Outreach and Education

Jayme Tucker was awarded the Houston Section "Spirit of Apollo" Scholarship of $1000 for the 2005-2006 academic year. Jayme is a Senior Aerospace Engineering student at the University of Texas Arlington (UTA). Jayme is at the top of her UTA engineering class and on-track to be an honors graduate; while also working part-time for an aerospace company and as a volunteer mentor. Jayme is also an AIAA student member. Jayme was selected by the scholarship committee from a highly competitive field of six applicants from several Texas Colleges.

The "Spirit of Apollo" Scholarship honors the historic accomplishments of the Apollo Space Program by encouraging outstanding students at Texas Colleges to continue their studies in engineering, math or science. Qualified applicants must have completed their freshman academic year with a GPA of at least 3.0 on a 4.0 scale. The qualified applicants must provide an essay, three letters of recommendation, college transcripts, along with a description of extracurricular activities and work experience. Additional information and the application form for our annual scholarship can be found on the Houston Section's webpage.

Congratulations to Jayme Tucker as this year's scholarship winner -- and to all the other applicants for their distinctive accomplishments!

AIAA Houston October Glider Workshop

JOY CONRAD KING, PRE-COLLEGE

The AIAA Houston Section hosted a Glider Workshop on Saturday, October 22 at the Johnson Space Center Gilruth pavilion. The weather was crisp that morning as three pilots (Helen DCouto, Glen Doggett, and David Fuller) talked about flying and answered questions from the audience. Each of the 120 students who attended then built their own glider out of balsa wood, glue, and clay. They were given basic instructions, but there were quite a few design modifications made! 12 volunteers were on hand to help them as well as several parents. After the gliders were built, the students could compete in two competitions, one for accuracy and one for length of flight. The winners in the length of flight competition were:

K – 2nd grade Clay Woodcook (5.40 second flight)

3rd – 4th grade Megan Murphy (7.00 second flight)

5th – 8th grade Jesse Ramirez (10.56 second flight)

Congratulations to all the students who participated (even the two whose gliders ended up on the roof!).

Section Announcements

AIAA HOUSTON EXECUTIVE COUNCIL

Assistant Newsletter Editor Needed

The Houston section is looking for some help in producing the newsletter. The assistant editor would be responsible for helping to collect articles for the upcoming issue, proofread, etc. Please contact the editor for more information at editor@aiaa-houston.org.

2006 Congressional Visits Day Scheduled

You're invited! Every year, AIAA members come to Washington, D. C. to take part in our annual Congressional Visits Day (CVD). Here, you'll meet with national decision-makers to discuss critical industry issues in civil aeronautics, civil astronautics, and defense.

What's our goal? Through face-to-face meetings with Members of Congress, congressional staff, key Administration officials, and other decision-makers, Congressional Visits Day raises their awareness of the long-term value that science, engineering and technology bring to America.

The 2006 CVD is scheduled for **4-5 April 2005** in Washington, D.C. Anyone who is interested in attending this year as part of the Houston Section contingency, please contact Nicole Smith at PublicPolicy@aiaa-houston.org. For more information about AIAA Public Policy (including CVD and our Legislative Action Center), please visit the following link: http://www.aiaa.org/content.cfm?pageid=7

CALENDAR

[Dates, events, and times are subject to change. See the AIAA Houston web site for more information at: www.aiaa-houston.org]

November	
7	Executive Council Meeting (ARES Corp.)
10	Lunch n' Learn: " Systems Engineering Benchmark Study" by Jack Gavalas/Booz-Allen-Hamilton (JSC)
15-16	American Astronautical Society (AAS) National Conference (South Shore Harbour)
December	
5	Executive Council Meeting (ARES Corp.)
TBD	Dinner Meeting (Gilruth)
TBD	Lunch n' Learn
January	
9	Executive Council Meeting (ARES Corp.)
19	Dinner Meeting: "First Flight of a Mars Airplane" by Dr. Robert D. Braun/Georgia Tech & AIAA Distinguished Lecturer; Joint with USALA/NMA Gilruth)
20-21	Future City Competition - Houston Regional, Phase II (San Jacinto Central)
21	Mars Rover Model Competition (UH)
TBD	AIAA Aerospace Historical Site Dedication at JSC
TBD	Lunch n' Learn
February	
6	Executive Council Meeting (ARES Corp.)
24	Engineers Appreciation Social – During National Engineers Week (Gilruth)
TBD	Lunch n' Learn
March	
6	Executive Council Meeting (ARES Corp.)
April	
3	Executive Council Meeting (ARES Corp.)
6-8	Student Paper Contest, College Station
12	Yuri's Night - World Space Party
27-29	Region IV Student Paper Conference (Texas A&M University, College Station)
TBD	"Space Trivia Night" (Gilruth)
TBD	"Spirit of Flight" Airshow (Lone Star Flight Museum, Galveston)
TBD	Texas A&M University Student Branch Banquet (College Station)
May	
1	Executive Council Meeting (ARES Corp.)
5	"Space Day" Event
19	Annual Technical Symposium (Gilruth)
20	Career & Professional Development Workshop (Gilruth)
TBD	Mixer with the Mars Society - Houston Chapter
June	
5	Executive Council Meeting (ARES Corp.)
15	Annual Honors & Awards Banquet: "SR-71 Blackbird – An Engineering Marvel" by Col. R. Graham/USAF Retired & AIAA Distinguished Lecturer (Gilruth)

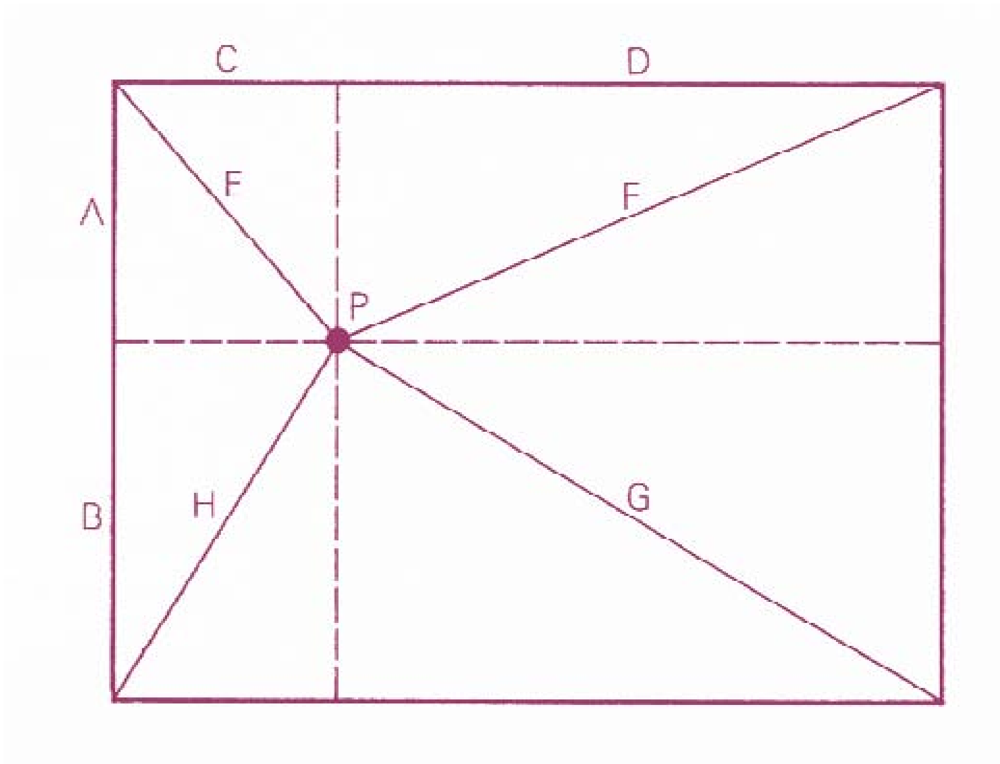
Cranium Cruncher

BILL MILLER, SENIOR MEMBER

Last Issue

Last month's oil well puzzle was from Chapter 12 of Martin Gardner's Sixth Book of Mathematical Games from *Scientific American* (1971).

Referring to this figure, because adding the dashed lines make a set of right triangles, we have,



$E^2 = A^2 + C^2$ and $G^2 = B^2 + D^2$

So,

$E^2 + G^2 = A^2 + C^2 + B^2 + D^2$

Similarly,

$F^2 + H^2 = A^2 + D^2 + B^2 + C^2$

Since the right hand side of the last two equations are the same, we can say, $E^2 + G^2 = F^2 + H^2$

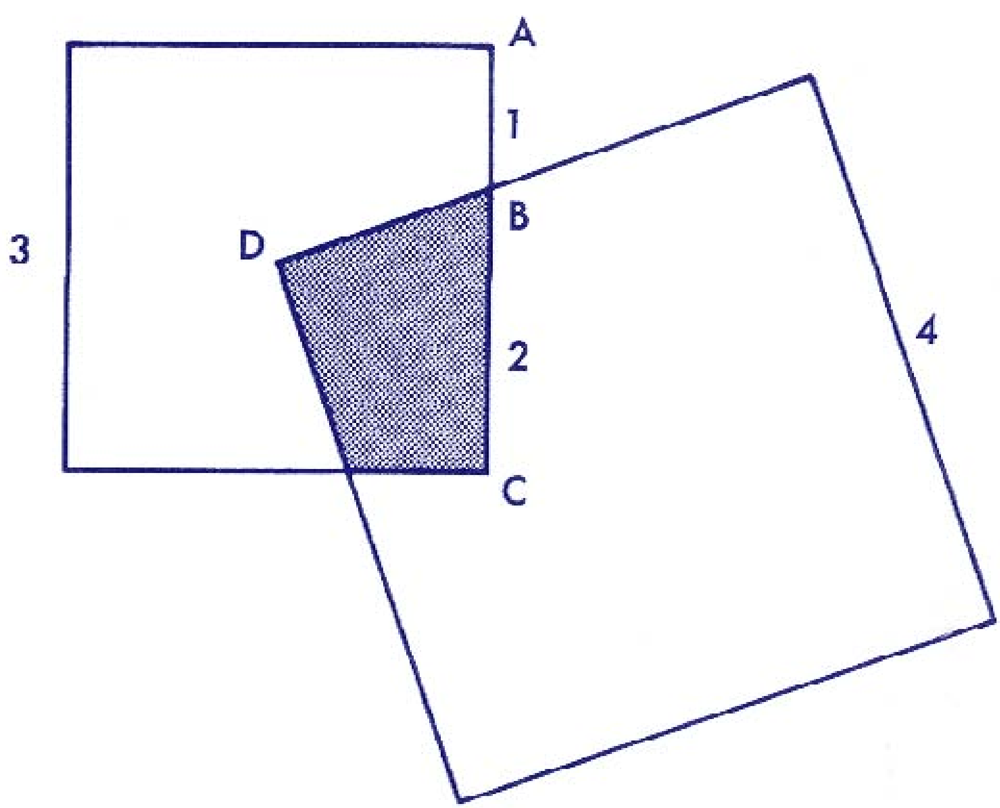
Since three of these distances are given in the problem, it is easy to solve for the missing distance, which works out to be 27,000 feet.

Correct solutions were received from:

Wendell Mendell
Brian Johnson
Josh Gibson
Brandon Burns
Frank Baiamonte
Glenn Jenkinson

Current Cruncher

Referring to the figure at right, compute the area of the shaded region. Both figures are squares, and point D is at the center of the smaller square.



Send solutions to Bill Miller at wbmiller3@houston.rr.com. The answer, along with credits, references, and names of the solvers, will be provided next time.

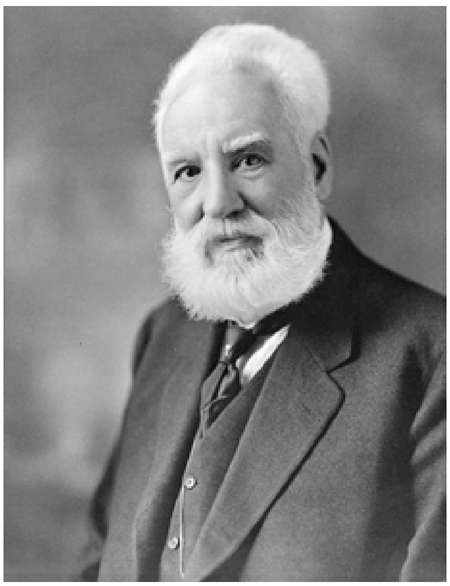
Odds and Ends

SPECIAL EVENTS, PICTORIALS, ETC.

The Engines of our Ingenuity

John Lienhard, M.D. Anderson Professor Emeritus of Mechanical Engineering and History at the University of Houston, wrote of “Amateurs and Professionals” in his column “The Engines of Our Ingenuity”: “*…Goddard's invention of the high-altitude rocket in the 1920s was a one-man effort. Goddard was a highly trained professional, but he changed the world by thinking like an amateur. His rocket didn't reflect established expertise. It was a leap of the mind and a leap of the heart. Goddard had no guarantee of success, and he saw a lot of failure before his rockets flew… The creative part of engineering is often done by professionals, but only in that moment when they lay expertise aside and behave like amateurs. Invention, by its nature, lies outside the professional's arsenal of established knowledge. You can spot the pros in a group of professionals and amateurs. Their faces are blanked and detached. They limit contact with the amateurs, because amateurs are potentially dangerous. They* [amateurs] *don't play by rules. They risk error. They're the ones who join the game with their hearts – as well as their heads.*”

At left: Robert Goddard stands beside one of his early rockets.—this one is the first liquid fueled rocket.



Who is the man above, left? He was credited (until recently) with the initial invention of a common household device.

From the Library of Congress web site:

“*[He] might easily have been content with the success of his invention. His many laboratory notebooks demonstrate, however, that he was driven by a genuine and rare intellectual curiosity that kept him regularly searching, striving, and wanting always to learn and to create. He would continue to test out new ideas through a long and productive life. He would explore the realm of communications as well as engage in a great variety of scientific activities involving kites, airplanes, tetrahedral structures, sheep-breeding, artificial respiration, desalinization and water distillation, and hydrofoils.*

…

However, these interests may be considered minor activities compared to the time and effort he put into the challenge of flight. By the 1890s, [he] had begun experimenting with propellers and kites. His work led him to apply the concept of the tetrahedron (a solid figure with four triangular faces) to kite design as well as to create a new form of architecture. In 1907, four years after the Wright Brothers first flew at Kitty Hawk, [he] formed the Aerial Experiment Association with Glenn Curtiss, William "Casey" Baldwin, Thomas Selfridge, and J.A.D. McCurdy, four young engineers whose common goal was to create airborne vehicles. By 1909, the group had produced four powered aircraft, the best of which, the Silver Dart, made the first successful powered flight in Canada on February 23, 1909. [He] spent the last decade of his life improving hydrofoil designs, and in 1919 he and Casey Baldwin built a hydrofoil that set a world water-speed record that was not broken until 1963. Months before he died, [he] told a reporter, "There cannot be mental atrophy in any person who continues to observe, to remember what he observes, and to seek answers for his unceasing hows and whys about things."

The Library of Congress holds a collection of Alexander Graham Bell family papers here:
http://memory.loc.gov/ammem/bellhtml/bellhome.html

Odds and Ends (Page 2)

SPECIAL EVENTS, PICTORIALS, ETC.

These images are not from the recent JetBlue landing at Los Angeles International Airport, but from a prior similar incident in 2001.

http://www.flickr.com/photos/73615743@N00/

For Kids and Parents: Celebration Seltzer Rockets

[From: www.kidsdomain.com/craft/seltzerrockets.html]

These rockets can't burn anyone!
Parental supervision is recommended.

What You Need

Film canister with snap on lid (Fuji)
Toilet paper roll (double roll size, preferred, Waxtex wax paper rolls appear to fit the film canisters, without having to cut them.)
Construction paper
Scissors
Scotch tape
Markers, crayons, or paints
Stickers, optional
Alka-Seltzer tablets (generic works fine)
Water in a container
Eye protection (glasses)

How To Make It

1. Cut straight up the side of the toilet paper roll.
2. Insert the film canister at one end, making sure the end with the lid sticks out about 1/8".
3. Tape along one edge of the toilet paper roll onto the film canister. Roll the toilet paper roll around the canister and tape tightly into place.
4. Cut a circle out of construction paper, cutting a pie shaped wedge out of the circle. Experiment with different sizes of circles to see if it makes a difference in how the rocket reacts upon launch.
5. Roll the paper into a cone shape and tape onto the other end of the toilet paper tube.
6. Decorate your rocket with markers, stickers, crayons, or paints.
7. Cut 4 squares out of construction paper to make fins if you wish. Tape on to lower sides of rocket.
8. Take outside: the rocket, water, Alka-Seltzer tablets, and eye protection.
9. Put on your eye protection.
10. Turn the rocket upside down, remove the lid from the canister, and fill 1/4 full with water. Drop in tablet and immediately replace lid and set on ground. Back up!

Experiment with using one or two tablets into the canister to see if it will shoot up higher. Be sure to look for the tablets after the rocket fires, we were able to reuse some of them a couple of times. Be sure to rinse off your driveway or sidewalk after finishing with your rockets.

Upcoming Conference Presentations by Houston Section Members

COMPILED BY THE EDITOR FROM AIAA AGENDAS

Information here is taken from AIAA conference agendas. As such, it is subject to change. AIAA-Houston members can also inform the editor of any upcoming presentations at any conference (AIAA or other) via email at: editor@aiaa-houston.org.

44th AIAA Aerospace Sciences Meeting and Exhibit
Reno, Nevada
9 - 12 Jan 2006

Water Recovery Systems for Exploration Missions
K. Pickering and M. Anderson, NASA Johnson Space Center, Houston, TX; L. Carter, NASA Marshall Space Flight Center, Huntsville, AL; B. Motil, NASA Glenn Research Center, Cleveland, OH; M. Flynn, NASA Ames Research Center, Moffett Field, CA; and J. Garland, Dynamac Corporation, Kennedy Space Center, FL

Research and Development Needs for Active Thermal Control Systems for Human Rated Space Vehicles
D. Westheimer, NASA Johnson Space Center, Houston, TX; M. Hasan, NASA Glenn Research Center, Cleveland, OH

BLIMPK/Streamline Surface Catalytic Heating Predictions on the Space Shuttle Orbiter
J. Marichalar and W. Rochelle, ESCG/Jacobs Sverdrup, Houston, TX; B. Kirk and C. Campbell, NASA Johnson Space Center, Houston, TX

Oral Presentation: Quantitative Applications for Optical Emission Spectroscopy in Plasmas (Invited)
V. Donnelly, University of Houston, Houston, TX

Exploration- Related Research on ISS: Connecting Science Results to Future Mission
J. Rhatigan, J. Robinson and C. Sawin, NASA Johnson Space Center, Houston, TX

In Situ Resource Utilization: Technical and Programmatic Efforts Under the NASA Vision for Space Exploration
K. Sacksteder, NASA Glenn Research Center, Cleveland, OH; W. Larson, NASA Kenedy Space Center, Kennedy Space Center, FL; G. Sanders, NASA Johnson Space Center, Houston, TX; R. Schlagheck, NASA Marshall Space Flight Center, Huntsville, AL

The In- Space Soldering Investigation (ISSI): Experiments Aboard the International Space Station
R. Grugel, NASA Marshall Space Flight Center, Huntsville, AL; L. Cotton, The Boeing Company, Houston, TX; P. Segre, Emory University, Atlanta, GA; J. Ogle, Sverdrup, Huntsville, AL; G. Funkhouser, Morgan Research, Huntsville, AL; and F. Parris, Sverdrup, Huntsville, AL

Developing Fabrication Technologies to Provide on Demand Manufacturing for Exploration of the Moon and Mars
M. Hammond, NASA Marshall Space Flight Center, Huntsville, AL; J. Good, Muniz Engineering, Houston, TX; S. Gilley, Tec-Masters, Inc., Huntsville, AL; and R. Howard, Teledyne Brown Engineering, Huntsville, AL

Weather Support to the Space Shuttle: An Overview
W. Vaughan, University of Alabama in Huntsville, Huntsville, AL; B. Boyd, U.S. Air Force Weather Service, Patrick AFB, FL; D. Bellue, NASA Johnson Space Center, Houston, TX; J. Madura, NASA Kennedy Space Center, Kennedy Space Center, FL; T. Garner, NASA Johnson Space Center, Houston, TX; J. Weems, U.S. Air Force Weather Service, Patrick AFB, FL; and H. Herring, Computer Sciences Raytheon, Patrick AFB, FL

Space Shuttle Thermal Protection System Repair Flight Experiment Induced Contamination Impacts
K. Smith, C. Soares, R. Mikatarian, and D. Schmidl, The Boeing Company, Houston, TX; C. Campbell and S. Koontz, NASA Johnson Space Center, Houston, TX; D. McCroskey and J. Garrett, Open Source Initiative, Mountain View, CA

Recent Improvements in Ion Cyclotron Heating Efficiency in the Vasimr Engine
E. Bering and M. Brukardt, University of Houston, Houston, TX; J. Squire, V. Jacobson, T. Glover and G. McCaskill, Muniz Engineering Inc., Houston, TX

Analysis of ISS Plasma Interaction
B. Reddell, J. Alred and R. Mikatarian, The Boeing Company, Houston, TX; J. Minow, NASA Marshall Space Flight Center, Huntsville, AL; S. Koontz, NASA Johnson Space Center, Houston, TX

Impact of Plasma- Induced Arcing on ISS Touch Temperature
J. Alred and R. Mikatarian, The Boeing Company, Houston, TX; T. Schneider, NASA Marshall Space Flight Center, Huntsville, AL; S. Koontz, NASA Johnson Space Center, Houston, TX

Current Collection Characteristics of ISS Russian Thermal Blanket Material
T. Schneider, NASA Marshall Space Flight Center, Huntsville, AL; K. Hwang, Morgan Research Corporation, Huntsville, AL; J. Vaughn and J. Minow, NASA Marshall Space Flight Center, Huntsville, AL; K. Wright, University of Alabama in Huntsville, Huntsville, AL; B. Reddell, J. Alred, R. Mikatarian, and P. Leung, The Boeing Company, Houston, TX; and S. Koontz, NASA Johnson Space Center, Houston, TX

Impact of Solar Array Position on ISS Vehicle Charging
J. Alred and R. Mikatarian, The Boeing Company, Houston, TX; S. Koontz, NASA Johnson Space Center, Houston, TX

First Data from ISS FPMU On- Orbit Ionosphere and Floating Potential Measurements
B. Reddell, R. Mikatarian and L. Kramer, The Boeing Company, Houston, TX; K. Wright, National Space Science and Technology Center, Huntsville, AL; C. Swenson, Utah State University, Logan, UT; J. Alred, The Boeing Company, Houston, TX

Internal EMU Resistance Impact on Suit Arcing During EVA
L. Kramer and P. Leung, The Boeing Company, Houston, TX; T. Schneider, J. Vaughn and T. Black, NASA Marshall Space Flight Center, Huntsville, AL; D. Hamilton, Wyle Laboratories, Houston, TX

Plasma- Induced Dielectric Breakdown of Chromic Acid Anodized Aluminum Surfaces
T. Schneider and J. Vaughn, NASA Marshall Space Flight Center, Huntsville, AL; L. Kramer, The Boeing Company, Houston, TX; P. Leung, The Boeing Company, El Segundo, CA; T. Black and B. Teipel, NASA Marshall Space Flight Center, Huntsville, AL

Upcoming Conference Presentations by Houston Section Members

CONTINUED ...

A Numerical Study of the Accuracy of the Immersed Boundary Method
F. Pacull and M. Garbey, University of Houston, Houston, TX

Plasma Deatchment Simulation in the VX- 30 System
A. Ilin, Muniz Engineering, Inc., Houston, TX; F. Chang Diaz, NASA Johnson Space Center, Houston, TX; J. Squire and T. Glover, Muniz Engineering, Inc., Houston, TX

Stereo PIV for Near Wall Measurements
I. Ekoto and R. Bowersox, Texas A&M University, College Station, TX; L. Goss, Innovative Scientific Solutions Inc., Dayton, OH

Partially- Averaged Navier- Stokes Method for Turbulent Flows: k- w Model Implementation
S. Lakshmipathy and S. Girimaji, Texas A&M University, College Station, TX

Marathon UAV Development
Z. Reeder, Texas A&M University, College Station, TX

Investigation of Turbulent Rectangular Jets Using PANS Method
S. Girimaji and T. Lavin, Texas A&M University, College Station, TX

Functional Decomposition of a Portable Life Support Subsystem for the NASA Extra-Vehicular Activity Mobile Unit Used in Explorations 1 Through 5
L. Wiseman, S. Abdelfattah, T. Lalk, M. Schuller, and E. Marotta, Texas A&M University, College Station, TX

The Effect of Diamond Injector Geometry on Supersonic Jet Interaction Secondary Flow
J. McLellan, R. Bowersox, and R. Srinivasan, Texas A&M University, College Station, TX

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