

Horizons

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Make It So

jon s. berndt



AIAA HOUSTON
American Institute of Aeronautics and Astronautics

horizon: 1 a : the apparent junction of earth and sky ... **d :** something that might be attained

Have we just passed through a pivotal moment in human space exploration history?

In 2004, AIAA and AIA (Aerospace Industries Association) each made similar observations and recommendations about issues of interest to aerospace professionals in our community. Among the recommendations conveyed are these:

- Develop and operate a modern, safe, reliable and cost effective space transport successor to the space shuttle, that supports long term goals of the U.S. human space exploration program.
- Vigorously promote and support programs aimed at growing and sustaining a capable science and technology workforce.

These recommendations follow on the heels of the CAIB Report on the Columbia Accident, which pointed out "two realities" that have faced NASA in its long-range outlook: the lack of a clear vision laying out human spaceflight goals over the past 30 years, and the lack of sustained government commitment for a successor to the space shuttle.

Perhaps the above recommendations and realities are finally being addressed. In mid-November Congress suddenly reversed itself and fully funded NASA for the amount requested by the administration for 2005, thanks to the strong support provided by Tom Delay, and

others. Earlier this year, President Bush unveiled the Vision for Space Exploration (VSE), billed as a carefully laid out and affordable long-term map for the human exploration of space, that includes a return to the moon. A recent market study conducted by Dittmar Associates showed that a large

haps have the line-item veto. We've got to exercise not only overall budgetary control, but stop these earmarks. We're harming agencies like NASA and their ability to carry out their mission because we're diverting so much of the funds to other projects that are unnecessary and wasteful."

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- Sen. John McCain (R. AZ)

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majority of Americans support the VSE and a return to the moon. Finally, the President who presented the VSE was just recently reelected to another four year term.

The road ahead will be challenging on many fronts. The VSE is by definition a long-term undertaking, and will need to be sustainable over multiple administrations. As part of making that happen, the public must be engaged, benefits must be realized and communicated, and potential funding annoyances must be addressed. As an example of the latter, Senator John McCain of Arizona pointed out one recurring financial concern on a recent airing of Meet the Press: "We've got to have some kind of way of challenging these earmarks. We've got to have the president per-

There will also be technical challenges ahead, and trade-offs will need to be made between development of new or utilization of existing technologies. The Congressional Budget Office publication "A Budgetary Analysis of NASA's New Vision for Space Exploration" reports that the NASA budget allocation for the Crew Exploration Vehicle through 2020 (research and development, four operational vehicles, testing and operations) will total \$24.7 billion. Recalling past efforts at developing a replacement for the space shuttle, the CAIB stated that it "believes that the country should plan for future space transportation capabilities without making them dependent on technological breakthroughs."

The VSE makes a point to men-
(Continued on page 3)



American Institute of
Aeronautics and Astronautics

Important notes:

- Not a member? See the end page.

Chair's Corner

t. sophia bright, chairperson, aiaa houston

We are about halfway through the 2004/2005 term and we have been making great strides towards realizing our goals for this term. One of those goals was to improve how we communicate with our membership. In an effort to improve our newsletter service we have adopted two changes:

- The overall newsletter layout
- Increased distribution of the electronic newsletter

As we roll into the next half of the term we hope to continue to provide our membership with interesting and meaningful programs and services. We have several dinner meetings, social activities, lunch and learns, and other programs planned for the spring. Additionally, we will continue to work to keep our local membership in touch with what is happening on both the Regional and National level of AIAA.

If you are interested in getting involved with AIAA please do not hesitate to contact me or any of the

other members of the Executive Council. There are still a few positions open on the organization chart and each of the subcommittees are always interested in getting more help for our upcoming activities.

On behalf of the Houston Section I would like to wish everyone happy holidays! We look forward to seeing you in the new year!

Best regards,

T. Sophia Bright
2004 - 05 Chairperson, AIAA Houston Section



From the Editor

jon s. berndt

Greetings. You will notice that this month's newsletter is much different from past newsletters. I have taken on the responsibility of refining the newsletter, and serving as the editor.

I hope the new format is viewed as an improvement. *Horizons* will continue to evolve to meet the needs of AIAA members in this community. Discussions between the past and present chairpersons and myself have targeted new features to be added to the newsletter, but we would also like your input. One concern with producing the newsletter in this geographic area is that there is already a plethora of great publications such as the Roundup, various local corporate publications, and good coverage of aerospace related news in local newspapers. So, there is a possibility of duplication of cover-

age. That is not necessarily a bad thing by itself, but we would of course like to provide unique features.

Most items that we already cover will remain, such as reviews and accounts of local AIAA events, reports of participation in national AIAA events by local members, notice of upcoming events, etc.

Some of the various items that have been suggested as new features are: a photo highlight, featuring a captivating photograph with wide appeal of local members at work or local events; a humor corner; lightweight technical papers with wide appeal; etc. Another feature that has high appeal is a Letters to the Editor section, where members could submit letters for open publication (anonymously, if requested).

One new feature (which may or may not be a regular one) is a list of materials that can be found on the web such as important and timely policy papers, insightful articles, and relevant reference materials. See the "Staying Informed" feature in this issue.

Again, please share with us your thoughts and feelings about the new format, and about what you would like to see in future newsletters. Even better, let us know if you would like to volunteer to write an article! Please send inquiries, Letters to the Editor, etc. to chair@aiaa-houston.org.

Happy Holidays,

Jon S. Berndt

(Continued from page 1)

tion exploring potential commercial opportunities “for providing transportation and other services supporting the International Space Station and exploration missions beyond low Earth orbit.” Companies such as Scaled Composites (SpaceShipOne) have recently demonstrated increasing resourcefulness and maturity – and perhaps just as important,

providing incentives for entrepreneurial investment in space, by creating significant monetary prizes for the accomplishment of space missions and/or technology developments and by assuring appropriate property rights for those who seek to develop space resources and infrastructure.” NASA has now funded a program of contests and prizes called *Centennial Challenges*.

A Vision has been provided. Funding has been allocated. The public is supportive. Now it is up to a team including many of us here, in the words of the fictional Captain Jean-Luc Picard of Star Trek's U.S.S. Enterprise, to help to “make it so”.

speed and agility – in going after the Ansari X-Prize. Taking a cue from the success of that contest, the *President's Commission on the Implementation of the United States Space Exploration Policy* recommended that “Congress increase the potential for commercial opportunities related to the national space exploration vision by pro-

AIAA itself strongly supports embracing private enterprise in this endeavor. In Testimony to the President's Commission on Implementation of the United States Space Exploration Policy in February, AIAA stated that “... the U.S. should encourage private sector involvement in areas such as:

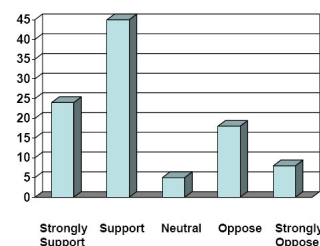
- Developing launch systems

and services that support the new initiative and related programs such as the ISS

- Operating new communications satellites and ground systems to relay data, voice, and video signals from the Moon and Mars to Earth
- Coordinating operations support—at the national and the international levels—for exploration missions
- Stimulating new innovations in the development of exploration technologies”

Regarding the second recommendation made, in support of sustaining and growing the workforce: how many of us in this community made a career choice at an early age, inspired by the accomplishments of the Apollo program, for instance? We are again looking forward to new Horizons – new and challenging goals that might be attained—goals that *should* be attained.

A Vision has been provided. Funding has been allocated. The public is supportive. Now it is up to a team including many of us here, in the words of the fictional Captain Jean-Luc Picard of Star Trek's *U.S.S. Enterprise*, to help to “make it so”.



Percentage of Americans expressing support, neutrality, or opposition to the Plan for Space Exploration. (Source: Dittmar Associates, Seabrook, TX)

Horizons

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T. Sophia Bright

Houston Section Chairperson

OPEN

Publications Chair

Jon S. Berndt

Editor

Regular Contributing Authors

T. Sophia Bright

Jon S. Berndt

Michael Oelke

Elizabeth Blome

Bill Miller

Daniel Noble

Chris Taylor

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Please address all correspondence to the Houston section chairperson:

T. Sophia Bright

(281) 244-4135

email: chair@aiaa-houston.org

AIAA Houston section web site:

www.aiaa-houston.org



A Lunch And Learn Summary Report

Better Faster Cheaper – A Better 50X \$12M Example From ISS GN&C Systems Flight Readiness Certification

nazareth bedrossian and gary brown

On October 28, 2004, the Houston AIAA Systems Engineering Technical Committee was pleased to present a Lunch-and-Learn seminar by Dr. Nazareth Bedrossian entitled “Better Faster Cheaper – A Better 50X \$12M Example From ISS GN&C Systems Flight Readiness Certification”. This lunch-and-learn was conducted in Building 16 of the Johnson Space Center, and was enjoyed by approximately 30 people.

This presentation described the systems engineering approach, used for Flight Readiness Certification (FRC) of the International Space Station (ISS) GN&C systems. The objective of FRC is to certify the integrated structure and control systems meet operational objectives in the presence of uncertainties for each assembly stage. The FRC success criteria require that for a range of parameter variations the integrated system which includes the flexible structure, Russian, US and other international partner control systems, is stable with adequate stability margins and meets transient and steady state performance requirements.

Dr. Bedrossian first reviewed the key characteristics of ISS assembly, which drive the FRC process. These are; a large number of structure and controller configurations and combinations, many operating modes, uncertainty in flex models and mass properties, many schedule changes, time critical analysis, and sharply reduced budgets. Thus, the certification process and tools needed to be able to accommodate these characteristics while achieving mission risk reduction.

It was proposed that the key to

risk management for ISS FRC is confidence in understanding and predicting integrated system behavior in the presence of uncertainties. To achieve this aim, there are two competing philosophies, which Dr. Bedrossian termed the scientific and engineering approaches. In the scientific or top-down approach, the system is modeled to its highest fidelity and this model is then used for analysis or derivation of more simplified models. In the engineering or bottoms-up approach, one starts with a simple system model and uses it for analysis and then gradually adds fidelity. The competing philosophies are manifest in aerospace practice as high-fidelity time-varying models or simulations versus lower fidelity linear or nonlinear time-invariant models or simulations.

Based on the confidence proposition for risk management of complex systems like the ISS, this objective can be achieved by rapidly assessing the system performance for a large number of parameters and operating conditions rather than a detailed analysis of a single operating point. Confidence can be achieved by an optimal combination of the bottoms-up and top-down approach, not by excluding one or the other. With respect to FRC, these are termed screening and simulation or legacy analysis.

Screening analysis rapidly evaluates a wide range of operations and parameters using high-speed tools that capture dominant dynamics thus providing confidence in risk estimates. This is achieved by using time-invariant flexible structural models, frequency and time domain analysis methods. Further, the process and tools were

tailored to maximize value added. Considering the FRC task in its entirety, it was noted that the true value-added contribution of the analyst was in identifying the test scenarios, interpreting the test results, and deriving conclusions and recommendations. Modifying a simulation for a new ISS assembly stage configuration was not considered value-added work. The majority of the analysis cost and time impact was traced to the type of tools used. To reduce this overhead, modular and dynamically scalable analysis tool architecture was developed on a COTS platform, that was easy to reconfigure and automate, would execute rapidly, while requiring minimal effort to develop and maintain. Efficiency was obtained by automating the simulation configuration for each ISS assembly stage, as well as automating analysis and documentation phases.

Simulation analysis is used to perform detailed narrow-scope evaluations and spot-checks. This is used to assess time-varying effects and calibrate screening results. This is achieved by using high-fidelity time-domain simulations. Simulation analysis is sparingly used with a small portion of certification effort. The reason for this is that in general these tools have been developed using custom software running on workstations and as a result have been difficult to use, have lower throughput, are expensive and time consuming to reconfigure, develop and maintain, and require dedicated tool experts.

Using screening analysis, substantial productivity gains have been obtained in actual ISS FRC

(Continued on page 5)

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activities at NASA/JSC during the past 6 years. Screening analysis and associated tools have provided the order of magnitude improvement used to justify the “better, faster, cheaper” claim. The improvement is achieved by comparison to an all simulation analysis approach. Based on actual ISS FRC expenditures, and by costing the screening effort using

simulation analysis expenditures, savings >\$12,000,000 have been achieved. By using linear single-configuration flex models, automated configuration features, execution speed is improved by >50X. ISS integrated system behavior understanding and predictions have been confirmed using flight data. This indicates that confidence is both cheaper and

faster to obtain than accuracy and that accuracy does not correspond to confidence.

Dr. Bedrossian has been involved in spacecraft simulation development, control system design and verification for over 15 years. He is the group leader for aerospace systems at The Charles Stark Draper Laboratory, Inc. He holds a PhD from MIT.

Trajectory Optimization

douglas yazell

A crowd of sixty people came to listen to our section’s lunch-and-learn on September 17, 2004, in building 16 at NASA/JSC: “Trajectory Optimization, from Euler to Lawden to Today”, by Mr. Christopher D’Souza. He works in the Clear Lake area for The Charles Stark Draper Laboratory. He has been involved in spacecraft trajectory optimization, guidance, and control for over 20 years. He performed mission design and navigation analysis for the Magellan and Galileo missions. He has been involved in autonomous rendezvous and docking navigation and mission design and analysis for the past eight years. His research interests include real-time trajectory optimization for multi-hybrid systems applied to missiles and spacecraft.

The event was organized by our section’s Astrodynamics technical committee, and co-sponsored by our Guidance, Navigation, and Control technical committee. Our speaker allowed us to post his PowerPoint charts on our web pages at <http://www.aiaa-houston.org/tc/astrodynamics/> and <http://www.aiaa-houston.org/tc/gnc/>. We hope you will want to read them and spread the word about the many such resources on our local web site.

From the Greeks in Carthage in

the 7th century BC, our speaker moved to the Italian Lagrange (1736 – 1813), his friend Euler (1707 – 1783), and then Hamilton (1805 – 1865) and Jacobi (1804 – 1851). After a mention of work done in Chicago in the early 1900’s, we learned that American Derek Lawden applied the calculus of variations to rocket trajectories. In the mid-1950’s, the Russian Pontryagin revolutionized optimal control and trajectory optimization. American Arthur Bryson at Harvard University recognized the importance of that work and applied it to a task for the military: the fastest possible time to climb to 20 kilometers. It was accomplished in 338 seconds (compared to a predicted 332 seconds) by our local resident John Young when he was a Lieutenant. The history review concluded with mentions of Bellman, Breakwell, Miele, and Kelly.

Mr. D’Souza then discussed the mathematics currently used in this discipline and some “wave of the future” techniques. Fuel, time, and power are some simple examples of things to be optimized using a cost function (aka performance index), obtaining “states” and controls while satisfying various constraints. The Pontryagin Minimum Principle was discussed in detail before moving on to di-

rect and indirect methods for optimal control problems. Trajectory optimization packages include POST, SORT, and OTIS. State of the art optimizers for optimal control include SOCS and DIDO (Direct and Indirect Optimization, also named for Queen Dido of ancient Carthage, as mentioned earlier). Pseudospectral methods were referred to as the wave of the future.

Examples included a launch vehicle with three stages to orbit, orbit transfer, and current and future challenges such as Multi-Agent Hybrid Control (MAHC), real-time trajectory optimization, and Neighboring Optimal Guidance (NOG).

Please keep watching for upcoming events on our web site at www.aiaa-houston.org, and consider joining or chairing one of our local technical committees. We don’t impose much on your time, but there are many potential benefits: learning and teaching in that discipline, technical presentations at lunch-and-learns and our Annual Technical Symposium (<http://www.aiaa-houston.org/ats2004>), contact with mirror committees on the national AIAA level, getting to know your peers from many local companies, etc.

A Lunch And Learn Summary Report

A Lunch And Learn Summary Report

Some Aspects of N-Dimensional Theoretical Mechanics ellen gillespie and murugan subramaniam

On July 7th 2004, the Houston AIAA GN&C Technical Committee was pleased to present a Lunch-and Learn seminar by Dr. John E. Hurtado of Texas A&M entitled "Some Aspects of N-Dimensional Theoretical Mechanics". This lunch-and-learn was conducted in Building 16 of the Johnson Space Center, and was enjoyed by approximately 30 people.

The underlying idea of Dr. Hurtado's talk was that the motion of an M-DOF mechanical system can be viewed as a rotation of an N-dimensional rigid body using the Cayley form of the dynamics equations. Dr. Hurtado first reviewed the basics of Euler, Kane, Lagrange, and Poincare formulations of the dynamic equations of motion. He then discussed the Hamel coefficients that appear in the Poincare method. For the rotational dynamics of a rigid body, the Hamel coefficients turn out to be the permutation symbol (ϵ_{ijk}) and the Poincare equations reduce to the classical Euler equations. This result provides insight into how rotation should be defined for an N-dimensional rigid body. For example, in three dimensions, ϵ_{ijk}

relates the 3x3 skew-symmetric angular velocity matrix to the 3x1 angular velocity vector. In N-dimensions, we define a generalized Levi-Cevita permutation tensor that relates a NxN skew-symmetric "angular velocity" matrix to a Mx1 "angular velocity" vector. The Hamel coefficients can be expressed in terms of the generalized Levi-Cevita tensor and the resulting Poincare equations are the generalized Euler equations for an N-dimensional rigid body. The matrix form of these equations is called the Lax pair representation.

The Cayley form of the dynamic equations uses the Cayley transform that expresses an orthogonal matrix C as a function of a skew-symmetric matrix Q. For an M-DOF system, the Mx1 vector of generalized coordinates can be used to build an NxN skew-symmetric matrix, Q. A proper NxN orthogonal matrix C is defined from Q using the Cayley transform and an NxN skew-symmetric "quasi-velocity" matrix is defined from Q and its derivative using the Cayley kinematic transform. The resulting matrix differential equations are identical to the Lax pair representation of the rotational motion of an N-dimensional rigid body. Hence, the Cayley form enables one to interpret the motion of an M-DOF mechanical system as a rotation of an N-dimensional rigid body.

Dr. Hurtado and his students have applied the Cayley form to general spacecraft motion. Orbit and attitude motion as well as rotational motion of a spacecraft containing three internal momentum wheels were examined. Extensions of 3-dimensional attitude representations were successfully used to generate a minimum parameter representation of principle planes such that the principle rotations were geometrically decoupled.

The conclusion is that using this technique to create a generalized, common description for complex systems, such as space vehicles and robots can prove useful in the analysis, design, and control of these systems.

Dr. Hurtado is an Assistant Professor in the Dept. of Aerospace Engineering at Texas A&M.

Staying Informed jon berndt

"Exploration is not a luxury. It defines us as a civilization. It directly or indirectly benefits every member of society. It yields an inspirational dividend whose impact on our self-image, confidence, and economic and geopolitical stature is immeasurable."

James Cameron in *Wired!*

It doesn't need to be explained that there is a lot of information on the web. This column will point out useful web sites, documents, policy papers, periodicals, etc. that may prove to be useful or interesting for readers. This month's focus is on the Vision for Space exploration.

The Vision for Space Exploration

www.nasa.gov/missions/solarsystem/explore_main.html

Congressional Budget Office Report on Moon To Mars

www.cbo.gov/ftpdoc.cfm?index=5772&type=1

Report of the President's Commission on Implementation of United States Space Exploration Policy

www.nasa.gov/pdf/60736main_M2M_report_small.pdf

Wired! Magazine, December 12, "The Drive to Discover", Guest Editor, James Cameron

www.wired.com/wired/archive/12.12/

AIAA Testimony to the President's Commission on Implementation of U.S. Space Exploration Policy

www.aiaa.org/pdf/public/durochertest.pdf

New Members

elizabeth blome, membership chair

We are pleased to announce that the following people have transferred to the Houston section (USA is United Space Alliance, LM is Lockheed Martin, TAMU is Texas A&M University):

- Chad Brinkley, Cimarron
- Joy Conrad King, USA
- Erik Evenson
- David Fuller
- Adonios Karpetsis, TAMU
- Hyoung Kim
- Amy Lin
- Michael Martin, TAMU
- Joseph Mills
- Chris Moore
- William Saric, TAMU
- Theresa Spaeth
- Elizabeth Zapata

If you see one of these folks at the next section event, please give them a hearty welcome.

We are pleased to introduce the

following new members to AIAA:

- Daniel Ayewah, TAMU
- Jon Berndt, LM (Sr. Member)
- James Blakeslee
- Andres Canales
- Jerry Cluba, NASA
- Alicia Cole-Quigley
- Julia Cox, Rice University
- Pedro Davolas
- James Doeblbler, TAMU
- Bret Drake
- Erik Evenson
- Christopher Foster
- Kaibin Fu
- Jason Garcia
- Todd Griffith
- Jefferson Howell, NASA
- Heather Hughes, TAMU
- Schedir Illoldi, TAMU
- Tapan Kulkarni
- Amanda Lampton, TAMU
- Kipp Larson, LM
- Joseph Loftus

- Jeffrey Marshall, TAMU
- Chuck Miller, LM
- Catherine Modica, LM
- Mandy Nakai, TAMU
- Lena Norris, LM
- Joshua O'Neil
- Ozden Ochoa, TAMU
- Don Purdum, LM
- Srinivas Ramakrishnan, Rice University
- Brandon Rogers
- Alicia Rutledge, TAMU
- Malak Anees Samaan
- Christie Sauers
- Brian Scheffman
- Xiuhua Si, TAMU
- Timothy Snyder, LM
- Theresa Spaeth
- Grant Threatt, LM
- Jaime Valverde, LM
- Luis Velasquez, LM
- James Watson, USA
- John Zipay, NASA

Did You Know:

The Houston Section has 3 members who were recently selected as Associate Fellows. Congratulations to William Atwell, Edgar A. Bering, III, and Bonnie Dunbar.

Help AIAA Help You - Update Your Membership Records

elizabeth blome, membership chair

It is often said that the aerospace industry is the only place where you can have the same job for five years and work for five different companies. That is especially true given the industry wide consolidation that has happened in the last few years. As companies have changed so have the building signs and the business cards. Additionally, our environment provides most people with the ability to move from one company to another as we try to expand our occupational horizons.

With all of these potential changes have you verified if your AIAA member record is up to date? Knowing where our members are working is vital to the Houston Section in obtain-

ing corporate support for local AIAA activities (such as our monthly dinner meeting, workshops, etc.). Please take a few minutes and visit the AIAA website to update your member information or call customer service at 1-800-NEW-AIAA (639-2422). Feel free to also contact me at 281-244-7121.

The AIAA-Houston section is currently missing information for the following members. If you know where they are, please let them know their contact information is not up to date for AIAA. Or, if you prefer, email me, Elizabeth.c.blome@nasa.gov with any contact information you have. Thank you in advance for your assistance in this matter!

Missing In Action:

- Robert Ambrose, Mitre
- Larry Bell
- Chad Brewer, TAMU
- Robert Lurgio
- Jeffrey Marshall, TAMU
- Elizabeth Savage
- Scott Stover
- Monish Tandale, TAMU
- Nicholas Tyler, TAMU
- Erica Walsh
- Brian Ward



Wings Over Houston

sarah shull, young professionals chair

photographs by michael oelke

Ellington Field — Saturday, October 16th was a scorcher, even by Houston standards. Did such high heat and humidity keep Houston aerospace enthusiasts at home? Of course not! Twenty eight members of the Houston Section turned out for a group outing to watch the WOH airshow. This group included an almost equal mix of A&M students, UH students, and professional members. The day was spent admiring an impressive array of modern civilian aerobatic and state-of-the-art military hardware. I'm looking forward to WOH 2005 already! [Images shot with a Canon Digital Rebel fitted with a 300mm zoom lens.]

[Editor: This year the CAF B-17 known as "Texas Raider" was absent from the airshow. It is currently partially disassembled, and in "heavy maintenance". The major repair work to the wing spars and terminal end fittings are near completion. The wings should be ready for reassembly around January. The FAA has issued an airworthiness directive (AD 2001-22-06) that addresses inspections to B-17 wing spar structural elements to check for cracks and corrosion. See the CAF Gulf Coast Wing web site for more details, and a link to the AD: www.gulfcoastwing.org—and to read about how to support the restoration.



Cranium Cruncher

bill miller and douglas yazell

October 2004 puzzle

Given an aircraft velocity vector's coordinates before and after a rotation of that vector, find the rotation axis. Is it unique? If not, describe all possible solutions.

October 2004 answer

The solution is not unique. One rotation axis is normal to the two given vectors, and the rotation is the angle between those vectors. Another rotation axis lies between these two vectors, and the rotation is 180 degrees. The plane of symmetry between these two vectors contains all solutions for these rotation axes. In that plane, every line containing the origin of the coordinate system is a correct solution.

It is interesting to picture those circles traced by the tips of that rotating vector in the two cases. The first is a circle of maximum size and the rotation is a minimum. The second is a circle of minimum size and the rotation is maximum. Visualize the circles between those two which are related to other correct rotation axes. The minimum circle grows larger and tilts until it reaches the maximum circle, keeping those two points on it at all times (the tips of those two stationary vectors). We have now pictured them during a 90-degree rotation. Continue that for another 90 degrees (or 90 degrees in the other direction), and we have specified all possible rotation axes. They are the lines specified by 2 points: the origin of this coordinate system and the center of one of these infinite number of circles.

The path traced by these circles is interesting. Each circle can be viewed as the base of a right circular cone whose vertex is the origin of this coordinate system. The two stationary vec-

tors lie on the side of each cone. The circles always lie on a sphere whose center is the origin and whose radius is the magnitude of the rotating vector. The centers of these circles follow a circular path. To see it, I examined right triangles whose hypotenuse is fixed in the plane of symmetry between those two vectors. It is the line segment from the origin to the point between the tips of the two vectors. I concluded that the line segment from the middle of this hypotenuse to the corner containing the 90-degree angle has a fixed length which is half of the hypotenuse. That corner with the 90-degree angle is the moving center of these circles. So this puzzle led me to examine cones inscribed in a sphere and right triangles inscribed in a circle.

We don't need to calculate those rotation matrices to get full credit for this puzzle's solution, but by picking a rotation vector in the plane of symmetry, we can find the corresponding rotation angle and rotation matrix. By picking a rotation angle, we can find a corresponding rotation vector in the plane of symmetry and rotation matrix.

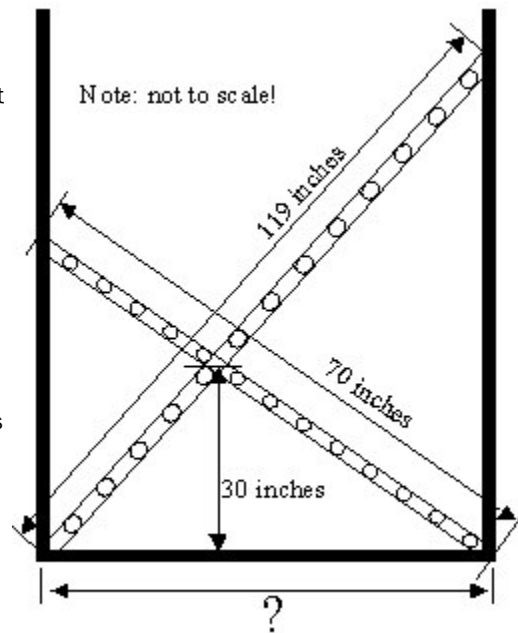
In matrix form, the solutions to last month's puzzle are the same as the solutions to this month's puzzle. We called them direction cosine matrices last month and rotation matrices this month. We found a surprising amount of "easily" visualized geometry related to the solutions, all of which apply to both puzzles. I looked at several texts on these well-documented subjects, but the problem is never posed this way. I don't know of any text or paper which documents these solutions to these two puzzles.

This month's puzzle

Aerospace engineer Eddie Vis-

cosity is walking down a narrow alley between two JSC buildings. He has to duck because two ladders are crossed in the alley (see the illustration for the exact setup). Eddie wants to submit a Close Call on this hazard so he whips out his trusty Swiss Army tape measure and measures the obstruction. He finds that the point where the two ladders cross is only 30 inches above the ground. The ladders themselves are 119 inches and 70 inches long.

As Eddie walks away he realizes that he didn't write down the width of the alley (although he does remember that it was an integer). He wants to include this information on the Close Call but decides he will figure it out later; after all, it seems like a simple trig problem. Can you help Eddie out by supplying the width of the alley?



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

A random drawing will be conducted to award a prize to one of the readers who supplies a correct answer (limit one prize per person per year). The prize this time is our section's Evolution of Flight poster celebrating 100 years since the Wright brothers' first powered flight in 1903. This \$20 value (available to those who wish to make that donation to our section) is 2 feet by 3 feet and is printed on photo quality paper.

Houston Section Hosts the Region IV Town Hall Visit by Dr. Don Richardson

t. sophia bright, chairperson, aiaa houston section

The Houston Section recently had the opportunity to host AIAA President Dr. Don Richardson while he tours the various AIAA regions for a series of Town Hall meetings. The Houston Section represented Region IV for this leg of his trip. During Dr. Richardson's visit, he and AIAA liaison office representative Mr. Ola Martin met with several representatives from NASA/Johnson Space Center (JSC)

public

- How AIAA might affect contractual requirements to allowable charging of both labor and material/travel, or just material/travel with the employee donating all or part of their time
- How AIAA's role in public policy might impact International Traffic in Arms Regulations (ITAR) and Export Control laws

the rest of the Region IV membership at a Town Hall forum that took place at the Lakewood Yacht Club on Thursday, October 21st. Dr. Richardson discussed the AIAA Strategic Plan and indicated that members could learn more about the plan by going out to the AIAA website (www.aiaa.org) and reading the article entitled "NEW DIRECTIONS: DYNAMIC AIAA AND OUR STRATEGIC PLAN". The talk generated a great deal of discussion and the audience was very interested in both sharing their views and asking how the National organization could or would address the issues they were seeing in their offices. Dr. Richardson said that he looks forward to additional feedback from members. He encouraged everyone to contact their local section leadership or directly contact representatives at the national level to convey their concerns or comments.

It wasn't all work for Dr. Richardson while he visited the Houston area. Mr. Grant Murray, the Protocol Coordinator from the Public Affairs Office took Dr. Richardson and Mr. Martin on a tour of the International Space Station and Space Shuttle Mock-up facility in building 9N and of the Mission Control Centers in building 30.



Mr. Ola Martin, Dr. Don Richardson, and Mr. Grant Murray in the Japanese Experiment Module (JEM) Mockup.

and the contractor community to discuss how the center and the related industry can support the AIAA membership. The discussion also included how AIAA could benefit the industry. The specific items discussed were:

- Conveying the benefits of joining a professional society
- How to get involved with the various technical committees within AIAA
- How AIAA can do more to promote the industry to the

Dr. Richardson also met with the Houston Executive Council. The opportunity for the Section Leadership to have an open dialog and discuss issues that cut across local and national organization was very beneficial. As with his other meetings there was a great deal of discussion concerning AIAA's involvement in public policy and how to expand the presence of AIAA in the public eye.

Dr. Richardson also addressed

Overall, the visit with Dr. Richardson was quite successful and we look forward to future opportunities to meet with representatives from AIAA National. We hope that the series of meetings and discussions that we had while he was here will go a long way in promoting a better relationship between AIAA and the industry representatives that will benefit our section members. We have extended an invitation to have Dr. Richardson visit the Houston Section in the future.

Report on the Activities of the Section

daniel nobles, programs chair

On September 28th, several members attended Seabrook Beach Club for a purely social event. We sat out on the patio, and drank a few beverages by Clear Lake. We had some nice conversation in a fun atmosphere and a few of us even played dominos. It was a great way to wind down on a Friday after such a busy week.

On October 1st, our members were welcomed for a tour of the Neutral Buoyancy Lab. There was a very high demand for this tour, in which they toured the control room and pool facilities. Many thanks go out to Brenda Weber, AIAA Councilor and Kim Curry, who assisted in coordinating the event.

On October 16th, the Houston Section welcomed 20 students from University of Houston and Texas A&M University to Clear Lake for the Wings Over Houston Air Show at Ellington. All had a great time. Many thanks

go out to Sarah Shull, our Young Professionals Chair, who coordinated the event.

On October 21st, our National AIAA President gave a very informative Town Hall Meeting at the Lakewood Yacht Club. He discussed changes in the national organization, and broke down changes that will occur in the future. He fielded questions from the audience, and dinner was great. The atmosphere at the Yacht Club was very soothing. The windows had a lake view, and it was a quiet night.

In general, the section is planning to alternate each month between tours and dinner meetings. There also will be at least one social event per month. If something is of interest in the local community, such as an air show, balloon launch, or Baseball game, the section will organize a group to meet and go together. Our intent is to spend

no budget on purely social activities. Each guest will be expected to pay their own way.

There are several things of interest that are being lined up for next year. Bill Chana, a distinguished AIAA Lecturer is scheduled to give a talk about Triphibian Aircraft on February 16th at Gilruth Ballroom. We have been speaking with General Howell to set a date in January to possibly give a "State of the Center" Address. Next spring, we hope to set up at least one more event to interact with our student sections. April 23rd is the Lonestar Flight Museum's Annual Air Show. At our Annual Awards Banquet, which is scheduled for June 16th at Gilruth Ballroom, Seth Shostak will give a talk about "The Search for Extraterrestrials", in which he will talk about SETI's Project Phoenix! We are off to a good start, and look forward to many exciting events in the following year.

Outreach and Education

first-person account by helen d'couth

Every pilot has their own story to share. For me, I owe a huge part of my story to the AIAA. Aviation has been my deepest passion ever since I could say the word "plane". When I was six, my mom began working at NASA and we moved right by Ellington Field. I knew from the moment I saw those first F-16s fly over our house that one day I wanted to be in the cockpit, flying. I enjoyed going to my mom's work and talking with pilots and astronauts and listening and learning about their flying experiences. As I listened to their stories, I dreamed of the day that I'd have a story to share. Now I do and I owe a huge part of it to the AIAA. In 2003 (when I was in 8th grade), the AIAA was having a glider

workshop at NASA to celebrate the 100th anniversary of powered flight. I attended the workshop and they had several guest speakers that were pilots and one of them was a glider pilot from the Soaring Society of America. I remember her describing gliders and then she mentioned that 14 yr. olds could solo a glider. That's when it dawned on me that I could learn gliding. I talked to my parents and went to the SSA website, where I found that there were two glider ports in Houston. So, I went out to the Soaring Club of Houston and took a demo ride. I was hooked before we even took off. I joined the club and did lots of flying over the summer, aiming to solo on my 14th birthday, which got

rained out. But, I still soloed the weekend after on October 30. Being able to learn gliding has been one the most amazing experiences in my life. If it weren't for the workshop that the AIAA had held I would never have known that we had glider ports in Houston and that I could learn to fly! I would really like to thank the AIAA for having this workshop and reaching out to the younger population. You never know how your actions can really inspire people to follow their dreams. Happy Flying,

Helen D'Couth



CALENDAR

December

- 2 Lunch and Learn, "Model Predictive Control", Abran Alaniz, 12:00-13:00, Bldg 16, Rm 111/113
- 6 Executive Committee meeting
- 10 Social, Sherlock's Pub, 20:00, 2416 Bay Area Blvd.

January

- 10-13 43rd Aerospace Sciences Meeting (Reno, NV)
- Early State of Center Presentation – early to mid January
- 10 Executive Committee Meeting – January 10th
- 13 Social
- 19 Ballunar Society Tour
- 20 Naz. Bedrossian, Draper, "Network Centric Computing", Systems Engineering TC
- 22 Mars Rover Competition
- YP – Aeros Game!
- Future City Design Competition
- Begin soliciting and assembling Associate Fellow and Fellow nomination packages
- Lunch and Learns

February

- 7 Executive Committee Meeting
- 16 Dinner Meeting, Gilruth Ballroom
- Bill Chana - Triphibian Aircraft: water, snow, land
- 17 Lunch and Learn: Graphical Object Simulation Tools & Techniques by Draper/Mark Jackson
- 20-26 Support E-Week Activities
- 22 Social
- Mars Settlement Design Competition
- Continue soliciting and assembling Associate Fellow and Fellow nomination packages
- Mid-Level Professional LnL TBD
- Lunch and Learns

March

- 1 Appoint Nomination Committee
- 4-6 Mars Settlement Design Competition
- 7 Executive Committee Meeting
- 15 Nomination Slate submitted and formation of Teller Committee
- 16 Tour, Ellington AFB
- 17-19 Science and Engineering Fair of Houston
- 18 Social
- Educational Outreach Activities
- Nominee List must be sent to section members by the end of March
- Lunch and Learns

April

- 2 Houston Rocket Club, Student Section Bonding
- 4 Executive Committee Meeting
- 14 Social
- 15 Election Ballots sent out
- 15 Associate Fellow Nominations due
- Dinner Meeting – TBD
- 23 Air show – Lonestar Museum
- 28 JSC Chili Cookoff

May

- 2 Executive Committee Meeting
- 4-6 Host Space Ops Workshop, Space Ops / ATS Gilruth
- 13 Social
- Facility Tour (TBD)
- 15 Ballots should be tallied by May 15th
- Compile and submit awards for banquet
- Finish nomination packages for Fellows
- Lunch-n-Learns

Odds and Ends

humor, photographs, etc.



A manned Apollo vehicle departs Florida in this rarely seen image. Can anyone identify this flight, the circumstances—and most importantly—where a clean copy of the image can be found? (sorry: no prize!)



From the description supplied: "One of SAA's first B-747s retiring to Rand Airport, South Africa (elevation 5568 feet with 4898 long x 50 feet wide runway!) The 747-100 outer-to-outer main gear tire width is 41.33 ft."

Airline "Maintenance Log" Entries

These purported "Qantas Maintenance Log" entries are almost certainly *not* from any airline source at all. In any case, they are worth repeating ("P" stands for "Problem", "S" stands for "Service Action").

P: Left inside main tire almost needs replacement.
S: Almost replaced left inside main tire.

P: Test flight OK, except autoland very rough.
S: Autoland not installed on this aircraft.

P: Something loose in cockpit.
S: Something tightened in cockpit.

P: Dead bugs on windshield.
S: Live bugs on backorder.

P: Autopilot in altitude-hold mode produces a 200-fpm descent.
S: Cannot reproduce problem on ground.

P: Evidence of leak on right main landing gear.
S: Evidence removed.

P: DME volume unbelievably loud.
S: DME volume set to more believable level.

P: Friction locks cause throttle levers to stick.
S: That's what they're there for!

P: IFF inoperative.
S: IFF always inoperative in OFF mode.

P: Suspected crack in windscreen.
S: Suspect you're right.

P: Number 3 engine missing.
S: Engine found on right wing after brief search.

P: Aircraft handles funny.
S: Aircraft warned to straighten up, fly right, and be serious.

P: Radar hums.
S: Reprogrammed radar with words.

P: Mouse in cockpit.
S: Cat installed.

For those of you with kids (and for the kid in you) this site has some "precision paper space models" you can print out and then construct yourself. [Editor: I've started the Saturn 1B.] These are really slick:

<http://www76.pair.com/tjohnson/ppsm.html#current>

Might be something fun to do during your holiday vacation. Now, if they only had a simple paper model of White Knight and SpaceShipOne. Oh, wait! They do! <http://www.currell.net/models/ss1.htm>.



Houston Section
P.O. Box 57524
Webster, TX 77598

Non-Profit
Organization
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Webster , Texas

AIAA Mission

Advance the arts, sciences, and technology of aerospace, and nurture and promote the professionalism of those engaged in these pursuits. AIAA seeks to meet the professional needs and interests of its members, as well as to improve the public understanding of the profession and its contributions.

Become a Member of AIAA

Are you interested in becoming a member of AIAA, or renewing your membership? You can fill out your membership application online at the AIAA national web site:

www.aiaa.org

Select the AIAA membership option.
