Horizons

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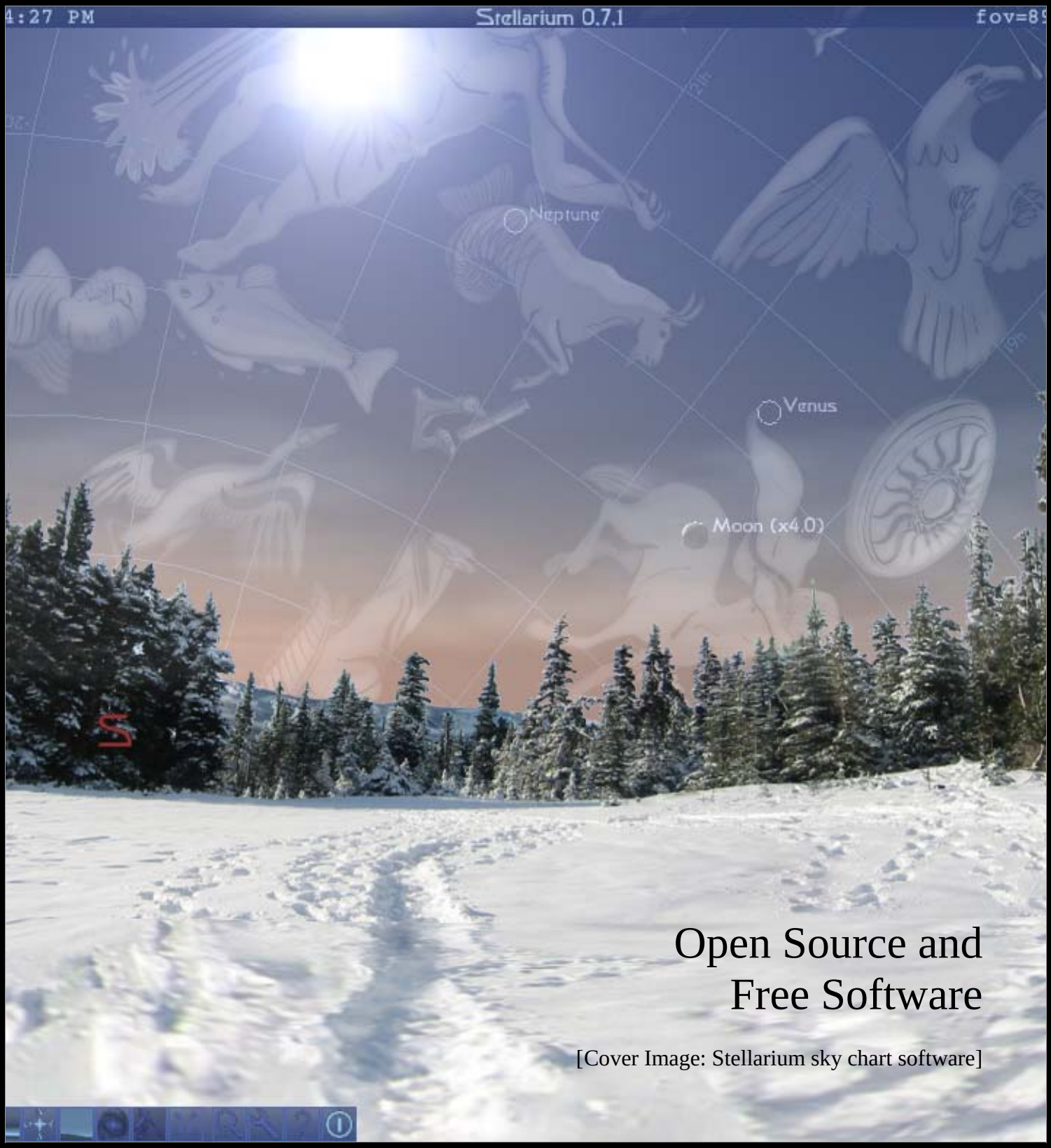

Open Source and Free Software

[Cover Image: Stellarium sky chart software]

AIAA HOUSTON

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Jon S. Berndt
Editor

T A B L E O F C O N T E N T S

Cover: Screenshot of the open source Stellarium sky charting software in action.

From the Editor Open Source Software

JON S. BERNDT

Do the phrases "Open Source Software" (OSS) and "free software" bring to mind applications that are perhaps put together somewhat loosely – maybe applications that crash periodically? Or, does it suggest that an application is not commercially viable, so that it is merely given away? The views presented in the previous two sentences (though not so prevalent, anymore) are giving way to the reality of a growing number of OSS applications that are very good and widely used.

NASA is one of the biggest users of OSS and has even written its own OSS license (NOSA, the NASA Open Source Agreement), while open-sourcing a growing amount of software. According to the statement at the Ames Open Source web page (see the *Staying Informed* column for specific links) the motivations for doing so are listed as:

- to increase NASA software quality via community peer review
- to accelerate software development via community contributions
- to maximize the awareness and impact of NASA research
- to increase dissemination of NASA software in support of NASA's education mission

According to an article by Ann Barcomb at O'Reilly's ONLamp.com web site, OSS provided leverage to the Mars Exploration Rover (MER) program through the use of several OSS products, conserving team resources. Despite initial concerns by managers, it was decided that in their case the risks were no more hazardous than those posed by commercial applications and, in fact, the availability of the source code provided additional benefits. Jeff Norris (NASA JPL) wrote on the extensive use of OSS in the MER Science Activity Planner software (SAP) in the January/February 2004 issue of IEEE Software, ("Mission Critical Development with Open Source Software: Lessons Learned"). He stated, "An in-house system developed hastily will rarely approach the quality of a mature, widely-used open source project." Additionally, the support provided by the OSS developers was faster than that provided by the commercial vendors. With mature OSS projects, the developers themselves are normally available via email and supports lists, and are typically very responsive.

NASA is not alone in government awareness and acceptance of OSS. The U.S. DoD requires that OSS complies with the same DoD policies that COTS software does. A MITRE Corporation study, "Use of Free and Open-Source Software (FOSS) in the U.S. Department of Defense", concluded in 2003 that:

"… FOSS software plays a more critical role in the DoD than has generally been recognized. FOSS applications are most important in four broad areas: Infrastructure Support, Software Development, Security, and Research. One unexpected result was the degree to which Security depends on FOSS. Banning FOSS would remove certain types of infrastructure components (e.g., OpenBSD) that currently help support network security. It would also limit DoD access to—and overall expertise in—the use of powerful FOSS analysis and detection applications that hostile groups could use to help stage cyberattacks. Finally, it would remove the demonstrated ability of FOSS applications to be updated rapidly in response to new types of cyberattack. Taken together, these factors imply that banning FOSS would have immediate, broad, and strongly negative impacts on the ability of many sensitive and security-focused DoD groups to defend against cyberattacks."

Yet, one cannot be careless about incorporating OSS in a mission critical application. An AIAA paper ("Open Source Software: Free Isn't Exactly Cheap") presented at the Infotech@Aerospace Conference last September cautioned that the restrictions of the GPL, the cost of investigating the pedigree of the code, and verifying that the code complies with any of a myriad of specifications, processes, and other bureaucratic bottlenecks can make OSS more costly to use than commercial software. The article reads as if a lawyer wrote it. In fact, one of the three authors is the Associate General Counsel for Intellectual Property for a major aerospace corporation.

During the development of the MER SAP, OSS was evaluated based on several criteria:

- **Maturity** (How long has the software been in development, and how many releases have there been?)
- **Longevity** - How much longer will it last (How many developers are working on it, and when was the last release?)
- **Flexibility** (Use it the way it is meant to be used. Is the development team open to suggestions?)

One does need to be careful in evaluating the fitness of a particular OSS project in addressing a need. As Jeff Norris wrote of their "lessons learned", *"… open source components can accelerate development and cut costs, but the consequences of selecting the wrong component can erase these benefits.*"

The world of online cooperation is making a mark on the world in many ways. In the current issue of *Time* magazine, the collaborative online encyclopedia, Wikipedia, is hailed as an innovative example of what a collection of individual contributions can accomplish when coupled with the distribution stream provided by the Internet. While probably not changing the world, OSS will continue to change the software industry. With the appearance of new and innovative entrepreneurs in the commercial space industry, one might even ask the question: Hey, could something similar to the OSS paradigm be applied to, say … a space program?

- JSB

Chair's Corner

STEVE KING, AIAA HOUSTON CHAIR

In what almost seems as a flash, the first eight months of my term as Chair has flown by. The Houston Section has accomplished much since last summer ranging from thought provoking dinner programs, well attended lunch n' learns, a Glider Workshop to assembling bikes for needy children during the holidays. We have a lot more in store for you in the coming months. Final plans are in place for our Region IV Student Paper Conference, which will be held at Texas A&M University in April. Three dinner programs are on the books with a wide variety of topics including restoration of JSC's Saturn V, Space Shuttle Orbiter lessons learned, and flying the SR-71 Blackbird. We hope to exceed last year's 200 attendees at this May's Annual Technical Symposium. So be on the lookout for its call for abstracts and registration details. This will all be complemented by several Young Professional outings, a fun filled Space Trivia night being planned, support of Yuri's Night, technical lunch n' learns, AIAA's Congressional Visits Day in April, and so much more.

None of this would be possible without the energy and time of Houston Section volunteers. Most are members of our Executive Council and it is now that time of year to start identifying willing candidates to serve as Section Officers and Councilors for the next term, which starts July 1st. These are positions were one can learn new and hone their leadership skills. But more importantly they provide the lifeblood for the long-term success of our organization. We have made some strides in getting more of the Section's 1250 members involved in our activities; however, more should become active members, the kind that would be missed and are not content with just having their name on a list. We all have various demands in our lives and it can be quite a balancing act at times. But consider why you are an AIAA member and what benefits result from it, and let me know if you can take on an active part. Let's continue the journey…

FYI – I thought the following concise list of leadership principles was worth sharing with you. It was taken from Kelly Perdew's *TAKE COMMAND: 10 Leadership Principles I Learned in the Military and Put to Work for Donald Trump*. He was "The Apprentice" winner in 2004:

- Integrity: Take the harder right over the easier wrong.
- Duty: Do what you're supposed to do, when you're supposed to do it.
- Passion: Be passionate about what you do, or do what you're passionate about.
- Impeccability: If it is worth doing, it is worth doing right.
- Teamwork: There is no "I" in TEAM.
- Selfless Service: Give back.
- Planning: Fail to plan, plan to fail.
- Loyalty: Up, down, and across your organization.
- Perseverance: It's not the size of the dog in the fight; it's the size of the fight in the dog.
- Flexibility: The person with the most varied responses wins.

A Survey of Selected Open Source and Freely Available Software for Engineering and Science, and for Education, Home, and Work

Feature Article

JON S. BERNDT, EDITOR

What do the concepts of *public domain*, *open source*, and *free* software bring to your mind? At one time, some years ago, many freely available applications had to be built from source code and debugged by the user. It was often an arduous and occasionally unsuccessful effort. Things have changed quite a bit. Today, some formerly commercial products have been "open sourced", some open source products are now also commercially marketed ("open source" and "commercial" are not incompatible ideas), and hundreds or thousands of open source or free software products have appeared. The distribution methods have also improved considerably.

The selection of open source and free software titles now includes many engineering and scientific applications, as well as operating systems and environments. There also exist applications that are available freely – but without the source code – for personal, educational use. We will review some of the most interesting applications in these categories. First, we will discuss some definitions.

What is ***open source*** software? It is a software application that is distributed with its source code, which may be freely modified and redistributed. One might ask what is appealing about open source software – why open source?

"*When programmers can read, redistribute, and modify the source code for a piece of software, the software evolves. People improve it, people adapt it, people fix bugs. And this can happen at a speed that, if one is used to the slow pace of conventional software development, seems astonishing.*"

- OpenSource.org

Open source software is available and distributed under any of a number of licenses, including the GPL (Gnu General Public License), which can all be read about at OpenSource.org.

What is ***public domain*** software? The most common definition this writer has seen describes public domain software as "*software that is freely distributed to anyone who wants to use, copy, or distribute it.*" Public Domain software is also often described as having no copyright – though proper attribution is required. Public domain software may sometimes be distributed as an application only – the source code is not required to be distributed.

In yet another kind of *freely available* software, the Free Software Foundation (www.fsf.org) defines ***free software*** as embodying four basic freedoms:

- *The freedom to run the program, for any purpose.*
- *The freedom to study how the program works, and adapt it to your needs. Access to the source code is a precondition for this.*
- *The freedom to redistribute copies so you can help your neighbor.*
- *The freedom to improve the program, and release your improvements to the public, so that the whole community benefits. Access to the source code is a precondition for this.*

It may appear a bit confusing, with several interpretations of what constitutes free software. In fact, there are quite a number of "approved" licenses listed at OpenSource.org. For specific information about each of the applications to be presented, it is best to view the license for that application.

[Note: Neither AIAA nor this author necessarily endorses any of these software products. They are presented here for informational purposes only.]

GNU/Linux Operating System (GPL)

GNU/Linux is the well-known, freely available operating system and application software, the kernel of the operating system having grown from Linus Torvald's college project, and the supporting operating system and other application software coming from the GNU project. Today, Linux workstations are replacing workstations from mainframe manufacturers such as Silicon Graphics because the performance of the Linux machines is often as good or better than the existing mainframes, and the maintenance is much less expensive.

There are many distributions of GNU/Linux (a *distribution* is a collection of GNU software, and the Linux kernel, and additional software that aids in installation and maintenance). Perhaps the most popular distribution of GNU/Linux now is Fedora. From the web site, http://fedora.redhat.com/:

"Fedora is a set of projects, sponsored by Red Hat and guided by the Fedora Foundation. These projects are developed by a large community of people who strive to provide and maintain the very best in free, open source software and standards.

Fedora Core, the central Fedora project, is an operating system and platform, based on Linux, that is always free for anyone to use, modify, and distribute, now and forever."

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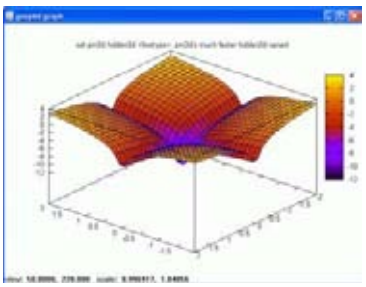
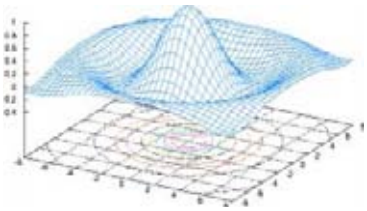
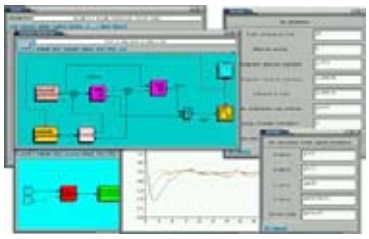


Gnuplot



Octave



SciCos

(Continued from page 5)
Fedora can be downloaded from the web site and burned to several CDs. Most newer computers can boot directly from the main CD.

XFree (GPL)
www.xfree.org

XFree is a freely redistributable open-source implementation of the X Window System. What's it for? It's the basic windowing system for Linux and other workstations for local or remote applications. XFree has been in development for many years and continues to be actively developed. XFree is a possible alternative to such commercial products as eXceed. For more information, see http://www.xfree.org. XFree is an integral part of Linux, Mac OS X, and it can be run on PCs, too.

Cygwin (GPL, public domain …)
www.cygwin.com

"Cygwin is a Linux-like environment for Windows. It consists of two parts:
- A DLL (cygwin1.dll) that acts as a Linux API emulation layer providing substantial Linux API functionality.
- A collection of tools, which provide Linux look and feel."

One can install the packages directly from the cygwin web site. Once installed (and depending on the applications selected for installation) the user effectively has a Linux-on-Windows workstation, including perl, C and C++ compilers, the X-Window System, etc.

While GNU/Linux, XFree, and Cygwin are not engineering or science applications by themselves, there are quite a few engineering, and science applications (and common system and utility applications) that usually come packaged with these distributions that deserve individual mention. The included or available-for-download applications also include a plethora of software development tools:

gcc, g++, g77: The GNU C, C++, and Fortran 77 programming language compilers
doxygen: source code documentation generation application (www.doxygen.org)
cvs: Concurrent Version System code management application

Engineering and Science Applications

Gnuplot (GPL)
www.gnuplot.info

"Gnuplot is a portable command-line driven interactive data and function plotting utility for UNIX, IBM OS/2, MS Windows, DOS, Macintosh, VMS, Atari and many other platforms. The software is copyrighted but freely distributed (i.e., you don't have to pay for it). It was originally intended as to allow scientists and students to visualize mathematical functions and data. It does this job pretty well, but has grown to support many non-interactive uses, including web scripting and integration as a plotting engine for third-party applications like Octave. Gnuplot has been supported and under development since 1986.

Gnuplot supports many types of plots in either 2D and 3D. It can draw using lines, points, boxes, contours, vector fields, surfaces, and various associated text. It also supports various specialized plot types."

Octave (GPL)
www.octave.org

"GNU Octave is a high-level language, primarily intended for numerical computations. It provides a convenient command line interface for solving linear and nonlinear problems numerically, and for performing other numerical experiments using a language that is mostly compatible with Matlab. It may also be used as a batch-oriented language.

Octave has extensive tools for solving common numerical linear algebra problems, finding the roots of nonlinear equations, integrating ordinary functions, manipulating polynomials, and integrating ordinary differential and differential-algebraic equations. It is easily extensible and customizable via user-defined functions written in Octave's own language, or using dynamically loaded modules written in C++, C, Fortran, or other languages."

SciLab / SciCos
www.scilab.org
www.scicos.org

"Scilab is a scientific software package for numerical computations providing a powerful open computing environment for engineering and scientific applications. Developed since 1990 by researchers from INRIA and ENPC, it is now maintained and developed by Scilab Consortium since its creation in May 2003.

Distributed freely and open source via the Internet since 1994, Scilab is currently being used in educational and industrial environments around the world.

Scilab includes hundreds of mathematical functions with the possibility to add interactively programs from various languages (C, Fortran...). It has sophisticated data structures (including lists, polynomials, rational functions, linear systems...), an interpreter and a high level programming language."

From the SciCos web site:

***"Scicos** is a graphical dynamical system modeler and simulator toolbox included in the Scilab® engineering and scientific computation software. With **Scicos** you can create block diagrams to model and simulate the dynamics of hybrid dynamical systems and compile your models into executable code. **Scicos** is used for signal processing, systems control, queuing systems, and to study physical and biological systems. New extensions allow generation of* hard real-time *control executables, as well as component based modeling of electrical and hydraulic*

(Continued on page 7)

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circuits."

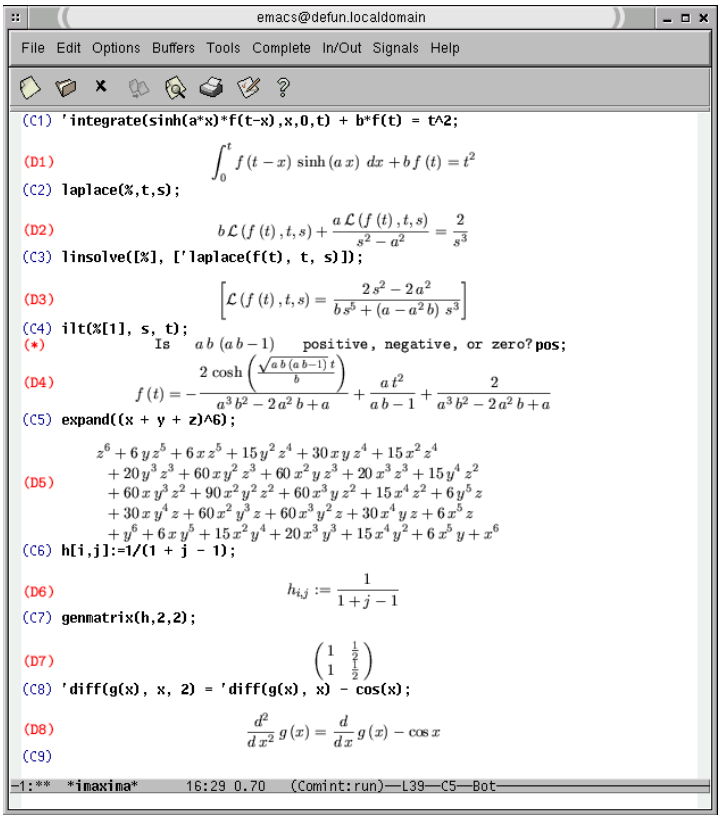
Open Scene Graph (GPL)
www.openscenegraph.org

"The OpenSceneGraph is an open source high performance 3D graphics toolkit, used by application developers in fields such as visual simulation, games, virtual reality, scientific visualization and modeling. Written entirely in Standard C++ and OpenGL it runs on all Windows platforms, OSX, GNU/Linux, IRIX, Solaris and FreeBSD operating systems."

developed at MIT in the 1970's. It is quite reliable, and has good garbage collection, and no memory leaks. It comes with hundreds of self tests."

IT++ (GPL)
itpp.sourceforge.net

"IT++ is a C++ library of mathematical, signal processing, speech processing, and communications classes and functions. It is being developed by researchers in these areas and is widely used by researchers, both in the communications industry and universities.



Above: Maxima running in GNU Emacs in Imaxima mode

Maxima (GPL)
maxima.sourceforge.net

"Maxima is a full symbolic computation program. It is full featured doing symbolic manipulation of polynomials, matrices, rational functions, integration, graphing, etc. It has a symbolic debugger source level debugger for maxima code. Maxima is based on the original Macsyma

Since 2004, IT++ is also being developed as a part of the European Network of Excellence (NEWCOM)."

Engauge Digitizer (GPL)
digitizer.sourceforge.net

"Engauge converts an image file showing a graph or map, into numbers. The image file can come from a scanner, digital camera or screenshot. The numbers can be read on the screen, and written or copied to a spreadsheet."

FlightGear (GPL)
www.flightgear.org

FlightGear is a platform independent flight simulator. FlightGear is actually an assemblage of several open source projects, including plib (www.plib.org), the platform-independent GUI (Graphical User Interface) library, and SimGear, the 3D simulation utilities library.

The goal of the FlightGear project is to create a sophisticated flight simulator framework for use in research or academic environments, for the development and pursuit of other interesting flight simulation ideas, and as an end-user application. Some recent interesting projects include:

- ATC Flight Simulators is building FAA certified training simulators that leverage FlightGear for the visual system, the instrument panel display and modeling, as well as much of the internal systems modeling. http://www.atcflightsim.com/products/820/FS/
- An in-cockpit display based on FlightGear. The display draws all the restricted airspace boundaries in 3D, combined with FlightGear's 3D terrain to produce a compelling and intuitive situational awareness aid. http://www.cobbin.com/
- The University of Minnesota is using FlightGear as a synthetic vision system for one of their UAV projects. The aircraft telemetry is sent to the ground station in real time where it is fed into FlightGear to produce a real time synthetic view of the UAV and its environment. The display can be drawn from the UAV's perspective, from a chase perspective, or a ground perspective. In addition, FlightGear can overlay live synthetic cockpit instruments, draw restricted airspace

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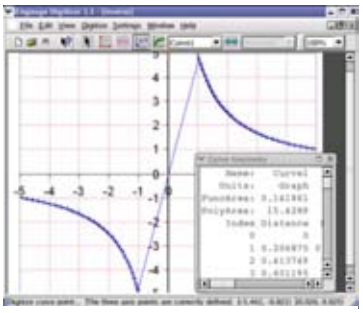
Image generated using Open Scene Graph.



Engauge Digitizer

FlightGear Concorde model.

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boundaries, and draw routes or waypoints in the synthetic display. See a movie of the live camera view side by side with the live synthetic view: http://www.flightgear.org/~curt/Models/Special/Rascal110_2/

Above: "Rocket" ©2004 by Jochen Diehl (Used with permission). Image created with POV-Ray software.

- Mathworks has built a direct network interface from their aerospace blockset to FlightGear. This allows their customers to use FlightGear as a real time visualization tool for their Simulink models. Enough big name customers have requested this feature that they built the interface directly into their product. http://www.mathworks.com/

JSBSim (GPL)
www.jsbsim.org

JSBSim is an open source FDM (flight dynamics model). It is the default FDM for FlightGear. With JSBSim, aircraft models are specified completely in a file using a formal XML language (i.e. the simulation is data driven) and – having been perhaps the first to use XML in specifying an aircraft simulation model – JSBSim was an early example and some inspiration for an emerging AIAA standard (see daveml.nasa.gov). JSBSim can be run as a batch mode, standalone, application or integrated into a larger package (such as with FlightGear and other simulators). Among the more interesting uses of JSBSim are:

- Teaching modeling and simulation concepts as part of the Modeling and Simulation Familiarization Tool developed at the Air Force Research Laboratory (Wright-Patterson AFB).
- Providing flight modeling capabilities for a battlefield simulation framework developed by the Man-System Interaction department at the Swedish Defence Research Agency.
- Serving as the flight model for a dynamic soaring study at Sandia Laboratories.
- Serving as the flight model for an Ares Mars Airplane educational demonstrator (see www.redcanyonsoftware.com).
- Serving as the 6DOF simulation core in a real-time, flight-hardware-in-the-loop test platform that is used for flight hardware/software development, integration, and testing in support of several Unmanned Aerial System (UAS) programs.
- JSBSim has also been successfully integrated with COTS and open source Control System Computer Aided Design (CSCAD) packages to support flight control law development and analysis.

Open Dynamics Engine (LGPL)
www.ode.org

"ODE is an open source, high performance library for simulating rigid body dynamics. It is fully featured, stable, mature and platform independent with an easy to use C/C++ API. It has advanced joint types and integrated collision detection with friction. ODE is useful for simulating vehicles, objects in virtual reality environments and virtual creatures. It is currently used in many computer games, 3D authoring tools and simulation tools."

Educational and Productivity Software

Stellarium (GPL)
www.stellarium.org

This sky chart application is – in a word: stunning. Stellarium is a planetarium on your PC, and is a great tool for locating stars and planets, constellations, and other celestial objects.

Virtual Moon Atlas (GPL)
astrosurf.com/avl/UK_index.html

"Software for Lunar observation and survey. Lets you visualize the real Moon aspect at any time. VMA is also an aid in studying lunar formations using a features database and picture library."

The Gimp (GPL)
www.gimp.org

Gimp (Graphical Image Manipulation Program) is a paint and photo-retouching program along the lines of Adobe Photoshop.

POV-Ray (GPL)
www.povray.org

POV-Ray (Persistence of Vision) is a ray tracing application that can be used to render photo-realistic images, accounting for material and lighting characteristics. Scenes are created algorithmically in a text editor, or via a 3D editor such as Blender.

Blender (GPL)
www.blender3D.org

"Blender is the open source software for 3D modeling, animation, rendering, post-production, interactive creation and playback. It is available for all major operating systems under the GNU General Public License."

InkScape (GPL)
www.inkscape.org

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"Inkscape is an Open Source vector graphics editor, with capabilities similar to Illustrator, Freehand, CorelDraw, or Xara X using the W3C standard Scalable Vector Graphics (SVG) file format. Supported SVG features include shapes, paths, text, markers, clones, alpha blending, transforms, gradients, patterns, and grouping."

Commercial, "Free" Software

Various companies offer "personal", downloadable versions of their software as a way to familiarize individuals with their software products, ostensibly hoping to be remembered when it comes time to buy software at work. Ulterior motives notwithstanding, such an approach can be a great way for individual users to learn new skills. Normally, the license for such free commercial software development products does not allow the product to be used for creating commercial applications. Here is a selection of some free, commercial products:

Microsoft Visual Studio Express Editions

http://msdn.microsoft.com/vstudio/express

Microsoft has "Express Editions" of its software development products available for download, including Visual Web Developer, SQL Server, Visual C++, Visual C#, Visual Basic, and Visual J#.

Borland Software Development Products
www.borland.com

Borland offers the Personal version of its C++BuilderX (http://www.borland.com/downloads/download_cbuilderx.html) and the Foundation version of its JBuilder (http://www.borland.com/downloads/download_jbuilder.html) development tool free for download.

ATK Satellite Toolkit
www.atk.com

"STK is the core product of the STK software suite and it is free to all qualified users. STK provides the analytical engine to calculate data and display multiple 2-D maps to visualize various time-dependent information for satellites and other space-related objects such as launch vehicles, missiles, and aircraft. Basic applications include calculating and visualizing a vehicle's position and attitude, determining acquisition times, and analyzing the vehicle's field of view."

Alibre Design Express
www.alibre.com

"Alibre Design Xpress is a 3D solid modeler for creating mechanical parts, assemblies, and 2D drawings. Alibre Design Xpress equips the person needing basic 3D design capabilities."

Autodesk Maya Personal Learning Edition
http://www.alias.com/glb/eng/products-services/product_details.jsp?productId=1900003

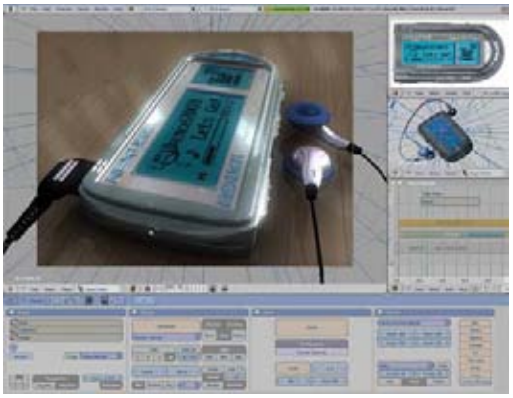
"Maya Personal Learning Edition gives 3D graphics and animation students, industry professionals, and those interested in breaking into the world of computer graphics (CG) an opportunity to explore all aspects of the award-winning Maya Complete software in a non-commercial capacity."

Orbiter Space Flight Simulator
http://orbit.medphys.ucl.ac.uk/orbit.html

"ORBITER is a free flight simulator that goes beyond the confines of Earth's atmosphere. Launch the Space Shuttle from Kennedy Space Center to deploy a satellite, rendezvous with the International Space Station or take the futuristic Delta-glider for a tour through the solar system - the choice is yours. But make no mistake - ORBITER is not a space shooter. The emphasis is firmly on realism, and the learning curve can be steep. Be prepared to invest some time and effort to brush up on your orbital mechanics background."

Public Domain Aeronautical Software ($295)
www.pdas.com

"For many years the Air Force, Navy, NASA and educational institutions have sponsored the development of computer software that is useful to aeronautical engineers, airplane designers, and aviation technicians. Public Domain Aeronautical Software was founded to make this treasure house of valuable software available to the aeronautical community at an easily affordable price for use on desktop computers. These programs include complete public domain source code, descriptions, and sample cases (both input and output). All of the programs come ready to execute under Windows and most of the programs have Macintosh and Linux executables.



Above: Blender user interface

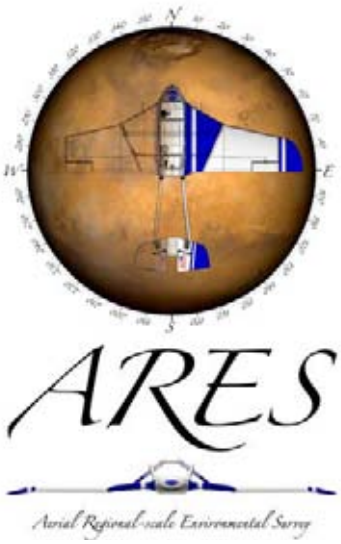
Above: screenshot from Orbiter Space Flight Simulator.

All of this is available to you on the CD-ROM Public Domain Computer Programs for the Aeronautical Engineer. The source code is not copyrighted and may used in whole or in part in any of your aeronautical studies. Most were developed under NASA or DOD sponsorship, but some are contributions from individual authors and all have significant value added by PDAS."

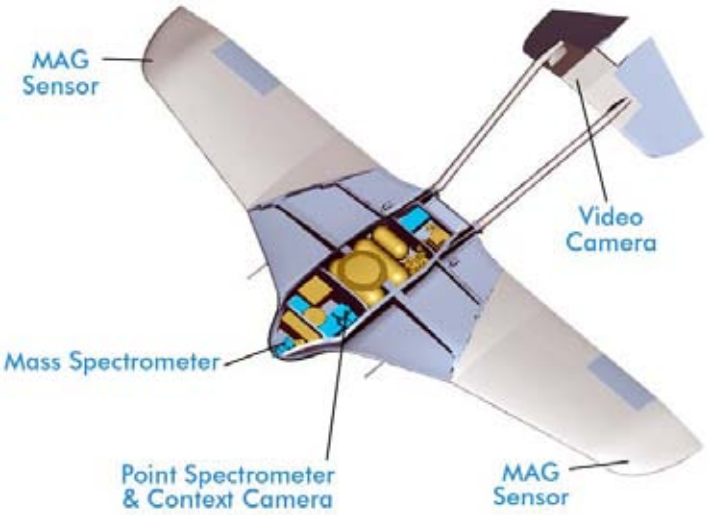
Dinner Lecture Summary Report

ARES Mars Airplane

JON S. BERNDT, EDITOR



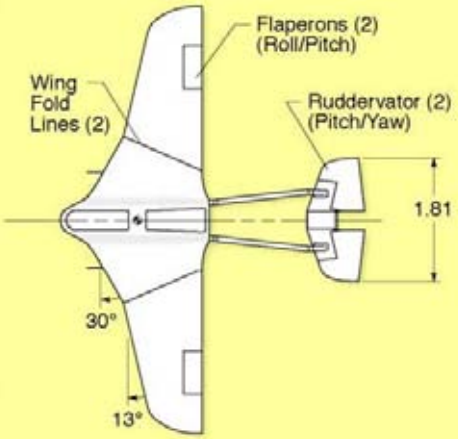
On February 9, AIAA Distinguished Lecturer Dr. Robert D. Braun of the Georgia Institute of Technology spoke about the Mars airplane concept, ARES (Aerial, Regional-scale Environmental Survey). Dr. Braun served as the Mission Architect in the development of the ARES Mars Scout project from 2001 to 2003. ARES was one of four projects vying for selection as the first Mars Scout mission, scheduled for launch in 2007. ARES was ultimately not selected for that opportunity—Phoenix won that honor. However, there is another Mars Scout opportunity planned for 2011, and ARES will be a strong contender for that competition.

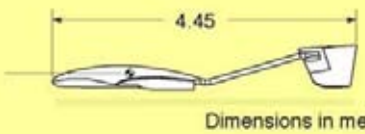


We have all seen the pictures from Mars-orbiting platforms and from rovers. The appeal of a Mars airplane is that it gives a perspective in between the land- and orbit-based views. The benefits include:

- Simultaneous, in-situ, regional-scale measurement of the Mars atmosphere, surface, and interior
- Bridges critical scale and resolution measurement gaps of remote sensing and surface exploration
- Scout for future sample return and surface mission site selection
- Magnetic survey with spatial resolution two orders of magnitude higher than provided by Mars Global Surveyor, with ability to resolve the crustal magnetism source structure
- High-resolution measurements that cannot be achieved from orbit
- Geologic diversity from regional-scale coverage that cannot be achieved by surface missions
- In-situ atmospheric science
- Ability to traverse terrain inaccessible to surface vehicles
- Ability to precisely target science features
- Measurement of vertical surface structure not visible from orbit

Parameter	Value	Benefit
Reference Area	$7m^2$	Enable STA access through pullout margin
Mean Aerodynamic Chord	1.25 m	Mitigates performance risk because Reynolds number is in a validated, predictable regime
Aspect Ratio	5.6	Balances aeroshell packaging and deployment risk (3 folds) with science range
Propulsion	Pulsed Rocket	Low risk, proven propulsion for low density applications
Number of Folds	3	Low number of folds increases deployment reliability





Dimensions in meters

The requirements that drove the aircraft design specified that the aircraft must be able to fly 500 km. (~300 miles) at an altitude less than 2 km., that it must fit inside a 2.65 meter (8.7 foot) diameter aeroshell, that it must maintain constant communication with the relay spacecraft, and that it must tolerate the launch and entry loads.

The choice of propulsion system was driven by a desire to meet the range requirement using as simple a system as possible. Any propeller used in the low density Martian atmosphere would have to be huge. However, it would also have to fit inside the aeroshell, requiring it to be folded – increasing complexity. A rocket engine was ultimately selected as the only other viable option. A 62 N. (14 lb.) thrust Aerojet thruster was

(continued from page 10)
selected.

The mission profile follows that of previous Mars missions up to the point just prior to Mars atmospheric entry. Just after the carrier spacecraft and the aeroshell separate about 9 hours prior to entry, the carrier spacecraft (based on the Genesis spacecraft) adjusts its trajectory to miss the planet and place itself optimally to serve as the relay link between the ARES airplane and Earth. The aeroshell carrying the ARES airplane enters the atmosphere, a parachute slows its descent, the airplane is reeled out below the backshell and released. A drogue is deployed that aids in deploying the tail boom, after which the wings unfold and lock into place. The wing is hinged such that aerodynamic forces help to unfold the wings. Springs also help to deploy the wings. Once that is done, the airplane orients itself and proceeds to fly down to its cruise altitude.

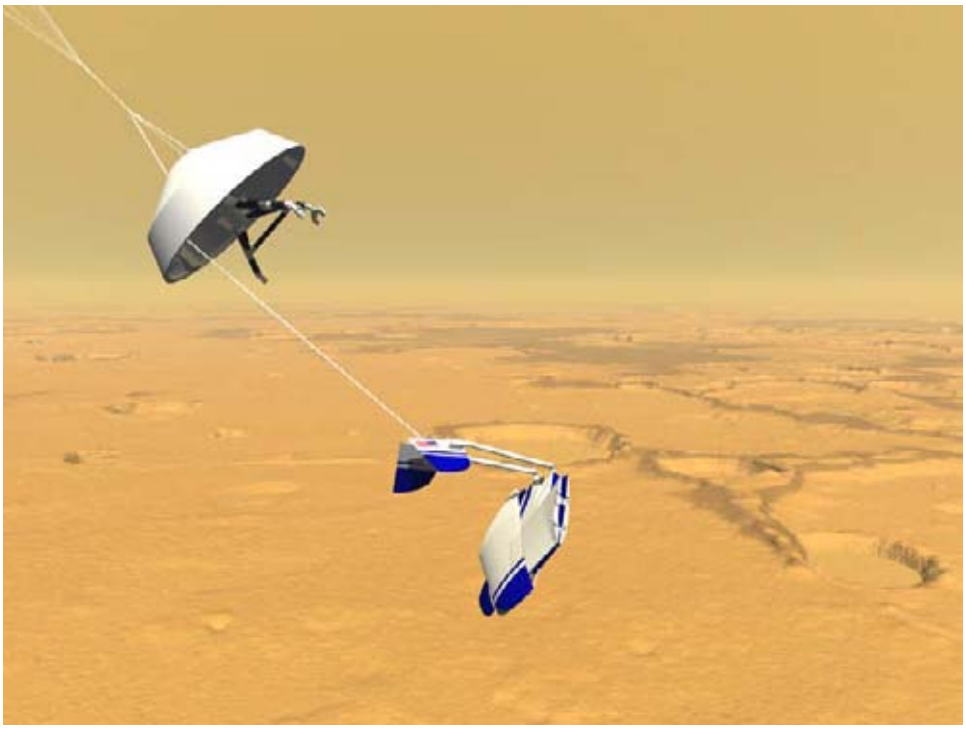
The science payload consists of:

- 2 wing-tip mounted magnetometers
- a nose mounted mass spectrometer
- a nadir pointing context camera
- a nadir-oriented point spectrometer
- a tail mounted video camera

While acquiring the measurements using these instruments, the aircraft would be commanded to fly a racetrack pattern. Maneuvers (turning, altitude adjustments) would be made gently in order to maintain a steady platform for the science instruments and to maintain communications with the relay spacecraft. After flying for 60-80 minutes, the spacecraft would descend and impact the ground as gently as possible.

A half-scale ARES vehicle has been flown in a drop test from a balloon at an altitude with conditions analogous to Mars. The deployment and flight sequence was performed and it worked as expected. A full-scale vehicle will be test-flown later this fall.

Above: ARES full-scale test article with development team. NASA Image



Left: ARES deploys from backshell.

Student Report

Mars Sample Return Mission Design at Texas A&M University

PRERIT SHAH, SENIOR, AEROSPACE ENGINEERING, TEXAS A&M

During the fall of 2005, a group of Texas A&M University (TAMU) undergraduate students participated in the Mars Sample Return (MSR) mission design study supported by NASA JPL. The main objective of this study was to design a mission architecture for the MSR mission to be launched by NASA in 2016. During the study, several different options for each phase of the mission were considered, and trade studies were performed to determine the best mission architecture for the mission. Some of the required areas of technology advancement were also identified during this study. The students who participated in this project were exposed to real life space mission design process used in aerospace industry, and utilized space mission design principles during this project.

This project was conducted in three phases for the Space Systems Design class offered by Dr. Hyland at TAMU. During phase 1, all 21 students were introduced to spacecraft systems including propulsion, power, thermal, Guidance & Navigation, and trajectory design through a series of lectures and assignments. In phase 2, four contractor teams were formed and each team worked on the preliminary design concept for the MSR mission. At the end of phase 2, all four contractor teams presented their preliminary design concepts at a preliminary technical approach review. The MSR review panel consisted of several TAMU professors and visiting JPL consultants. The panel selected contractor #4 as their winning contractor, and recommended use of their design concept as a starting point for the MSR baseline design. Prerit Shah, who is a student member for GN&C TC, presented a summary of this baseline design at the AIAA Houston section Guidance, Navigation and Control technical committee's quarterly lunch meeting on 2nd November 2005. During phase 3, project leadership was elected and the whole team was reorganized into subsystem teams. Prerit was elected Project Manager for this study. The mission design team was supported throughout by project design laboratory Team X at JPL. This mission design team visited JPL for a week in November 2005 and conducted several con-

(Continued on page 13)

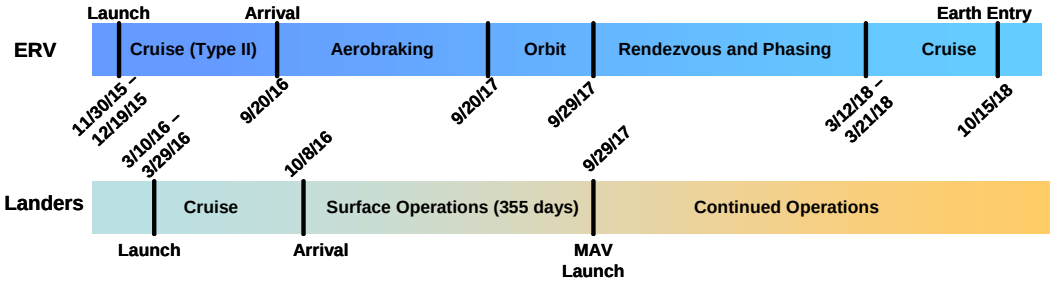


Figure 1 Mission Timeline

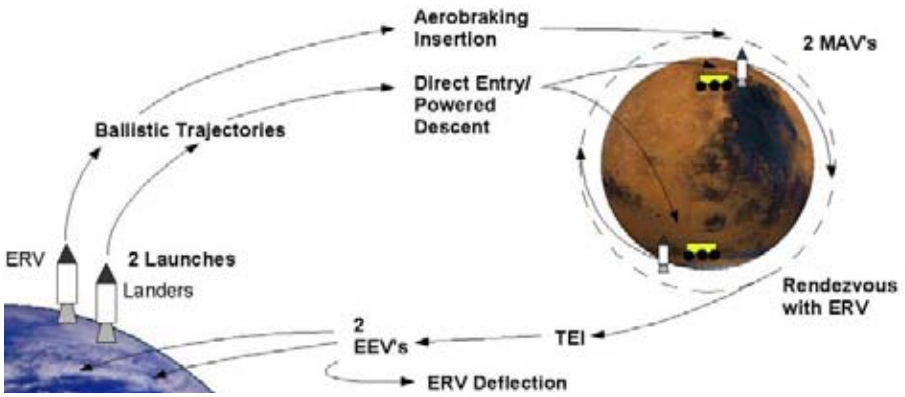


Figure 2 Mission Architecture

(continued from page 12)
current design sessions at Team X along with Team X experts.

During this study, the entire mission architecture including mission elements, launch vehicle, trajectory, orbit insertion methods, entry and landing devices, rovers and science equipment were identified. Analysis was also carried out for each subsystem such as power, propulsion and thermal for each of the mission elements. For every option, trade studies were performed on the basis of performance, risk and cost analysis. At the end of the semester, a final review was conducted by a review panel from JPL and the panel provided some positive feedback to the TAMU mission design team.

As the student engineers envision it, the project would take off in late 2015 with the launch of an Atlas V rocket carrying a spacecraft destined for Mars. That spacecraft would, in turn, carry an Earth Return Vehicle (ERV) that will carry sample back toward Earth. Another rocket, a Delta IV Heavy, launched few months later, would launch a Lander spacecraft to Mars. The Lander spacecraft will carry two Landers, which will land on Mars using the parachute and powered descent technique.

Once on Mars, the two Landers -- one landing on an ancient flood site known as Eos Chasma and the other in a large flat basin called Isidis Planitia -- would release wheeled rovers carrying automated tools to collect samples of soil, rock and atmosphere.

When the rovers have collected their samples -- a total of 500 grams (a little more than a pound) -- they will return to their Landers, where the samples will be transferred to small launch vehicles called Mars Ascent Vehicles (MAV) that will lift them to a low Mars orbit. In orbit, the MAVs will meet the second Earth-launched spacecraft, the Earth Return Vehicle, and transfer the loads of soil, rock and atmosphere to this vehicle. Then the spacecraft will return to earth, carrying the samples. In-situ Resource Utilization Plant (ISRU) carried on landers will produce the fuel for these MAVs on the surface of Mars.

The MSR project was a wonderful opportunity for the undergraduate students to participate in the real life mission design process and to learn about different space missions. The students would like to thank Texas A&M University and NASA JPL for providing them with this opportunity.

Mars Society of Houston Hosts 4Frontiers

CARL CARLSON, MARS SOCIETY EDITOR

Joseph E. Palaia, IV was the keynote speaker at the recent Mars Society of Houston Awards Banquet. Mr. Palaia, is VP of Operations and R&D for the 4Frontiers Corporation www.4Frontiers.com, the for-profit sister company to the not-for-profit Mars Foundation www.MarsHome.com.

4Frontiers derives its name from the four frontiers that are within our reach: Earth orbit, the Moon, Mars and asteroids. The company was formed because their eventual goal of a privately funded human mission to Mars, for settlement purposes, could not be undertaken by a not-for-profit entity (more on that goal later).

Mr. Palaia made it clear that all four frontiers are worth visiting and settling, and hopes we settle them all, but 4Frontiers is focused initially on Mars because it presents the lowest barrier to self-sufficiency. This is because Mars possesses, in abundance, numerous features and elements that cannot be found on the other three, (at least not all in the same place).

4Frontiers has a phased approach to eventually getting humans to Mars. But raising the billions of dollars it will take to do that is something that they are only planning for at this point. Initially, they are focused on becoming a serious player in the emerging space commerce industry, with the goal to provide consulting services, develop profitable technologies, and conduct public informative entertainment. The intent is that each of these will include revenue streams that will provide a near-term return on investment. For example, regarding public informative entertainment, 4Frontiers is presently siting a theme-park type attraction that features a scale model of the first human settlement on Mars. They are considering several locations, including desert areas, but will likely select Central Florida becuase "that is where the people are". For this initial phase 4Frontiers is looking for $24 million in venture capital. (NOTE: $200M is what we anticipate being worth as a corporation at the end of the 5 year plan).

Mr. Palaia pointed out that, as a non-governmental agency, they are free to seek product endorsement deals which could be an important revenue source. They don't plan to be in the transportation business at any point, but would rely on private contractors or NASA when the time came to send robotic payloads or, eventually, humans to Mars. Mr. Palaia stated, “After all, getting there is only half the challenge.” Most of the presentation was consistent with the message of the Mars Society -- not a surprise since several of the principals or advisors are former Mars Society members, most notably Bruce MacKenzie and Chris McKay. There was a heavy emphasis on in-situ resource utilization and settlement for the sake of settlement. What was different was a business plan that focused on near-term profitability, private sector initiatives and a stepping stone approach.

Joseph Palaia of 4Frontiers

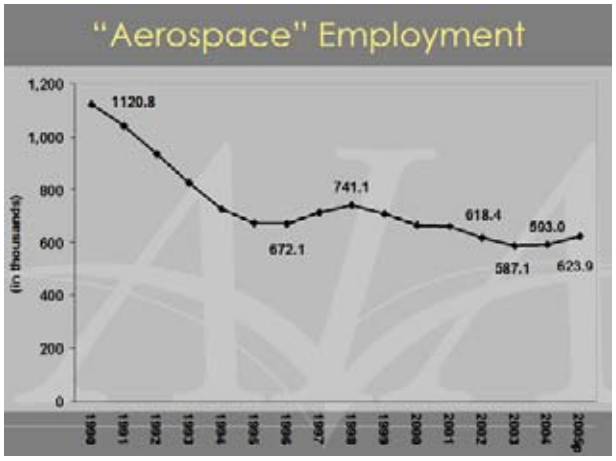
AIA (Aerospace Industries Association) Releases Year-End Aerospace Industry Statistics

The Aerospace Industries Association has released its annual industry statistics publications (see *Staying Informed* for the link).

In a word, the outlook presented is, "optimistic": sales are up almost 10 percent, profits rose to a record level, and profit *margins* rose as well, though not as much as in other industries. Their forecast is for continued growth.

Employment rose after sinking to a record low in the previous year. See www.aia-aerospace.org for more information.

(graphic courtesy of AIA)



Staying Informed

COMPILED BY THE EDITOR

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

Open Source Software at NASA Ames Research Center
http://opensource.arc.nasa.gov

Mission-Critical Development with Open Source Software: Lessons Learned
http://phk.freebsd.dk/pubs/ieee.software.pdf

Use of Free and Open Source (FOSS) Software in the U.S. Department of Defense
http://www.egovos.org/rawmedia_repository/588347ad_c97c_48b9_a63d_821cb0e8422d?/document.pdf

Developing an Open Source Option for NASA Software
http://www.nas.nasa.gov/News/Techreports/2003/PDF/nas-03-009.pdf

Open Channel Foundation
http://www.openchannelfoundation.org

SourceForge Open Source Projects Web Site
http://www.sf.net

ARES Mars Airplane Project Web Site
http://marsairplane.larc.nasa.gov

Simulating the ARES Aircraft in the Mars Environment
http://techreports.larc.nasa.gov/ltrs/PDF/2003/aiaa/NASA-aiaa-2003-6579.pdf

The Mars Airplane: A Credible Science Platform
http://www.ssdl.gatech.edu/Papers/Technical Papers/IEEE Paper ID1260 Final - from web site.pdf

Planetary Entry, Descent, and Landing (396 page seminar by Dr. Robert Braun)
http://pweb.ae.gatech.edu/people/rbraun/PlanetaryEDL.pdf (25 MB PDF)

NASA Learning Technologies
http://learn.arc.nasa.gov/

Aerospace Industries Association Year-End 2005 Industry Statistics
http://www.aia-aerospace.org/stats/resources/res_space.cfm

"Development with OSS [Open Source Software] is building momentum at the agency. This movement is a natural outgrowth of one simple question: Why should we spend taxpayer dollars developing something that already exists?—a question that led NASA to embrace commercial off-the-shelf hardware as a viable alternative to in-house hardware development many years ago."

Jeff Norris
NASA JPL
"Mission-Critical Development with Open Source Software: Lessons Learned"

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:

Marie Adams
Angela Braun
David Copeland
Kevin Daugherty
Jeremy Davis
Kyle DeMars
Peter Fahrenthold
Raymond Funke
Iffat Gillani
Karl Guillory
Dawn Hill
Ligia Illiescu
Kristin John
David Kanipe
Anup Katake
Natasha Lagoudas
Sunil Lakshmipathy
Michael Lembeck
Robert McCormick
Walter Miller
Clark Moody
Alexander Nicki
Katherine Ogden
Dipanker Sahoo
Christopher Savoie
Chris Shaw
Chandra Veer Singh
Christopher Thompson

Important notes:

- *Not a member? See the end page.*

Looking for Lost Members

ELIZABETH BLOME, MEMBERSHIP

We do not have current contact information for the following members, which means that either their email or mail addresses are no longer valid. If you know where they are, please either ask them to update their information on www.aiaa.org or send their new information to elizabeth.c.blome@nasa.gov.

Nick Baker
Marshall Cloyd
Yuanyuan Ding
Justin Doyle
Kevin Dries
Cory Logan
Jeffrey Marshall
Chuck Miller
Ozden Ochoa
Alicia Rutledge
Sean Welch
Bryan Witt
Pamela Workings

Help AIAA Help You - Update Your Membership Records

ELIZABETH BLOME, MEMBERSHIP

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 obtaining corporate support for local AIAA activities (such as our monthly dinner meeting, workshops, etc.). Please take a few minutes and visit the AIAA website at http://www.aiaa.org/ 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 or by email at elizabeth.c.blome@nasa.gov.

Membership Q & A

Q: How can I become a member of one of the AIAA Standing Committees?

A: You may nominate yourself or be nominated by another member for membership on an AIAA Standing Committee. You can also nominate other members. A description of the scope and volunteer contact for each of AIAA's Committees is located on the Standing Committees page. If you are interested in participating on a Standing Committee, please complete the online Standing Committee Nomination Form found on the Forms page at the AIAA web site.

Q: How do I become a member of an AIAA Technical Committee?

A: Any AIAA member is welcome to apply for membership on a technical committee. Technical Committee membership is generally for three consecutive one-year terms. Nominations open 1 August and close 1 November, although midyear placement on a Technical Committee is possible. For more information or to obtain a nomination form, go to the Technical Committee page at the AIAA web site.

A Lunch and Learn Summary Report

Where Did That Equation Come From?

ELLEN GILLESPIE AND DOUGLAS YAZELL, GN&C TECHNICAL COMMITTEE

On February 2nd 2006, the Houston AIAA GN&C Technical Committee was pleased to present a knowledge capture Lunch-and-Learn seminar by John Goodman of United Space Alliance. Approximately 35 people not only enjoyed learning about effective techniques employed by the author to retain shuttle flight software and GPS knowledge base, but they also got to participate in a discussion of how knowledge capture techniques have been used within their own organizations.

Knowledge capture is important to ensure the health of astronauts and vehicles. Due to the complexity of aerospace systems and the increasing length of aerospace Programs, it is important to ensure that the theory behind governing system equations and the rational behind Program decisions are preserved for future engineers. As the space shuttle, ISS, and future Programs last 30 years or more, Program knowledge is preserved in sources such as: textbooks, journal articles, conference papers, presentations, technical reports, software requirements, existing databases, and technical training material.

Often knowledge capture and preservation is haphazard. Teams that have individuals that recognize the importance of knowledge preservation and are good at generating technical documentation for their areas tend to do better at preserving their team's knowledge base. When the knowledge of a team is captured, the cost of training new engineers in that area is lower. Engineers that need to perform extensive research on how an existing system works waste valuable time and budget sifting through source code, data, equations, and documentation, sometimes re-deriving the equations themselves.

Mr. Goodman presented knowledge capture and management as a cultural problem that requires a grass roots solution. Since there will always be time, budget, and political constraints, he encouraged the audience to generate creative solutions at the engineering level that may be performed without seeking additional budget. This includes improving and preserving technical reports and presentations, as well as creating specific knowledge capture documentation. As examples, Mr. Goodman discussed how he delivered the information he had collected on various topics as JSC documents on "Space Shuttle RNP Matrix Computation", "Improvement of Space Shuttle Time to Node Computation", "Space Shuttle Lambert Guidance Improvement," and "Space Shuttle GPS lessons Learned." Additionally, Mr. Goodman discussed how the USA Engineering Knowledge Base (EKB) Initiative started at a low level at KSC.

This web-based database grew into a USA-wide program. It was noted that web based methods of knowledge capture provide everyone in an organization with an easy to use method for obtaining information.

Audience suggestions for knowledge capture solutions included resending technical presentations to all who attended a meeting with the agreed upon meeting decisions and why these decisions were made, capturing technical references (including equation numbers) in source code files, and strengthening technical training material in each group by ensuring adequate team skill mix.

The JSC technical reports server is available online at: http://ston.jsc.nasa.gov/collections/TRS.

$$\mathbf{Q} = \frac{\mu}{r^3 \mathbf{r}^T \mathbf{v}_{REQ}} \mathbf{r}\,\mathbf{r}^T$$

So where did the above equation come from? It's Laning and Battin's Q guidance equation.

The AIAA Houston Section's web site at www.aiaa-houston.org will soon contain a document created by John Goodman which is related to his lunch-and-learn presentation: "Knowledge Capture and Management for Space Flight Systems", NASA/CR 2005-213692.

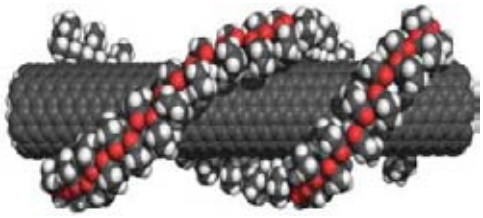
Our AIAA Houston Section GN&C technical committee currently has seven professional members from seven different GN&C organizations and two student members. Our charter and goals are presented on the web site at http://www.aiaa-houston.org/tc/gnc/. We support our section's Annual Technical Symposium, and our web page has a list of past lunch-and-learns, some of which contain links to the speaker's PowerPoint charts. (We are planning to add audio or video or both to some of these links.) Our next quarterly lunch meeting is scheduled for Wednesday, March 1, 2006. We are always looking for new members. If you are interested in joining our work, please get in touch with any member using the contact information on our web page.

NanoMaterials for Space Exploration

DOUGLAS YAZELL, MEMBER, HOUSTON SECTION GN&C TECHNICAL COMMITTEE

A Lunch and Learn Summary Report

Mr. Moloney provided an overview of nanotechnology in building 16 at NASA/JSC (rooms 111 and 113) on Friday, February 10, 2006. The following paragraph's brief summary and his biographical information are taken from our publicity flier.



The NASA Johnson Space Center NanoMaterials team centers its work on the growth, processing, characterization and application of nanomaterials for the needs of human space exploration. Given the challenges presented by NASA's space exploration initiative, which includes long duration human spaceflight to the Moon and Mars, the development of advanced materials has become paramount. Current technology in power & energy systems, air revitalization, radiation protection and EMI shielding, to name a few, will need improvement to meet these missions. For many of these applications, materials whose bulk properties are optimized on the nanoscale are necessary. This presentation will give an overview of the project's current efforts and collaborations, future direction, and highlight in detail some of our applications development in power & energy storage and regenerable life support.

Bio: Pádraig Moloney was born in Dublin, Ireland. He received his Bachelors of Science in aerospace engineering from the Massachusetts Institute of Technology (M.I.T.). His research at M.I.T. included a leading role in the development of the first artillery launched unmanned air vehicle (UAV) for Charles Stark Draper Laboratory, and a senior thesis on the acoustic and propulsive effects of micro gas turbine arrays for the M.I.T. Gas Turbine Laboratory. Padraig received Masters of Science in Nanoscale Physics from Rice University. Following work in the private sector on the development of web-based billing and financial algorithms, Pádraig joined NASA Johnson Space Center in 2001. His work with NASA began with the design of engineering product data management systems with a concentration on engineering data cryptography and digital signature. Since beginning his research with the NASA JSC NanoMaterials team in 2003, Padraig has become responsible for the team's efforts in applications research and development. This work concentrates on the application of nanomaterials, in particular single wall carbon nanotubes. This research and development effort brings together various NASA centers, industry, government and academic collaborators.

Rather than trying to transcribe the video for this article, we encourage those interested to borrow, copy, or keep one of our DVDs containing the video and audio recording of this event. (AIAA membership is not required.) We have five copies and we can create more. The recording started a little late, and there are some video blackouts while the audio continues, but the essential information is there, especially when combined with this article. As soon possible, we plan to put the audio/video file on our web site, along with audio and video files from some past lunch-and-learns.

In related news, an upcoming lunch-and-learn is tentatively scheduled for March 24, 2006. The speaker is Dr. Neva Ciftcioglu/NNBP, and the subject is NanoMaterials for Biological Applications. The sponsor for that event is the AIAA Houston Section Life Sciences, Space Processes, and Human Factors technical committee.

Please consider joining one of our AIAA Houston Section technical committees. Details are listed at www.aiaa-houston.org. Typical charters include providing a forum for the exchange of ideas regarding the state of the art and the future of each discipline and stimulating education, professional development, and accomplishment by fostering communication and providing resources. Typical goals include organizing lectures from government, industry, and universities, and monitoring and contributing to the mirror committee on the national level. We also support the AIAA Houston Section Annual Technical Symposium, which takes place at the Gilruth Center this year on Friday, May 19, 2006. Our GN&C technical committee is always looking for more members to join our current list of seven members from seven local GN&C organizations and two student members. Our next quarterly lunch meeting will be May 3, 2006. Contact information is on the web page and can be provided by Douglas Yazell at 281-244-3925.

Local Industry News and Announcements

USA POSITIONING ITSELF FOR POST-SHUTTLE WORK

United Space Alliance today announced the formation of a new Constellation Program Office and the selection of industry veteran Anne Martt as USA's Vice President and Constellation Program Manager. Martt will be responsible for the management and execution of all USA work in support of NASA's Constellation Program, including the transition of work, assets and resources from other programs such as the Space Shuttle and International Space Station programs.

"We fully expect USA to play an integral role in the Constellation Program from the early stages of system design and development through operations concept development and implementation," said USA President and Chief Executive Officer Mike McCulley. "We are already performing some early work, and Anne is the right person to ensure we efficiently maintain the highest possible quality and reliability in our products and services as we transition from Shuttle to Constellation."

As Program Manager reporting directly to McCulley, Martt will be responsible for the overall management of the organization including technical content, cost, schedule and risk. She will serve as the USA senior liaison to the NASA Constellation Program Office headquartered at the Johnson Space Center, and to the Constellation Program elements that reside at Kennedy, Marshall and NASA Headquarters. The appointment is effective immediately. [Source: United Space Alliance]

SPACEHAB SUBMITS PROPOSAL FOR NASA SPACE STATION LOGISTICS

Houston, Texas, March 7, 2006 – SPACEHAB, Incorporated (NASDAQ/NMS: SPAB), a leading provider of commercial space services, announced today that the Company has submitted its proposal to NASA to demonstrate its capability to provide commercial cargo transportation services to and from the International Space Station while providing space access to various customers worldwide.

A team of internationally renowned aerospace veterans, SPACEHAB, MacDonald Dettwiler Associates (MDA) Systems, Inc. and Ball Aerospace & Technologies Corp., propose to jointly develop and demonstrate a next generation commercial space service, called Apex, in response to NASA's Commercial Orbital Transportation Service (COTS) Demonstrations solicitation. This service offers frequent, reliable and affordable access to space in support of NASA's space station needs but also opens the door to commercial access to space by corporations, academic institutions and government users around the globe.

"Our Apex team provides a non-shuttle-based, end-to-end space access service that is an extension of the customer-responsive SPACEHAB service proven successful over the previous decade on numerous space shuttle and space station missions," stated Michael E. Kearney, SPACEHAB President and Chief Executive Officer. "As a pioneer in the development of the early stages of the space commerce market, SPACEHAB is ideally positioned to grow and expand the market via the COTS initiative and related commercial services." [Source: SPACEHAB]

For more information see www.spacehab.com.

SPACEHAB CHIEF TO SPEAK AT 2006 WALL STREET ANALYST FORUM

Houston, Texas, February 27, 2006 – SPACEHAB, Incorporated (NASDAQ/NMS: SPAB), a leading provider of commercial space services, announced today that Michael E. Kearney, President and Chief Executive Officer, will be a key presenter at the 17th annual Wall Street Analyst Forum in New York City on Thursday, March 2, 2006 at 9:00am Eastern Time.

To be held at the Princeton Club, Mr. Kearney will provide a 40-minute overview of SPACEHAB, one of the only 'pure plays' in space, and share the Company's vision, growth strategy and near-term business opportunities. Analysts and portfolio managers are invited to meet with Mr. Kearney; Brian K. Harrington, SPACEHAB Chief Financial Officer; and Kimberly Campbell, Vice President Corporate Marketing and Communications, as well as other leading members of the Aerospace and Defense sector. A formal presentation will be followed by a breakout session and one-on-one meetings.

Interested parties that would like to follow SPACEHAB's meeting can attend via webcast for thirty days following the event by accessing this link: http://www.investorcalendar.com/CEPage.asp?ID=100064. Since 1988 The Wall Street Analyst Forum has organized 75 major analyst conferences for NYSE, NASDAQ and AMEX companies with over 2,500 public corporations presenting during this time. The event is being held from February 27 - March 2, 2006. ." [Source: SPACEHAB]

For more information see www.spacehab.com.

97 AWARD FEE SCORE FOR MSOC

On February 23, 2006 NASA announced that the Mission Support Operations Contract (MSOC) team earned a 97 award fee score for the last six month evaluation. This is the fourth excellent evaluation score in a row having previously received 93, 95 and 97. Under the contract the MSOC team provides space operations and data services support for Space Shuttle missions and Inter-

(Continued on page 19)

(Continued from page 18)
national Space Station expeditions. These services include mission operations and planning ground systems support for the Mission Control Center (MCC) at JSC in Houston as well as ground systems services for JSC's Emergency Operations Center, the Electronic System Test Laboratory and Space Communications Integration. In addition MSOC performs operations, maintenance, and engineering for the Houston MCC and Backup Control Center and Houston Support Room in Moscow. Congratulations to Dan Brandenstein, MSOC Program Manager, and the entire MSOC team for this incredible achievement. [Source: LMSO] For more information see www.lockheedmartin.com

LMSO SUB ON FOSC WIN

Enterprise Advisory Services, Inc. (Easi), a Houston-based small business was notified by NASA that it won the Facility Operations and Support Contract (FOSC) at the White Sands Test Facility in New Mexico. LMSO is a subcontractor to Easi and will provide support to the White Sands Space Harbor (WSSH) facility on the White Sands Missile Range. The period of Performance is May 1, 2006 through April 30, 2011. FOSC support will include maintenance and operation of facility systems such as water and sewer, electrical distribution, buildings, roads and grounds, environmental remediation and compliance, operation of heavy equipment, lifting devices and equipment, drafting, documentation, technical library and configuration management, emergency services, and emergency notification paging/ radio systems. Congratulations to the LMSO proposal team for this important win. [Source: LMSO] For more information see www.lockheedmartin.com

NORTHROP GRUMMAN MOVES HUMAN SPACE EXPLORATION HQ TO HOUSTON

HOUSTON, Texas - February 15, 2006 - Program managers at NASA's Johnson Space Center (JSC) will be able to meet face to face with Northrop Grumman's (NYSE: NOC) lead human space exploration executives on a more regular basis now that the company has moved its human space exploration headquarters to Bay Area Houston, a two-minute drive from JSC.

Art Stephenson, the former director of NASA's Marshall Space Flight Center who was recently appointed to lead Northrop Grumman's new Space Exploration Systems organization, has moved both his office and his home to the Bay Area. Doug Young, program manager for the Northrop Grumman-Boeing team competing for NASA's new Crew Exploration Vehicle (CEV), will be transitioning to a permanent office in Houston this summer.

Northrop Grumman's Space Exploration Systems organization is part of the company's Integrated Systems sector based in El Segundo, Calif.

"It's important to me and Northrop Grumman that our key space management team is geographically close and therefore available to meet with NASA's Constellation Program office and other human spaceflight organizations on very short notice," said Stephenson. "Nothing says 'partnership' better than being there when your customers need to discuss critical program issues."

The Northrop Grumman-led CEV team includes Houston-based Boeing NASA Systems as its principal subcontractor. The two companies have been working together since mid 2004 to help NASA design, develop and produce the CEV, a successor to the Space Shuttle that will allow humans to travel to the International Space Station, the moon and beyond in coming decades. NASA expects to award the CEV prime contract in the third quarter of 2006.

Northrop Grumman opened its Bay Area Houston office in December, appointing Michael Lembeck, a former NASA official, to serve as the company's local director of operations. Located on Space Center Blvd, the office currently supports approximately 25 Northrop Grumman employees. The company expects local employment at Northrop Grumman, Boeing and the team's local suppliers to rise initially to more than 250 jobs if the Northrop Grumman-Boeing team wins the CEV development contract.

Stephenson's new assignment brings him back to a community where he has lived and worked before. In 1992, he became vice president of Oceaneering Space Systems, located in Houston's Clear Lake area. In 1997, he was promoted to president of Oceaneering Technologies, overseeing not only the company's Space Systems group in Houston but also its underwater search and recovery operations in Maryland. Stephenson remained in Houston until 1998 when he became the director of Marshall Space Flight Center, Huntsville, Ala. [Source: Northrop Grumman Corporation] For more information see: www.ngc.com

SPACEHAB REPORTS FINANCIAL RESULTS FOR SECOND QUARTER FISCAL YEAR 2006

Houston, Texas, February 7, 2006 – SPACEHAB, Incorporated (NASDAQ/NMS: SPAB), a leading provider of commercial space services, today announced financial results for the second quarter ended December 31, 2005 of its fiscal year 2006.

Second Quarter Results
SPACEHAB posted a second quarter fiscal 2006 net loss of $8.9 million, or $0.70 per share, on revenue of $11.8 million compared with second quarter fiscal year 2005 net loss of $1.2 million, or $0.10 per share, on revenue of $13.1 million.

(Continued on page 20)

Public Policy

2006 Congressional Visits Day

NICOLE SMITH, PUBLIC POLICY

Raise the Image of Aerospace in Washington!

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.

Congressional Visits Day (CVD) brings scientists, engineers, researchers, educators, and technology executives to Washington to raise the visibility of and support for science, engineering, and technology. "Team captains" coordinate the event for their state's delegation, which is open to all who believe that science and engineering are the cornerstones of our Nation's future. The Day consists of a series of briefings and meetings with "your" Congressional representatives. 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 2006** 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:

www.AIAA.org/PublicPolicy

Local Industry news (cont'd.)

(Continued from page 19)

The quarter loss includes a non-cash charge of $6.3 million as the Company wrote down the book value of one of its two pressurized space shuttle modules and changed the depreciable life of its remaining space shuttle assets to align with NASA's current launch manifest that anticipates retiring the space shuttle fleet at the end of 2010. "With a limited number of shuttle flights remaining, we anticipate that the most efficient use of our flight assets to support NASA's objectives is the combined use of our pressurized module flown in conjunction with our cargo carrying pallet in support of International Space Station assembly and operations," stated Brian K. Harrington, SPACEHAB Chief Financial Officer. "This approach optimizes the amount of equipment and provisions shipped to the space station. Since this more favorable method uses our single module, Flight Unit 2, we have reduced the book value of our aft module, Flight Unit 3, which in the past provided a larger, double module capability when needed," concluded Harrington. SPACEHAB's single module is under contract for use on the STS-116 and 118 shuttle missions as is the cargo carrier. Second quarter results also include a non-cash charge of $0.6 million of deferred financing cost relative to the note exchange transaction completed in November.

"As NASA and the aerospace community implement the nation's Vision for Space Exploration, we will be transitioning our existing programs away from shuttle operations, subsequently retiring certain space assets, and developing new capabilities and hardware that support next-generation services," stated Michael E. Kearney, SPACEHAB President and Chief Executive Officer. "As with most companies, requirements change, technology improves, and the need to develop new and improved assets is imperative for market leadership."[Source: SPACEHAB]

For more information see www.spacehab.com.

COMMERCIAL ORBITAL TRANSPORTATION SERVICES (COTS) DEMONSTRATION PROPOSALS SUBMITTED BY LOCAL COMPANIES

Triton Systems of the Clear Lake Area has submitted a response (partnering with several other organizations) to the NASA COTS Request for Proposals (RFP). Triton Systems is known for its Stellar-J reusable launch vehicle design.

Also, Advent Launch Services of Houston, Texas, has submitted a response to the NASA COTS Request for Proposals (RFP). Advent is is fielding a sea-launched, stackable, vehicle design. Regarding their submission to the COTS RFP, Advent President Jim Akkerman said: "Thank goodness NASA does know how to do business the commercial way".

For articles on both Triton System and Advent Launch Services concepts, see the September/ October 2005 issue of *Horizons* at www.aiaa-houston.org/ newsletter/sep05/sep05.pdf.

Outreach and Education

Ask-An-Engineer Program Volunteers Sought

Ask-An-Engineer is a program of the Precollege Outreach Committee. We get many questions from students and the general public about engineering questions and the field of aerospace engineering. The questions are usually not difficult, but we need people to answer them. If you are interested in fielding these questions, please contact Lisa Bacon at lisab@aiaa.org.

Family Science Festival Volunteers Sought

JOY CONRAD KING, PRE-COLLEGE CHAIR

Volunteers Needed for Science Festival March 25th

The Redd School in North Houston will be having a Family Science Festival on Saturday March 25 from noon-4pm. It is a free event open to the public, and they usually have over 500 attend. Every year it is space-based, and this year they are celebrating "Earth in Space". They will have a basketball court full of activities that families can enjoy. Volunteers are needed to staff an AIAA booth to demo aerospace activities. If anyone has a wind tunnel, they're welcome to bring it. If not, the Pre-College committee has other activities that you could bring. If you are interested in helping out, then please contact Joy Conrad King at aiaa_houston@yahoo.com or (281) 282-2621.

U.S. National Science Foundation Releases 2006 Science & Engineering Indicators

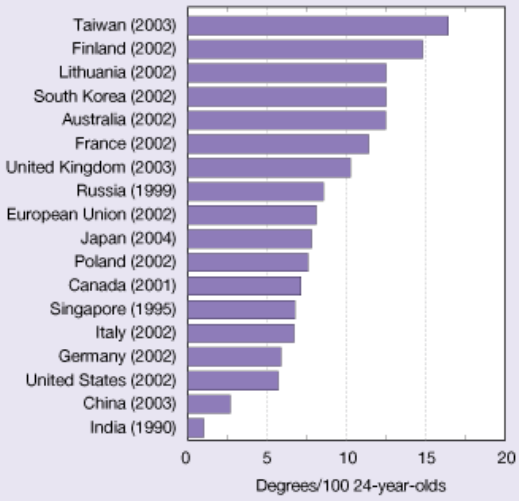
The U.S. National Science Foundation (NSF) has released its 2006 Science and Engineering indicators. One of the findings of the just-released publication — in a very small nutshell, is: "*In sum, prospects for the U.S. S&E workforce are for slower growth, rising retirements, and increasing average age.*" For more information see: www.nsf.gov/statistics/seind06/ Many more publications can be found at the NSF Division of Science Resources Stistics web page at http://www.nsf.gov/statistics/.

Figure O-38
Average science literacy score of 15-year-old students, by country: 2003

SOURCE: Organisation for Economic Co-operation and Development, Programme for International Student Assessment (2003). See appendix table 1-14.

Science and Engineering Indicators 2006

Figure O-24
NS&E degrees per 100 24-year-olds, by country/economy: Most recent year



NS&E = natural sciences and engineering

SOURCES: Organisation for Economic Co-operation and Development, Center for Education Research and Innovation, Education database, www1.oecd.org/scripts/cde/members/edu_uoeauthenticate.asp; United Nations Educational, Scientific, and Cultural Organization (UNESCO), Institute for Statistics database, http://www.unesco.org/statistics, and national sources. See appendix table 2-37.

Science and Engineering Indicators 2006

CALENDAR

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

March

21-22	NASA Project Management Challenge 2006 (Galveston)
23	Lunch n' Learn: "Finite State Dynamic Modeling and Uncertainty Methodologies Related to Orbiter Re-entry Survivability and Safe Haven Concerns" by Dr. Allan Benjamin/ARES (JSC Bldg 16 Rm 253/259)
24	Lunch n' Learn: "Nanobacteria - The Discovery of a New Life Form" by Dr. Neva Ciftcioglu of Nanobac Life Sciences (JSC Bldg 16 Rm 111/113)

April

3	Executive Council Meeting (ARES Corp.)
4-5	AIAA's Congessional Visits Day (Washington DC)
5	Dinner Meeting: "Space Shuttle Orbiter Lessons Learned" presented by Bo Bejmuk/Boeing (Gilruth)
12	Yuri's Night - World Space Party
27-29	Region IV Student Paper Conference (Texas A&M University, College Station)
29-30	"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.)
2-3	Physics Day Challenge (Space Center Houston)
5	“Space Day” Event
19	Annual Technical Symposium (Gilruth)
20	Career & Professional Development Workshop (Gilruth)
TBD	“Space Trivia Night” (Gilruth)
TBD	AIAA Aerospace Historical Site Dedication at JSC
TBD	Mixer with the Mars Society - Houston Chapter

June

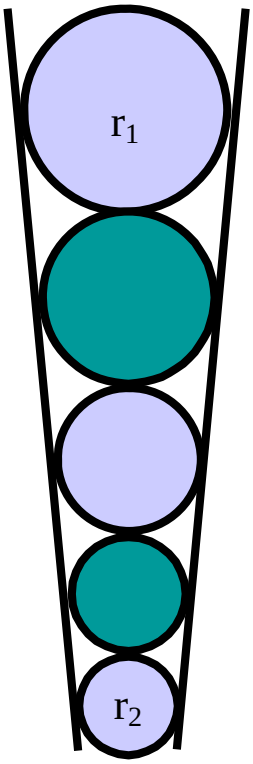
5	Executive Council Meeting (ARES Corp.)
22	Annual Honors & Awards Banquet: "SR-71 Blackbird – An Engineering Marvel" by Col. R. Graham/USAF Retired & AIAA Distinguished Lecturer (Gilruth)

Contact chair@aiaa-houston.org or events@aiaa-houston.org for further details.

Cranium Cruncher

BILL MILLER, SENIOR MEMBER

Last month's lunar sample problem was from Nick Hobson's web site "Nick's Mathematical Puzzles," at http://www.qbyte.org/puzzles/puzzle04.html. It is problem #37:



Five spherical lunar samples of decreasing size are placed into a conical funnel. The investigator notices that each sample is in contact with the adjacent samples as well as with the wall of the funnel (all the way around the sample). The largest sample has a radius r_1 of 18 millimeters, and the smallest has a radius r_2 of 8 millimeters. What is the radius of the central sample?

This was a tough one but some of you persisted and got it. Correct solutions were received from the following:

Darrin Leleux
Wendell Mendell
Douglas Yazell
Frank Baiamonte
Mark Matney

A solution is given on the web page, but Mr. Matney's solution is so elegant I thought I would quote it here in full:

"Each successive grain is a fixed ratio larger than the next smaller grain, because the problem looks the same at all size scales.

Therefore, if the 5th one is 18 / 8 = 2.25 times larger than the first, then each one is (2.25)0.25 times larger than the previous one, and the 3rd one is (2.25)0.5 = 1.5 times larger than the first, or 8 * 1.5 = 12 mm."

Thanks to all who participated.

Here's this month's puzzle, in honor of spring break:

The center of gravity of a full can of beer is at the centroid of the can. This is also true of an empty can. Therefore, as the level of the beer decreases, there must be a point at which the decreasing center of gravity is at a lowest point. As the beer level further decreases, the center of gravity must rise again. The problem is to find the level of the beer at which the lowest center of gravity occurs, given the following:

1) The can is a perfect cylinder.
2) Any asymmetry introduced by opening the can can be neglected.
3) The empty can weighs 44 grams.
4) The can holds 340 grams of beer.
5) The can is 20 centimeters high.
6) The metal's thickness can be assumed to be negligible.

Pop a cold one and work on it. Extra credit if you don't use calculus.

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 ESAS (Exploration Systems Architecture Study) Report, released some months ago, originally called for a CLV (Crew Launch Vehicle) consisting of a four-segment SRB (Solid Rocket Booster) and an SSME (Space Shuttle Main Engine) upper stage engine. A re-evaluation has lead NASA to alter the CLV design to use a five-segment SRB and an upgraded version of the Apollo-era J-2 engine that powered the upper stage of the Saturn vehicles, placing the Apollo Command Module into orbit.

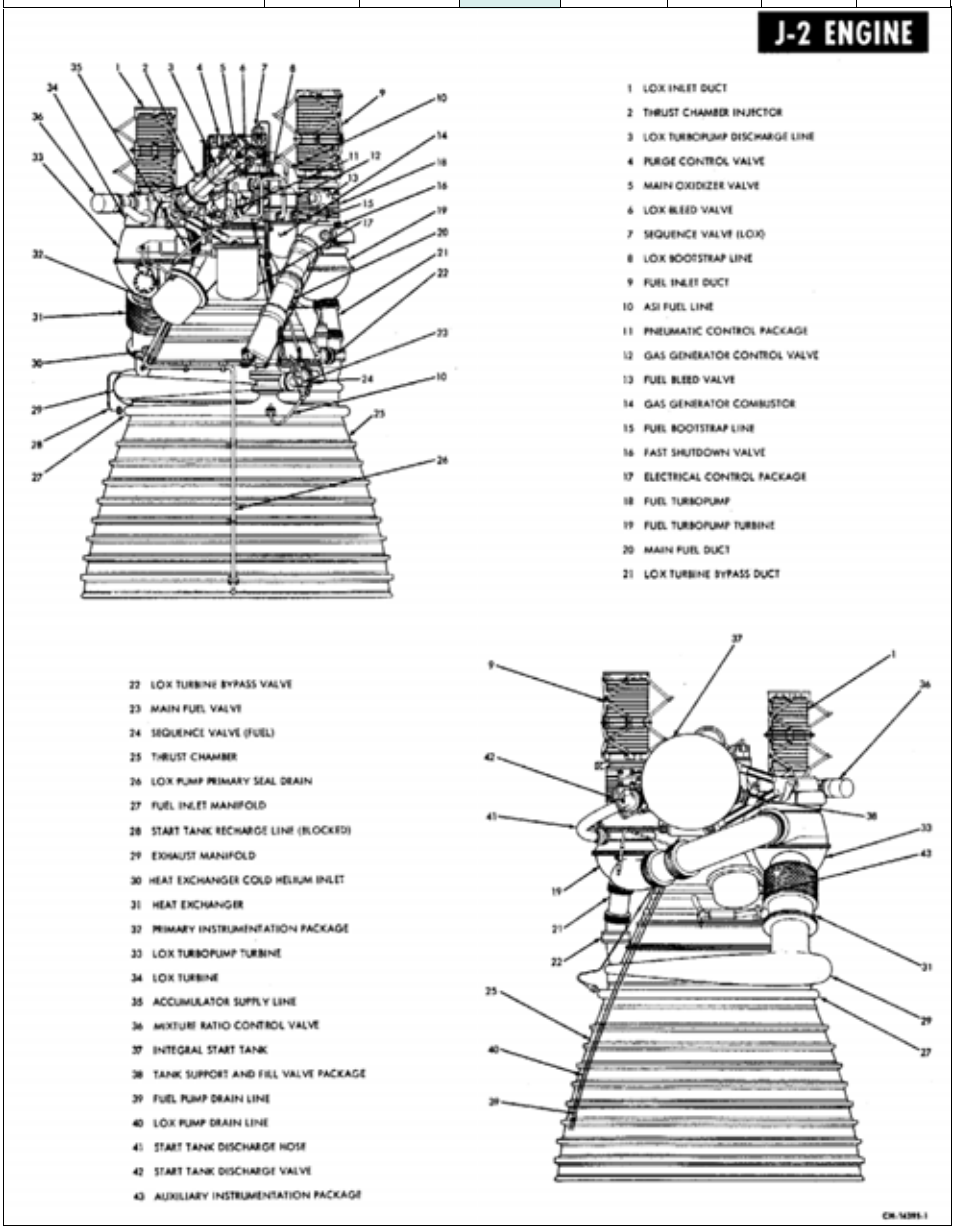
The J-2S ("S" refers to "simplified") was developed following the initial J-2 development effort, as NASA retained the J-2 development force for support during Apollo operations. The J-2X is the nomenclature used to refer to the new J-2 variant that would be produced for CLV. The J-2X appears to correspond to the shaded column in the table (top right).

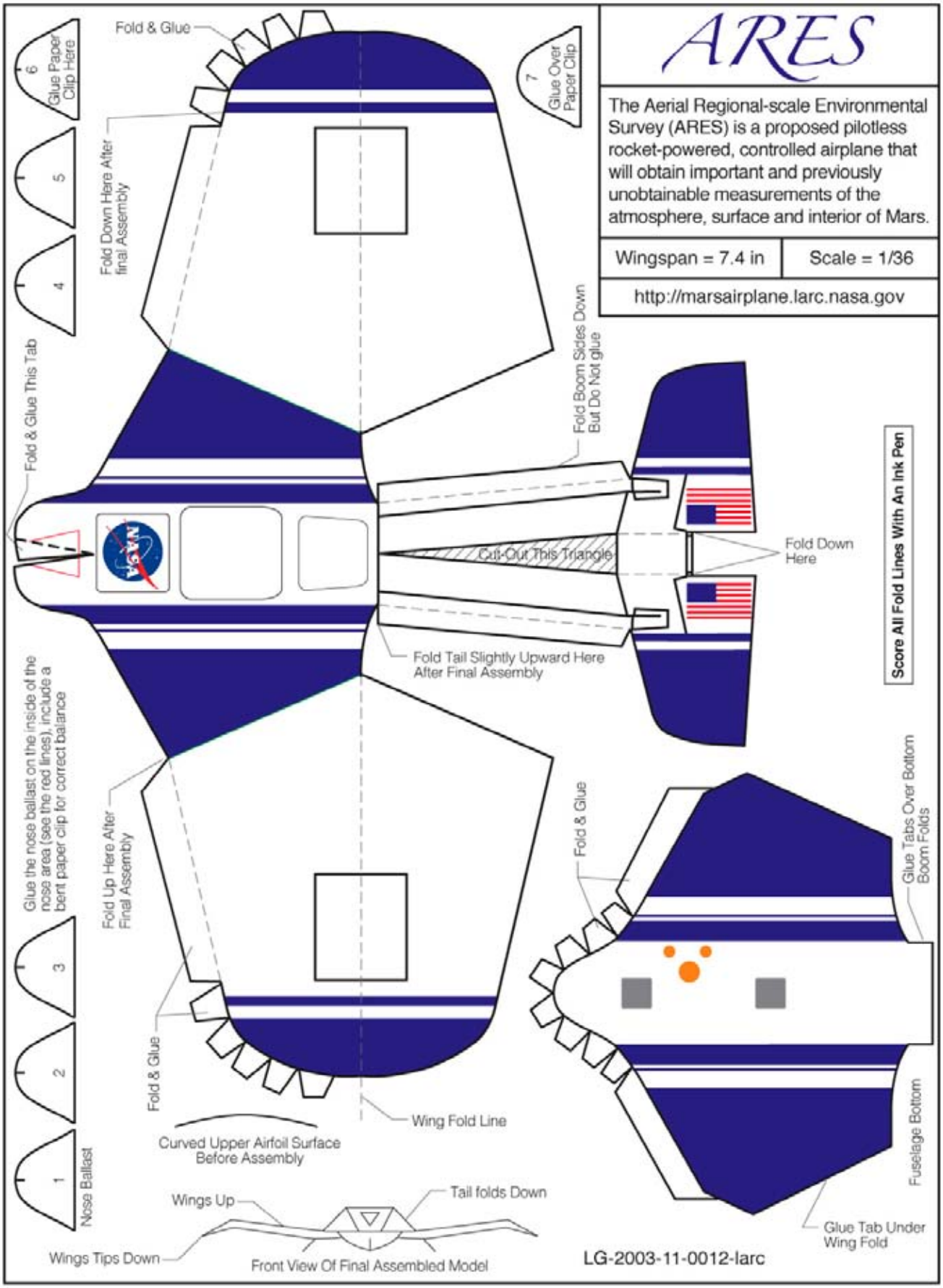
The J-2 is notable in many ways. The original contract made with Rocketdyne in September 1960 "included an especially notable feature. For the first time, a high-energy, high-thrust rocket engine contract specified a design to 'insure maximum safety for manned flight.'" ["Stages to Saturn" http://history.nasa.gov/SP-4206/ch5.htm#151] The ESAS report lists the probability of LOM (Loss of Mission) and LOC (Loss of Crew) at 1:433 and 1:1918, respectively—only slightly less than that of a four-segment SRB and SSME upper stage.

It was estimated in a 1993 study that "the J-2S could be brought to a production-ready status in a relatively timely and economic manner. … The first production engines would be available for delivery 4 years after authority to proceed." [AIAA 93-2129, "*J-2S Rocket Engine*", 29th Joint Propulsion Confernce and Exhibit]

The diagram of the original J-2 at right is taken from a great reference available online, "Skylab Saturn 1B Flight Manual" http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19740021163_1974021163.pdf.

Engine	J-2	J-2S					
	Baseline	Baseline	Performance Options				
			Nozzle Replacement		Uprated		
Expansion Ratio	27.5:1	40:1	80:1	105:1	40:1	80:1	105:1
Vacuum Thrust (lbs)	230,000	265,000	272,500	275,000	320,000	327,500	330,000
Vacuum I_s (sec)	425	436	448	453	435	447	451
Weight (lbs)	3,454	3,800	3,755	3,855	4,120	4,040	4,200
Length from Gimbal Plane	116 (in)	116	172	196	116	172	196 (in)
Exit Diam (in.)	80	80	112	128	80	112	128




ARES
The Aerial Regional-scale Environmental Survey (ARES) is a proposed pilotless rocket-powered, controlled airplane that will obtain important and previously unobtainable measurements of the atmosphere, surface and interior of Mars.
Wingspan = 7.4 in
Scale = 1/36
http://marsairplane.larc.nasa.gov
Fold & Glue
6 Glue Paper Clip Here
7 Glue Over Paper Clip
5
4
3
2
1 Nose Ballast
Fold Down Here After final Assembly
Fold & Glue This Tab
Glue the nose ballast on the inside of the nose area (see the red lines), include a bent paper clip for correct balance
Fold Up Here After Final Assembly
Fold & Glue
Curved Upper Airfoil Surface Before Assembly
Wing Fold Line
Fold Boom Sides Down But Do Not glue
Cut-Out This Triangle
Fold Down Here
Fold Tail Slightly Upward Here After Final Assembly
Score All Fold Lines With An Ink Pen
Fold & Glue
Glue Tabs Over Bottom Boom Folds
Fuselage Bottom
Glue Tab Under Wing Fold
Wings Up
Tail folds Down
Wings Tips Down
Front View Of Final Assembled Model
LG-2003-11-0012-larc

Upcoming Conference Presentations by Houston Section Members

COMPILED BY THE EDITOR FROM AIAA AGENDAS

Information here is taken from preliminary AIAA conference agendas. As such, it is subject to change.

36th AIAA Fluid Dynamics Conference and Exhibit
24th Applied Aerodynamics Conference
25th AIAA Aerodynamic Measurement Technology and Ground Testing Conference
37th AIAA Plasmadynamics and Lasers Conference
3rd AIAA Flow Control Conference
9th AIAA/ASME Joint Thermophysics and Heat Transfer Conference
5 - 8 Jun 2006
Hyatt Regency San Francisco at Embarcadero Center
San Francisco, California

Orbiter Return- to- Flight Entry Aeroheating
C. Campbell, G. Bourland and S. Bouslog, NASA Johnson Space Center, Houston, TX; T. Horvath, S. Berry and P. Gnoffo, NASA Langley Research Center, Hampton, VA

Overview of Boundary Layer Transition Research in Support of Orbiter Return to Flight
S. Berry, T. Horvath, and F. Greene, NASA Langley Research Center, Hampton, VA; G. Kinder, The Boeing Company, Huntington Beach, CA; and K. Wang, The Boeing Company, Houston, TX

Review of Orbiter Flight Boundary Layer Transition Data
C. McGinley and S. Berry, NASA Langley Research Center, Hampton, VA; G. Kinder, The Boeing Company, Huntington Beach, CA; M. Barnwell and K. Wang, The Boeing Company, Houston, TX

Boundary Layer Transition Results from STS- 114
S. Berry, NASA Langley Research Center, Hampton, VA; A. Cassady and B. Kirk, NASA Johnson Space Center, Houston, TX; K. Wang and A. Hyatt, The Boeing Company, Houston, TX

Entropy Generation and Lifespan in the Human Body - Estimation by Means of Energy Requirements
C. Silva and K. Annamalai, Texas A&M University, College Station, TX

Characterization of Wire Mesh Insulation for Deep Water Sea Pipe and Riser Applications
C. Silva, D. Kim, S. Abdel-Fattah and E. Marotta, Texas A&M University, College Station, TX

Thermal Modeling and Testing of an Avionics Board for a Small Free-Flying Satellite
S. Miller, NASA Johnson Space Center, Houston, TX; and E. Marotta, Texas A&M University, Collge Station, TX

Influence of Injection Slot Width and Stepped Flow on Platform Heat Transfer
L. Wright, Z. Gao and J. Han, Texas A&M University, College Station, TX

Film- Cooling Effectiveness Distribution on a Gas Turbine Blade with Showerhead and Spanwise Row Coolant Injection
S. Mhetras and J. Han, Texas A&M University, College Station, TX

Effect of Inlet Flow Incidence and a Cut- Back Squealer on Film- Cooling Effectiveness for an E3 Gas Turbine Blade Tip Profile
S. Mhetras and J. Han, Texas A&M University, College Station, TX

In- Plane Thermal Conductivity in Thin Carbon Fiber Composites
C. Silva, S. Coughlin, E. Marotta, and M. Schuller, Texas A&M, College Station, TX; and M. O'Neill, ENTECH, Inc., Keller, TX

Internal Energy Based Turbulence Models for Compressible Gaseous Flow
R. Bowersox and R. Srinivasan, Texas A&M University, College Station, TX

Unsteady Heat Transfer and Flow over a Bank of Flat Tubes
M. Ijaz and N. Anand, Texas A&M University, College Station, TX

Optimization of Heatsink Performance in Microelectronics Through Dimpled Surfaces: Geometry and Array
C. Silva, E. Marotta, and L. Fletcher, Texas A&M, College Station, TX

Annual Technical Symposium Approaching: CALL FOR ABSTRACTS

The Annual Technical Symposium is approaching. Abstracts are being called for, **due by MAY 1**. Topics of interest this year are:

Shuttle Retirement
Sustaining ISS Beyond 2010
Space Operations
Robotics Missions
Aerospace Technology
CEV & CLV
Moon, Mars, & Beyond
Commercial Crew/Cargo Transportation

- Abstracts should be 250 words or less.
- Note the tracking number and password supplied when an abstract has been submitted.
- Submitted abstracts may be updated using the tracking number and password.
- Abstracts will be published. No paper is required. Publication of the technical presentation on the AIAA Houston website is optional.
- Export compliance for abstracts and presentations is the responsibility of the authors.
- ATS registration is a separate process from the abstract submittal process.
- Authors will be notified via e-mail of abstract acceptance on May 8, 2006 (Monday).

Registration can be done online at www.aiaa-houston.org/ats2006
Contact Tim Propp for details: vicechair-tech@aiaa-houston.org

AIAA Local Section News

Assistant Newsletter Editor Sought

An assistant newsletter editor is being sought. Interested parties should contact the newsletter editor at editor@aiaa-houston.org.

AIAA Career Center Launched

AIAA is pleased to provide members with a new Career Center – the most comprehensive career and recruiting site for the aerospace industry. The Career Center will offer extensive resume and position databases, powerful and user-friendly searching capabilities, which allow you to find the job or candidate you're looking for!

Employers
· Post your job to the largest exclusive audience of aerospace industry professionals.
· Online management of job postings, including activity reports.
· Access to a searchable resume database.
· Competitive job posting pricing.

Job Seekers
· AIAA Career Center is dedicated exclusively to the Aerospace Industry and it's free.
· Receive automatic notification of new jobs matching your criteria.
· Post your resume – confidentially, if preferred – so employers can actively search for you

AIAA cares about your career development. Lifelong learning is a prerequisite to any successful career - and AIAA is committed to providing resources to help our members grow. Visit http://careercenter.aiaa.org and start using the AIAA Career Center to make YOUR career connections.

Ask-An-Engineer Program Volunteers Sought

Ask-An-Engineer is a program of the Precollege Outreach Committee. We get many questions from students and the general public about engineering questions and the field of aerospace engineering. The questions are usually not difficult, but we need people to answer them. If you are interested in fielding these questions, please contact Lisa Bacon at lisab@aiaa.org.

Call for Section Officer & Councilor Candidates

The Houston Section is seeking qualified candidates for election to fill expiring Section Officer and Councilor positions. Available officer positions for the 2006-2007 term include:

- Chair - Elect
- Vice Chair - Operations
- Vice Chair – Technical
- Treasurer
- Secretary.

In addition seven of ten Councilor positions will need to be filled. Complete position descriptions can be found at www.aiaa-houston.org/pd, and as defined in the Section's Bylaws at http://www.aiaa-houston.org/bylaws. Officers serve a one-year term and elected Councilors serve a two-year term.

The 2006-2007 term runs from 07/01/06 through 06/30/07. All nominees must be members of the Houston Section and in good standing with AIAA. As a volunteer organization, the Section is very much dependent upon the willingness of members to give of their time and energy, and in agreeing to serve in leadership roles. All interested parties should contact Steve King, Section Chair, at 281-283-4283 or chair@aiaa-houston.org by Wednesday, March 29, 2006 at 4:00 pm. After this date, additional nominations may be made by petition through Thursday, April 13, 2006. Contact Dr. Syri Koelfgen, Section Secretary, at 281-244-2407 or secretary@aiaa-houston.org for petitioning details. Thanks for your support!

AIAA Foundation Award to Dr. L. S. Fletcher, Texas A&M

Dr. L. S. Fletcher, Texas A&M, has been selected to receive the 2006 American Institute of Aeronautics and Astronautics (AIAA) Foundation Award for Excellence. This special honor was established in 1998 by the AIAA Foundation Board of Trustees to recognize unique contributions and extraordinary accomplishments by organizations or individuals promoting aerospace.

Past recipients of the AIAA Foundation Award include: Alan Mulally, Gen. John Shalikashvili, John Travolta, General Tommy Franks, Daniel Goldin, Norman Augustine, The Honorable John Glenn, and the National Reconnaissance Office.

Dr. Fletcher will be invited to attend *AIAA's Aerospace Spotlight Awards Gala* on 25 April 2006, at the Renaissance Washington Hotel, Washington D.C. as honored guests of AIAA.

AIAA Thermophysics Award to JSC's Dr. Carl Scott

Dr. Carl Scott, NASA Johnson Space Center, has been selected to receive the American Institute of Aeronautics and Astronautics Thermophysics Award for 2006.

The award is presented for an outstanding singular or sustained technical or scientific contribution by an individual in thermophysics, specifically as related to the study and application of the properties and mechanisms involved in thermal energy transfer and the study of environmental effects on such properties and mechanisms.

The citation for the award reads: "For pioneering in the investigation, understanding, and education of the effects of surface chemistry on the aerothermodynamic heating of re-entering spacecraft at hypersonic velocities." The award consists of an engraved bronze medal, a certificate of citation, and a rosette pin.

Dr. Scott will be invited to receive the award at the 6 June 2006 Awards Luncheon held in conjunction with the AIAA Plasmadynamics and Lasers Conference, 5-8 June 2006, at the Hyatt Regency Embarcadero Center, San Francisco, California.

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

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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.

American Institute of Aeronautics and Astronautics

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www.aiaa.org

Select the AIAA membership option.