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“Beyond fantasy. Beyond obsession. Beyond time itself ... “

After stepping off the ferry onto Mackinac Island, I took a carriage to the hotel which was hosting the AAS/AIAA Astrodynamics Specialist Conference. During the ride, I noticed a poster emblazoned with the eye-catching tagline above. “Wow, this is really innovative publicity for our conference,” I thought. When we got a little closer, I saw that it was actually a poster for Somewhere in Time, a movie from 1980 that was filmed at the island’s Grand Hotel. Though it may have been a misconception, it wasn’t a bad experience to build expectation.

And the expectation was exceeded. Our AAS/AIAA Astrodynamics Specialist Conference was held this year on August 19-23 at Mackinac Island, Michigan. This conference has a distinguished forty year history of uniting specialists from around the world to discuss solutions to thorny problems and to share cutting-edge techniques. The quality of the papers and their authors’ expertise make the oft-used phrase “world class” truly justified here.

About 170 papers were presented in twenty-four sessions. Subjects ranged from space debris to atmospheric density analyses, from planetary mission trajectories to large space structure dynamics, and from Cassini operations at Saturn to STEREO operations observing the Sun-Earth system. The authors were sent by government agencies, leading universities, and high-tech companies from sixteen countries. In fact, every continent but Antarctica was represented.

Dr. Roger Launius of the National Air and Space Museum delivered a plenary address entitled “Space: Journeying Toward the Future.” This talk highlighted the contributions of our community in light of Sputnik’s fiftieth anniversary this year.

Noteworthy awards were presented at the conference as well. Dr. Shannon Coffey received the prestigious and well-deserved AIAA Mechanics and Control of Flight Award. And it was my honor to present Purdue University’s Dr. Kathleen Howell with the AAS President’s Award in recognition of her dedication and contribution as Editor-in-Chief of The Journal of the Astronautical Sciences for fifteen years.

The Astrodynamics Specialist Conference is organized and carried out by AAS volunteers. These people are bringing to life our AAS Strategic Plan which says, “we are dedicated to harnessing the energy and capability of our members to make a difference.” Heartiest congratulations and many thanks to AAS General Chair Rich Burns, AIAA General Chair Dr. Dan Scheeres, AAS Technical Chair Dr. Ron Proulx, and AIAA Technical Chair Dr. Tom Starchville for an exciting and worthwhile conference. And heartiest congratulations and many thanks to all of the other volunteers who made this important conference a reality for the cause of advancing astronautics.

Mark Craig
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Putting NASA’s Budget in Perspective
by Jeff Brooks

“I think we should solve our problems here on Earth before we go into space.”

This line, or some approximation of it, has been heard countless times by nearly every advocate of space exploration. For many critics, it seems to sum up the totality of their thinking on the subject. Not a few politicians invoke this sentiment on those rare occasions when space exploration comes up in political discourse.

In October of 2006, on the 49th anniversary of the Sputnik launch, CBS News anchor Katie Couric summarized this attitude when she concluded her nightly broadcast by saying, “NASA’s requested budget for 2007 is nearly $17 billion. There are some who argue that money would be better spent on solid ground for medical research, social programs or in finding solutions to poverty, hunger and homelessness. I can’t help but wonder what all that money could do for people right here on planet Earth.”

When space advocates hear this argument, it is difficult not to become irritated - or even a little angry. When something that one cares a great deal about is treated with such disparagement, getting upset is a natural reaction. However, responding with irritation and anger does not help. If anything, it merely strengthens others in the belief that space exploration should not be a national priority.

It is important for space advocates to understand that this opinion is not held by people because they are hostile to space exploration itself, but because they lack sufficient information. Thanks to the mainstream media, which often emphasizes space-related stories only when something goes horribly wrong, a general impression has been created that space exploration does nothing more than produce a rather small amount of scientific information. Further, it is assumed that this science has little practical use and carries an enormous cost to the taxpayer. Once people have reached a comfortable belief about an issue, getting them to change their opinions is no easy task.

Regarding the assumption that NASA diverts resources from efforts to solve terrestrial problems, it is obvious to those who are knowledgeable about the potential of a robust space program that solutions to many of Earth’s problems are to be found in space. However, for the purposes of this essay, we shall limit ourselves to examining NASA funding. How does that funding compare to that of programs which are often cited as more deserving than the space agency?

According to budget documents obtained from the Government Printing Office, the national budget for 2007 totals about $2.784 trillion. At $16.143 billion, spending on NASA accounts for 0.58% of this number. During the mid-1960s, despite pressures of the Vietnam war effort and President Johnson’s Great Society programs, NASA spending consumed more than five percent of the federal budget.

How does NASA’s budget compare with the amount spent by the federal government on social programs? In the 2007 budget, the funding for social programs (calculated here as the budgets for the Department of Health and Human Services, Housing and Urban Development, Veterans Affairs, Social Security, Agriculture, and Labor) adds up to a whopping $1.581 trillion. For every $1 the federal government spends on NASA, it spends $98 on these social programs. If spending on social programs were reduced by one percent, NASA’s budget could be nearly doubled.

Do people who speak as if the country’s social problems would be solved if only we devoted NASA’s money to social programs seriously believe that an increase from $1.581 trillion to $1.597 trillion would make an appreciable
Jeff Brooks is a non-profit professional and political activist who lives in Austin, Texas. In addition to being a passionate advocate for space exploration, he has worked on a variety of consumer, environment, and government reform issues. He also writes the blog Movement for a New Renaissance. This article first appeared in the July 2 issue of The Space Review (online).
Experiencing Microgravity

by Lynn F. H. Cline

It started innocently enough; it was just another of the many e-mails that I receive every day. The subject line contained the baffling title “RGSFOP invite.” It turned out to be an invitation for me to participate in NASA’s Reduced Gravity Student Flight Opportunities Program (RGSFOP). This was a chance for me to experience some thirty parabolic maneuvers aboard an aircraft, as students conducted research experiments.

I will admit to being both excited by the opportunity and afraid. Having experienced motion sickness in the past, I worried that I would be one of those people who helped the aircraft earn its nickname as “the vomit comet.” After accepting my boss’ encouragement to go for it, I accepted the invitation.

As part of the flight preparation process, NASA required a Federal Aviation Administration Class III medical exam. Fortunately, we have an Aviation Medical Examiner on site here at NASA. I had just completed my annual physical, so up-to-date information was readily available.

After filling a few forms, I was approved to go to the next steps, which include physiological training and a chamber test. This involved taking a class in which a series of very enthusiastic instructors explained the effects of traveling to high altitude upon the human body. After scaring us with all the adverse impacts of exposure to this environment, such as hypoxia and hyperventilation, we then suited up to go into a hyperbaric chamber. The goal? To induce hypoxia! The idea was to demonstrate the effects of reduced barometric pressure changes, and allow students to practice principles and techniques learned in the classroom. In other words, a mild form of hypoxia was induced so we could recognize our individual responses to it.

We were each fitted with a cap and mask with a long hose to attach to the oxygen system. Someone commented that we looked like elephants. We entered the chamber, plugged into the oxygen system, and received instructions on operating the equipment. The chamber included a balloon and an inflated rubber glove hanging from the ceiling, which provided a way to easily note changes in pressure. We spent 30 minutes on oxygen for denitrogenation to minimize the risk of decompression sickness. Then we simulated a flight profile ascending at 5,000 feet per minute, leveling off at a barometric pressure level equivalent to 25,000 feet in altitude.

Once there, those sitting on my side of the chamber were asked to remove our masks and given sheets of paper with some simple exercises on them. These included some mathematical problems, and some questions designed to provoke thought, such as “list eight states that begin with ‘M’.”

More important than completing these exercises was to note our hypoxia symptoms at one minute intervals for five minutes. I recorded that I felt flushed, and had fuzzier vision than usual. Most of all, I had trouble concentrating. I kept staring at the paper, knowing that I was supposed to do something with it, but I was having trouble figuring out exactly what! Other students felt numbness in their fingers or tingling sensations. One person looked like he was hyperventilating.

The point made was that people experience a variety of symptoms. Each student learned to recognize theirs, in order to be able to know how to handle those symptoms in the event of a pressure loss while onboard the aircraft during the reduced gravity flight.

I also had the opportunity to observe the readiness review with the student groups, which was held in the aircraft hangar on the day before our flight. I was
privileged to join students from Cornell University, Portland State University, the University of California at San Diego, the University of Michigan, and Wichita State University. The students were bright, enthusiastic and articulate.

Experiments included test of a robotic system implementing control moment gyroscopes for lower power, a study about passive separation of two-phase flows in fluids, and a transmural pressure simulator aimed at reducing astronaut re-adaptation to gravity post-flight. The reviewers asked questions about the experiment operations, and some last minute adjustments were requested to meet safety requirements.

The students had established two teams, with one team to fly on May 3 and the other to fly on May 4. They had the green light to load their experiments on the aircraft.

The next morning we arrived for our flight. Those of us who hadn’t gotten flight suits already were issued one. Our pre-flight preparations included medication to reduce the likelihood of motion sickness. We were cleared for flight and invited to board the aircraft.

The aircraft has several rows of seats in the aft area, which were used during takeoff and landing. The remainder of the aircraft was open, with runners down the floor used to secure the experiments. The walls were padded and had cloth straps mounted high on the side walls to use as handholds.

Our flight profile called for thirty-two parabolas. Each parabolic pattern provided about thirty seconds of hypergravity (about 1.7G’s) as the plane climbed to the top of its arc. Once the plane started to “nose over” the top of the parabola and descend toward Earth, the plane experienced about twenty-five seconds of microgravity. We flew thirty parabolas which reached zero-g. We also flew one parabola that achieved the equivalent of lunar gravity, and one at the level of gravity on Mars.

The instructors had suggested we sit or lay down during ascent. I was surprised at how heavy I felt. I could raise my arm, but it took effort. Equally surprising was the quick transition to just the opposite – floating.

The student experiments were large, and I was very mindful of the students focused on getting data. I didn’t want to float aimlessly and risk bumping into them. The students strapped themselves to the floor or used handles built into the equipment to remain in place in order to record measurements, observe experiments or adjust equipment.

The sensation of floating was wonderful, but it was so brief! I found it hard to maneuver, and repeatedly ended up near the ceiling of the aircraft. I didn’t stray too far from the handholds so that I could prepare to land in an area clear of students when we approached the next pull. After a few tentative lifts, I maneuvered to another location and got a bit bolder. As we neared the end of each weightless parabola, a crewmember cried out “feet down,” warning us to position ourselves for the next pull.

At one point, I was walking forward to view the flight from the cockpit. Before I got all the way forward, we reached the heaviest part of the parabolic climb in hypergravity. I found I couldn’t go any further. I collapsed to my knees and stayed there until we hit microgravity. At that point, I was able to float forward and into the cockpit. It was amazing to watch the altimeter spin ridiculously fast as the plane went steeply up and then down again. There may be some things it’s better not to know!

I did get a little queasy about half-way through. When offered the chance to spin summersaults, I declined. I did manage to float upside down without incident. The veterans of these flights clearly had adapted to this environment. They were able to easily maneuver, take video and photos, and assist the students. I envied them their facility with this environment.

When we simulated lunar gravity, most of us did the Apollo-style bunny hop. Even a little bit of gravity meant we were back to standing on the floor instead of instantly floating up in the air. It proved easy to walk in the Martian gravity, which provided neither a heavy pull nor a floating sensation. After this experience, everyone reluctantly returned to their seats for the flight back to base.

The flight gave me a new appreciation for the environment in which our astronauts work. It also gave me hope for our future. With students of this caliber having an interest in space, I see that we do have a next generation to carry on human exploration of space. Would I go again? Yes, without hesitation!

**Lynn Cline** is Deputy Associate Administrator for Space Operations at NASA and a member of the AAS Board of Directors.
One of the most important space endeavors - tracking satellites and determining their orbits - is also among the least understood and appreciated. If we take knowledge of current and future satellite location for granted, our continued ability to determine that information is jeopardized. The objective of this article is to refresh understanding and explain problems that must be overcome.

Do you know where your satellite is tonight? Perhaps you do. A few national space tracking networks might also know, but the rest of us do not. Why don’t we? Satellites travel in circular or elliptical orbits, don’t they? Their behavior is predictable and repeatable, isn’t it? Satellites in geostationary orbits even stay in one place relative to the Earth. So why do we need sophisticated radars and telescopes to keep track of them?

Most tasks assigned to satellites demand extremely accurate orbits. Distances, angles, and times must be known precisely so that we can at least quantify inevitable uncertainties. How can we determine orbits that well? How do we know where the satellites may have migrated when they were out of sight?

Newton, Flamstead, Kepler, Leibnitz, Huygens, and Galileo made diligent observations and contributed immensely toward understanding of the motion of orbiting objects. As instruments and observations advanced, differences were noted in orbits from those predicted by two-body or linearized three-body motion. The degree to which these great men were incorrect is the essence of an astrodynmicist’s profession.

Satellites do not describe precisely elliptical or circular orbits. They are, in fact, unpredictable, and to a significant degree not repeatable. Astrodynmicists may know this, but many of those who depend on satellites do not.

Satellite orbits are not perfect ellipses or circles because the Earth’s gravitational field is not uniform. Satellites in different places experience varying gravitation even if they are at the same altitude. The Earth’s mass is not uniformly distributed, nor is the Earth perfectly spherical. The oceans and the Earth’s molten core are continuously in motion. This dynamic soup is influenced by the Moon and other bodies. There are even tides in the Earth’s crust.

As Earth is viewed from increasing distance, it gradually appears that its mass is concentrated at a point. Non-uniform mass distribution, however, is an essential factor for low Earth orbits. The predominant effects are static, but there are noticeable dynamic components with periods of hours or days. The Gravity Recovery and Climate Extraction (GRACE) mission documents these non-uniformities by monitoring the separation between two satellites which are several hundred kilometers apart and located in common, very stable polar orbits.

The relatively static portions of gravitational perturbations cause orbits to precess about the Earth’s axis. These forces make the semi-major axis of the orbit ellipse rotate about the Earth’s center within the satellite’s orbital plane. This lowest order (J2) effect makes Sun synchronous satellite orbits possible. Exploitation of this gravitational non-uniformity allows a satellite to always view the earth with the same lighting conditions. To this order of approximation, there is a unique relationship between altitude and inclination for which the orbit precesses around Earth’s axis at the same rate that
the Earth revolves around the Sun. Sun-synchronous orbits do not exist in Newton’s simple two-body problem with concentrated masses.

If non-uniform gravity were neglected, satellite positions propagated merely hours into the future would differ from their actual locations by hundreds of kilometers. This is enough of a disparity that we would not be able to observe the satellites if sensors were directed to their predicted locations.

Atmospheric density variations are important up to altitudes of many hundreds of kilometers. Though atmosphere is sparse at that altitude and drag is small, it is still noticeable relative to the diminishing gravitational forces at high altitude. Atmospheric drag is the principal reason that orbits decay and satellites descend, yet it is very difficult to predict drag forces due to the volatility of our space environment.

Drag is uncertain for a number of reasons. The orientation of satellites in orbit varies, often in unintended ways. The area that the satellite presents to the relative wind is uncertain. Uncertainties in the atmosphere’s composition are a significant source of disparity. Atmospheric density can vary appreciably in the course of a single satellite orbit. We fly satellites with well-known spherical drag coefficients in order to infer atmospheric variations, once we have confidence in the knowledge of non-uniform gravitation. Therefore, physical models of the atmosphere depend to some extent on the model of the Earth’s gravitation. This model was developed when atmospheric density variations were inferred from orbit observations.

Nearby massive bodies influence the orbits of satellites. If the Moon’s gravitation is strong enough to cause tides on Earth, it must also affect satellite orbits. We need to know something about the distribution of mass within the Moon in order to predict the perturbation. This causes more uncertainty.

Finally, radiation pressure can be appreciable relative to gravitation when spacecraft are far from the Earth. In addition to incident solar radiation, inputs include radiation reflected or emitted from the Earth. Momentum transfer from photons to spacecraft surfaces is significant for geostationary and geosynchronous orbits. Photon-induced drag varies as the satellite moves and the Earth rotates. There is at least diurnal variation.

Geostationary satellites are not actually geostationary. If the satellite orbit has any inclination or eccentricity, the orbit will rotate and precess. Radiation pressure, multi-body gravitation, and other effects will also change the orbit. Left unattended, a satellite in even the most circular and equatorially oriented orbit will drift in its orbit around the Earth.

**Orbit Determination and Satellite Tracking**

Determining orbits requires observations, physical hypotheses, and computational techniques. To say it more accurately, orbits are actually “estimated,” not precisely determined. We test our physical hypotheses against observations and determine the degree to which our hypotheses match reality. Measures of a solution’s quality, called “covariances,” are essential; they reveal the degree of uncertainty in the satellite states we predict. Almost no widely available sources of orbit data reveal covariances. As a result, those who rely on widely distributed orbit data seldom know how long mean orbits remain sufficiently valid. Therefore, it is very important that these users are provided with new mean orbit elements frequently.

For centuries, scientists have determined orbits using observations from the Earth. Radars gather precise range measurements on satellites. They are less precise in azimuth and elevation, which depend on mechanical measurements rather than electronic measurements. Even the registration of elements of a phased array radar relies on “imprecise” physical measurements. Telescopes can determine azimuth and elevation precisely (often taking advantage of magnification to perceive very small angles), but they do not measure range at all. The Global Positioning System (GPS) makes it possible to determine orbits from onboard measurements, which are subject to changing and often unfavorable geometry and the errors introduced by a rapidly moving platform. GPS is not precise to millimeter resolution when it is riding on a satellite that moves at a rate of kilometers per second.

Each of these sources is imprecise to a degree that affects many modern satellite applications. Sophisticated data fusion schemes can combine all of these sources in a profound, mathematically consistent manner to achieve results more precise than any of the independent contributions. While this technology is a great advancement, the process still demands continuous measurement and estimation.
Changes in solutions are not proportional to changes in independent variables or changes in the specification of the problem (such as the Earth’s gravitational field). The numerical solution of the governing equations is plagued by small differences in large quantities. While the difference between observation locations may be just a few kilometers, the satellite may be thousands of kilometers away.

The process of orbit determination is a journey of linear approximations, simplifying mathematics and moderating nonlinearity by focusing on small changes. Linearization restricts the time interval over which orbits can be predicted. The most widely used techniques (“General Perturbations”) still linearize around a trusted nonlinear solution or precise initial orbit and develop “differential corrections” to that solution.

There are also a variety of “semi-analytical” techniques that substitute approximate closed-form formulas for some of the numerical integration. Numerics are simplified by developing analytical expressions - approximate equations which don’t require complex numerical schemes. Such approximations were necessary to estimate orbits sufficiently in operationally meaningful time spans when computational capability was insufficient.

Full, nonlinear numerical solutions (“Special Perturbations”) have been in existence for many years, but such techniques have only recently been applied to the entire space population as permitted by advances in computational capability.

*Insufficient Observation*

The world doesn’t contain enough sensors to keep track of satellites with sufficient coverage and frequency. This problem overshadows imprecise measurements, approximate physics, and numerical and mathematical difficulties.

The European Space Agency (ESA) has published a survey of the world’s space surveillance capability. 5 Radars dominate low-Earth orbit observations, and telescopes are most productive for high and geostationary orbits. Most radars only “contribute” observations, and are not dedicated to observing satellites. The United States BM EWS and PAVE PAWS radars are a good example. Several scientific radio telescopes, such as the MIT Lincoln Laboratory Haystack facility, also contribute satellite observations when time allows.

Optimal distributions of sensors are not available — most are concentrated in the Northern Hemisphere. Two sensors on the equator 90 degrees apart in longitude with hemispherical coverage and unlimited range should “see” all but geostationary satellites at least once every six hours. In reality, that degree of coverage cannot be achieved. There are few feasible locations that meet the 90 degree equatorial criterion, and six hours may be much too long to observe and estimate the intense influence of non-gravitational forces on low-Earth orbiting satellites.

Amid these difficulties, those who own and operate satellites have the best possible observations of their own satellites. Long period, pseudo-random codes imposed on satellite downlinks can be used to range very precisely, just as GPS receivers determine “pseudo-range” to GPS satellites. However, satellite owner/operators can communicate with their satellites only from sparse ground stations. Without external data, they cannot observe or estimate where their satellites are between contact opportunities. If they relied on totally predictive (“open loop”) tracking based upon past observations, they could literally “lose” their satellite. These entities compensate for the growing uncertainty by using large search and capture volumes, and by interrogating the sky with much more energy than would otherwise be necessary. Satellite contacts are also much shorter.

Many independent analyses have explored optimal sensor distributions for specific criteria, such as the minimum value of the longest gap between observations of selected satellites sets. None is very practical or affordable.6

We must always live with uncertain satellite locations. The question becomes: “How much uncertainty is acceptable, and for which satellites?”

*The Significance of Orbit Determination*

Who cares if we know exactly where any particular satellite is? Why is this information so important?

There are several classes of satellite users: those who launch satellites, satellite operators, satellite service providers, satellite service users, and government agencies bound to protect and preserve space capabilities.

It’s a big sky, but satellites are concentrated in just a small fraction of it. There are few launch sites, and debris from past launches can persist at those latitudes. Therefore, it is prudent for satellite launch service providers to check for obstructions before launch activity begins.

Satellite operators need to know where their satellites are in order to provide promised services. They must also avoid physical or radio frequency interference (RFI) impingement upon other satellites. The same comments about crowded portions of the sky apply, including the geostationary region and polar orbits.

Satellite service providers such as DirectTV or Sirius Satellite Radio need to keep their satellites on track in order to fulfill service commitments. Those who need to contact non-geostationary satellites must have their antennas track the satellites across the sky.

Users have to know where satellites are, and the user community extends far beyond casual recreation. National
Oceanic and Atmospheric Administration (NOAA) remote locations must be able to contact search and rescue satellites. Environmental monitoring tasks, such as tracking electronically tagged wildlife, require knowledge regarding which satellites can retrieve uplinked data.

Imaging and surveillance require precise and virtually continuous orbit information to determine access. They must also be able to register images in a prescribed reference frame - one that isn’t moving as the satellites are.

The government also has a duty to monitor space for untoward acts toward spaceborne assets, and to preserve access and the orbital environment.

Almost everyone should care where satellites are. Almost everyone depends on satellite services and information.

Concerns and Remedies

Advancing commerce greatly burdens orbit determination. More satellites and more debris require more precise and timely assessment of satellite motion. This problem is so complex that the most modern computer architectures and precise observations are insufficient for some of the most important applications. There are many avenues to improve the situation without compromising national security or proprietary interests. We need to clear obstructions from these paths. Below, a few of these obstructions are named along with suggestions for their mitigation.

1. Orbit data are incomplete. Important tasks require quantified uncertainty, therefore covariances should be revealed. The International Standards Organization is addressing this concern with a standard and consensus-driven scheme for orbit data transfer. This could take several years, but the community is free to adopt this emerging standard as consensus grows.

2. Sensors are sparsely distributed. This problem should be attacked first through worldwide data sharing. The sensors currently in place do not incorporate collaboration among themselves, yet collaboration should be a high priority. Every trustworthy source should contribute its observations toward building a more robust orbit determination process. Sensors should be dedicated to satellite tracking rather than a best effort among other demands. A well-selected set of additional sensors should be funded and built. ESA is considering some.

3. Orbit data are not widely available and are often not in formats most efficient for the broad user community. Even the NASA Orbit Information Group (OIG) could not meet all community needs, leading to several no-cost, value-added secondary providers. The Air Force-sponsored Space-Track service, established under PL 108-36, made fundamental orbit data more widely available. However, it cannot meet the community’s needs at the existing level of effort.

4. Quantitative observations of satellites in orbit are not well enough characterized or sufficiently shared within the community that needs orbit information. The worldwide laser ranging network consists of more than thirty sites among countries whose national interests are not always congruent. It is a paragon of international collaboration for mutual benefit. However, it examines a small set of satellites expressly outfitted with reflectors and traveling in benign orbits. This network establishes a benchmark for calibrating other sensors. Within the constraints of each nation’s interests and security, greater collaboration and data exchange would enhance the quality and availability of satellite orbit knowledge.

Conclusion

The significance of timely and precise orbit information is masked from the broad user community which depends on satellites. The small community dedicated to determining and disseminating orbit data is underappreciated and often ignored. Fiscal pressures diminish the already insufficient capability. Upgrades to the former Naval Space Surveillance Fence have been delayed for many years. The PARCS radar in North Dakota and FPS-85 in Florida are annually in fiscal jeopardy; system-wide surveillance performance characterizations would highlight their importance. Essential orbit data dissemination capabilities, such as the NASA Orbit Information Group, have disappeared.

It is hoped that this article will illuminate the difficulty of the task at hand, and describe the significance of satellite orbit knowledge well enough to arrest this unfortunate trend.

Footnotes


3 In the simple two-body representation, six quantities, called orbit elements, are sufficient to describe an orbit forever (eccentricity, semi-major axis, inclination, argument of perigee, right ascension of the ascending node, and true anomaly). These are called “classical” or “Keplerian” element sets. When other forces are considered, these represent a “mean” or “osculating” orbit upon which perturbation effects are imposed.

4 It is difficult to measure atmospheric density explicitly; however, density is related to pressure, temperature, the composition of the atmosphere, and other quantities that can be measured directly. These other quantities are called “proxies.”


6 “European Space Surveillance System Study – Final Report, Donath, et. al., ESOC Contract 16407/02/D/HK(SC), Document DPRS/N/158/04/CC, 10 Dec 2004.”
CALL FOR PAPERS

ABSTRACT DEADLINE: November 1, 2007

31st AAS Guidance and Control Conference

Friday–Wednesday, February 1-6, 2008
Beaver Run Resort and Conference Center, Breckenridge, Colorado

We are currently seeking abstracts for potential papers for the conference. The deadline for abstract submission is November 1, 2007, however, the selection process is on-going and we have limited presentations, so the earlier you can submit your abstract the greater chance for acceptance. The conference will have the following sessions. Their themes are listed as well as the session chairpersons to contact for abstract submission. Sessions 1 through 8 are the traditional international sessions, and Session 9 will be ITAR-restricted (allowed attendance US Only).

Session 1 – “Advances in Guidance and Control”
Some projects require innovative G&C solutions that are outside the realm of conventional thinking. The papers in this session will focus on the latest in theoretical developments, cutting-edge hardware, unique mission possibilities, system architecture, autonomous operations, and system modeling and testing.

Contact: Jim Chapel, Lockheed Martin SSC, 303-977-9462 – jim.d.chapel@lmco.com
          Eric Lander, Advanced Solutions, 303-979-2417 – elander@go-asi.com

Session 2 – “Technical Exhibits”
The Technical Exhibits Session is a unique opportunity to observe displays and demonstrations of state-of-the-art hardware, design, and analysis tools and services applicable to the advancement of guidance, navigation, and control technology. The latest commercial tools for GN&C simulations, analysis, and graphical displays are demonstrated in a hands-on, interactive environment, including lessons learned and undocumented features. Associated papers not presented in other sessions are also provided and can be discussed with the author. Come enjoy an excellent complimentary buffet and interact with the technical representatives and authors. This session takes place in a social setting and family members are welcome!

Contact: Scott Francis, Lockheed Martin SSC, 303-977-8253 – scott.francis@lmco.com
          Rick Jackson, Lockheed Martin Ret., 303-985-1972 – ricski_jackson@yahoo.com

Session 3 – “Space Environment”
Space environments influence the design of missions on many levels. Space debris and radiation effects constrain the required shielding for spacecraft and GN&C components. Vehicle control performance is limited by the effect of disturbances, including aerodynamic, gravity gradient, solar radiation pressure, and magnetic torques. Orbital perturbations impact mission planning to view various ground and celestial targets. This session will feature papers which discuss the effect of the space environment on the design of GN&C components, spacecraft control systems, and mission designs.

Contact: Ian Gravseth, Ball Aerospace, 303-939-5421 – igravseth@ball.com
          Michael Osborne, Lockheed Martin SSC, 303-977-5867 – michael.l.osborne@lmco.com

Session 4 – “GN&C Fault Management”
The design of GN&C systems to be either single or multiple fault tolerant has many impacts on spacecraft complexity, V&V, and ultimately cost. As today’s space missions become more complex, even incorporating various aspects of entry, rendezvous, docking, and sample return, the tolerance for mission failure continues to decrease. Coupled with the increasing upset and latching susceptibility of commercial electronic parts, the need for innovative approaches to GN&C system fault tolerance is becoming paramount. This session explores the state-of-the-art system approaches to GN&C fault tolerance, and unique and innovative aspects of such design, including the use of functional redundancy and unconventional techniques.

Contact: Mary Klaus, Lockheed Martin SSC, 303-971-2724 – mary.a.klaus@lmco.com
          Steve Jolly, Lockheed Martin SSC, 303-971-6758 – steven.d.jolly@lmco.com
Session 5 – “Deep Space Navigation”
How do we get to destinations in deep space? This session seeks papers on the means. The Deep Space Network, radio and optical data types, and maneuver analysis and planning are the grist, down to arcana-like B-planes and K-matrices. Papers cover history, current configurations, hardware and software, and future plans. Errors are especially important: tracking data; solar system modeling; disturbances; and maneuver execution; all culminating in the Pioneer problem.

Contact: David Sonnabend, Analytical Engineering, 303-530-9641 – dsonnabend@worldnet.att.net
Shawn McQuerry, Lockheed Martin SSC, 303-971-5264 – shawn.c.mcquerry@lmco.com

Session 6 – GN&C Panel Session “2058: The Future of GN&C in 50 Years”
In 1957, the dawn of the Space Age began with the launch of Sputnik. Today, a mere 51 years later, we are still learning and growing as an industry with new technologies and methodologies to accomplish the Guidance and Navigation needs of our missions. Step forward to 2058, and there will be even more possibilities for GN&C. The question to our panelists: What will GN&C look like 50 years from now? This lively new session will draw on industry experts from around the world to discuss their individual perspectives on the future.

Contact: Christine Mollenkopf, Ball Aerospace, 303-939-5444 – cmollenk@ball.com
Jay Speed, Ball Aerospace, 303-939-5322 – jspeed@ball.com

Session 7 – “Human Exploration GN&C Challenges”
This session focuses on the recent work to provide humans improved access to earth orbit and beyond. Papers will include recent work for the Orion spacecraft and Ares launch vehicle projects, Commercial Orbital Transportation System (COTS), Automated Transfer Vehicle (ATV), H2 Transfer Vehicle (HTV), Progress, and other related programs that are supporting human exploration. In addition to programs, key technologies are addressed such as ascent, rendezvous, proximity operations, docking, transit, and return beyond earth orbit, entry, autonomy, and aspects of human rating.

Contact: Dave Chart, Lockheed Martin SSC, 303-977-6875 – david.a.chart@lmco.com
Rob Chambers, Lockheed Martin SSC, 303-977-9912 – robert.p.chambers@lmco.com

Session 8 – “Recent Experiences”
Lessons learned through experience prove most valuable when shared with others in the GN&C community. This session, which is a traditional part of the conference, provides a forum for candid sharing of insights gained through successes and failures. Past conferences have shown this session to be most interesting and informative.

Contact: Heidi Hallowell, Ball Aerospace, 303-939-6131 – hhallowe@ball.com
Zach Wilson, Lockheed Martin SSC, 303-971-4799 – zachary.s.wilson@lmco.com

Session 9 – “Space Situational Awareness (US Only)”
Recent events have underscored the current and near-term vulnerability of critical space assets to numerous types of attacks. Fundamental to preventing or responding to such attacks is simply the awareness that the event is in progress, and distinguishing it from natural events. This session surveys the GN&C concepts underlying Space Situational Awareness and explores key driving issues and developments.

Contact: Bill Frazier, Ball Aerospace, 303-939-4986 – wfrasier@ball.com
Alex May, Lockheed Martin SSC, 303-977-6620 – alexander.j.may@lmco.com

We look forward to seeing you at the conference!

Michael Drews, 2007 Conference Chair
Lockheed Martin Space Systems Company
Phone: 303-971-3622
michael.e.drews@lmco.com

Ron Rausch, Board Chairperson
AAS Rocky Mountain Section
Phone: 303-977-1895
ronald.d.rausch@lmco.com
AAS International Space University Scholarship Report

by Kirk Kittell

I spent summer 2006 at the International Space (ISU) University Summer Session Program (SSP) in Strasbourg, France, thanks to a scholarship from AAS. I’ve been long, long overdue to tell my story about it. Though the folks at AAS shouldn’t appreciate this delay—sorry, Jim!—it has given me time to reflect on the ten weeks that I spent there and what it has meant.

First thing you should know: I’m a cynic. In a previous life, I’ve been to fuzzy space conferences and drank the Kool Ade. I packed a fair amount of skepticism in my bag to France, just in case ISU really was Space Camp or Starfleet Academy as my friends suggested.

The first surprise was that I was one of the younger SSP participants, having just finished my MS at the University of Illinois in May 2006. This was the lower end of the age spectrum, the bottom 10 percent. From there, my colleagues ranged from PhD students in a variety of subjects (geomatics, engineering, pathology, and more) to where the majority came from: the real world. There was a mission manager from COMDEV in Canada; engineers from NASA, Boeing, and FAA in the US; a physics teacher from Norway; a business strategist from Spain; a captain from the French Air Force; lawyers and scientists and engineers from ESA; staff from the China Aerospace Science and Technology Corporation (who are hosting the 2007 SSP); and on and on.

The point: I spent the summer working with people who had decades of experience in the industry. It was a different environment and a welcome surprise.

SSP is divided into four major groups of activities: lectures, workshops, department activities, and team projects. Lectures and departments were organized into disciplines ranging from engineering to law and policy. There were three team projects: international collaboration in remote sensing (my team), use of nanotechnology in space missions, and a closed-loop lunar habitat. Workshops were held on numerous topics whenever experts came to the campus. With only one exception, each week consisted of six days of activity and one day of rest; rest is not a hallmark of the ‘Insufficient Sleep University’ program.

The lectures were informative—I knew nothing about astrobiology, export control laws, or satellite communication frequency bands prior to ISU. This was the common academic aspect of the program. Understandably, depth in each subject was sacrificed for breadth; subjects that I had studied in detail for one or two semesters were shoehorned into one or two hours. It was a design decision.

The workshops were quite interesting. Two stand out clearly in my memory. The first was a small satellite workshop run by the University of Stuttgart to give us a taste of the systems engineering approach to building satellites. This was one of the activities of SSP that nudged me toward my current career as a systems engineer. An added twist was that this was the first intimation that working in a close, intense group with people who mostly spoke English as a second language was going...
to be a challenging experience — for them and me.

The second workshop I remember as one of my most memorable experiences, called simply “International Negotiations.” It was performed as a game. There were four teams of five, Red, Yellow, Green, Blue, each representing a different nation, each with a different budget for space assets, each with different requirements. One team was required to fund two Earth observation missions, a manned mission to the Moon, and other science missions; other teams would have a different arrangement of missions that were required; one team was not allowed to disclose its requirements. The common theme is that each team had requirements beyond what they could fund alone. This required some missions to be joint missions.

The game consisted of three turns, each lasting an hour. At the beginning of each turn teams received an index card with instructions, which sometimes modified their budget for that turn or imposed limits on who they could partner with to fund a mission. After three turns, the winning team would be the one that fulfilled their requirements. Sounds simple, no? It was three hours of conniving, sending parts of your team to negotiate with other teams, persuading others that you were trying to help though you knew the real goal was to win.

The result: no team won. The exercise altered my perception in how you approach a problem that requires negotiation. They didn’t teach us that in my engineering courses.

The team project was the most intense and educational experience of the summer. Imagine the inputs: 35 people, varying levels of English comprehension, varying backgrounds and levels of experience, plus a summer of already intense work. The output of this was to produce a 100-page report and 45-minute presentation on our topic. The trick was to do this in four weeks with regularly scheduled reviews. Our report – SOL: Earth Observation Systems for Small Countries and Regions – turned out well, and has been presented by our team members after ISU at several conferences. It focused on Alsace, Catalonia, and Mauritius as model regions where existing space assets could be utilized to benefit local economies and disaster management agencies.

I was one of the three editors on the team report. This meant learning to work on a 24-hour report editing cycle with my two colleagues as the deadline approached. I took the most lessons home from this activity, things that I remember now at work. It was quite an experience to produce a technical report with so many inputs in such a short timeframe, and I’m glad I did it.

In the time since SSP 2006, it has been interesting to see how the ISU network works, since our SSP 2006 contacts have been aggregated into all of the ISU contacts. I am now a systems engineer at Orbital on the Launch Abort System for the Orion Crew Exploration Vehicle, which is a direct result of contact with ISU alumni. When people are traveling to a major space industry hub such as Houston or Los Angeles, the network buzzes with plans to meet. (On the day of submitting this report, there is an ISU DC dinner in Reston.) We hear when our friends switch from industry to government or vice versa, and when they’ve ascended to higher positions.

I don’t know how much of this you will trust from me – ISU does sound like Starfleet Academy in name, I’m afraid – but if you ever meet me at the AAS Goddard Memorial Symposium or National Conference, please ask me about my experience there. I’ll reiterate that it was a great experience and that you should consider sending your own developing employees as NASA, FAA, Boeing, and others do. I’m glad that AAS has taken a leading role in ISU and thankful that they chose me for last year’s scholarship.

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*Kirk Kittel* is a systems engineer for Orbital Sciences Corporation and recipient of the 2006 AAS Lady Mamie Ngan Memorial Scholarship to ISU.
2007 AAS NATIONAL CONFERENCE AND
54th ANNUAL MEETING - DRAFT PROGRAM

November 12-14, 2007
South Shore Harbour Resort, Houston, Texas

“Celebrating Fifty Years – But, What’s Next?”
(Check www.astronautical.org for updates)

MONDAY, NOVEMBER 12
5:30 – 8:00 p.m. Networking Reception for all Registrants and NextGen Invitees

TUESDAY, NOVEMBER 13
7:00 a.m. Corporate Sponsor Breakfast with JSC Center Director Michael Coats
7:30 a.m. General Registration / Networking / Continental Breakfast
9:00 a.m. Welcome and Introduction
Mark Craig, VP/Manager, Space and Ocean Systems Solutions, SAIC
AAS President
9:10 a.m. Opening Remarks and Introduction of Keynote Speaker
Michael Coats, Director, NASA Johnson Space Center
9:15 a.m. Carl Sagan Memorial Lecture and Award Presentation
Maria T. Zuber, E.A., Griswold Professor of Geophysics and Head of the Department of Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technology (confirmed)
10:00 a.m. BREAK
10:15 a.m. Session 1: Celebrating NASA’s Heritage – Fifty Years of Discovery and Achievement
Because this 54th AAS meeting falls in the 50th anniversary year of the founding of NASA, the opening panel will look back over those five decades. They will discuss the “wake-up call” of the Sputnik launch and how the U.S. space program and our competitiveness in the space race emerged, and then focus on the missions accomplished and lessons learned since 1958. Panelists will discuss “Fifty Years of Discovery and Achievement” in the areas of human spaceflight, astronomy, and planetary science. The panelists will also discuss the significant impact these achievements will have on the next generation of scientists and engineers.
Moderator: Joe Alexander, National Academy of Sciences (confirmed)
Panelists: TBD
12:00 p.m. Luncheon
Guest Speaker: TBD
1:30 p.m. Session 2: The Next Fifty Years – Goals and Challenges
Viewing the future through a rapidly changing, technology driven lens.
· Responsibility to Provide Environment and Tools to Motivate NextGe
· Role of Federal Government, Academia and Private Sector
TUESDAY, NOVEMBER 13 (continued)

(Session 2: The Next Fifty Years – Goals and Challenges - continued)
- What Stories Will NextGen Have for Their Grandchildren in 20

Moderator: Lon Rains, VP, Editorial, Space News (invited)
Panelists: Doug Cooke, Deputy AA, NASA/ESMD (confirmed)
          Paul Spudis, Lunar Scientist and Member, President’s Commission on VSE, APL (confirmed)
          Mr. Bretton Alexander, Executive Director, X-Prize Foundation (confirmed)

3:00 p.m.  Session 3 – Future Leaders View the Future

Moderator: TBD
Panelists: TBD

4:45 p.m.  Adjourn

7:00 p.m.  Pre-Banquet Reception

7:30 p.m.  Awards Banquet
Guest Speaker: TBD

WEDNESDAY, NOVEMBER 14

8:00 a.m.  Registration / Networking / Continental Breakfast

9:00 a.m.  Opening Keynote
Neil Milburn, VP, Federal Liaison & Program Manager, Armadillo Aerospace (confirmed)

9:30 a.m.  Session 4 – ISS: Critical Applications Beyond 2010
Detailed discussion of ISS as a National Laboratory

Moderator: TBD
Panelists: TBD

11:30 a.m.  Luncheon
Guest Speaker: TBD

1:15 p.m.  Session 5: NASA’s Partnership with the International Community

Moderator: Lyn Wigbels, RWI International Consulting Services (confirmed)
Panelists: TBD

3:00 p.m.  BREAK

3:15 p.m.  Session 6 – Public Policy Focus — New Champions in 2009?

Moderator: Bill Adkins, President, Adkins Strategies, LLC (confirmed)
Panelists: TBD

4:30 p.m.  Closing Remarks
Mark Craig, VP/Manager, Space and Ocean Systems Solutions, SAIC
AAS President

5:00 p.m.  Closing Reception
KATHIE HOWELL HONORED

The AAS recently honored Dr. Kathie Howell, Editor-in-Chief of *The Journal of the Astronautical Sciences*. She was presented with the President’s Recognition Award by Mark Craig during the Astrodynamics Specialist Conference in Mackinac Island, Michigan. The award was in recognition of achieving the impressive milestone of 15 years as Editor of the Journal. She took on the job in 1992, after serving over three years as Managing Editor. Dr. Howell is an AAS Fellow and received the prestigious AAS Dirk Brouwer Award in 2004.

AAS JOURNAL RANKED IN THE TOP 10

*The Journal of the Astronautical Sciences* was recently ranked number 4 out of all aerospace engineering journals by Eigenfactor, which measures a journal’s prestige based on per article citations and also the overall value provided by all of the articles published in a given year. Congratulations to Editor Kathie Howell, Managing Editor Hank Pernikca, and all the Associate Editors! The Journal has been published continuously since 1954. *Progress in Aerospace Sciences*, published by Elsevier, was ranked number one.

FORGING THE FUTURE OF SPACE SCIENCE

The Space Studies Board of the National Research Council is kicking off a year long series of public lectures and colloquia in cities across the country and abroad. “Forging the Future of Space Science – The Next 50 Years” will celebrate the spectacular achievements of space and earth science, examine new discoveries in both fields, and look ahead at what the next 50 years may bring. See http://tinyurl.com/2ztgmn for complete information.

SPACE RELATED EVENTS OF INTEREST

**September 24-28, 2007 – 58th International Astronautical Congress**  
*Touching Humanity: Space for Improving the Quality of Life*  
Hyderabad, India  

**October 17-19, 2007 – Short Course: The U. S. Government Space Sector**  
George Mason University  
Arlington, Virginia

**November 9-12, 2007 – SEDS National Conference**  
*SpaceVision 2007*  
Massachusetts Institute of Technology  
Cambridge, Massachusetts  

**November 15, 2007 – Sputnik 50th Anniversary Reception**  
Embassy of the Russian Federation  
Washington, DC  
Information will be posted on the AAS web site when available.

**November 16, 2007 – Sputnik 50th Anniversary Symposium**  
University of Maryland University College  
Adelphi, Maryland  
Information will be posted on the AAS web site when available.
SPACE RELATED EVENTS OF INTEREST (continued)

February 20-22, 2008 – ISU’s 12th Annual Symposium
Space Solutions to Earth’s Global Challenges
International Space University Central Campus
Strasbourg, France
www.isunet.edu

July 2-4, 2008 – 5th International Workshop on Constellations and Formation Flying
Evpatoria City, Ukraine
Conference Topics
• Analysis and synthesis of space systems
• Global navigation satellite systems
• Satellite systems for monitoring
• Others TBD

Call for Papers
Papers will be selected on the basis of abstracts of 300–500 words and should be submitted by e-mail attachment. Papers should be prepared using Microsoft Word 6.0, font size 14, Times New Roman, and printed through one space without equations and figures. Abstracts should contain the following information: title of paper; author(s) name(s); and affiliation. English will be the working language of the Workshop. Abstracts should be sent before March 1, 2008 to the Organizing Committee, as well as the registration form and registration fee.

Location / Transportation
Evpatoria City is located in Crimea, Ukraine on the coast of the Black Sea. Options to reach Evpatoria include: direct flight to Simferopol (capital of Crimea); flight to Kiev-Simferopol; or flight to Moscow-Simferopol. The distance between Simferopol and Evpatoria is about 60 km (approximately one hour by taxi). Participants should take a taxi from the Simferopol airport.

Social Program
A Social Program will be available during the Workshop. Sevastopol, Bachtchisarai, Yalta, Novi Swet, Foros, and Balaklava are available for visiting. Participants may also visit one of the world’s largest radio telescopes with a 70–meter antenna, other deep space communication facilities, and the Crimean astronomical observatory.

Registration Fee
The fee for participation in the Workshop is 500 Euros. This fee includes access to all sessions, the abstract book, and the welcome reception, and should be paid by registration or by a bank transfer to the “Space-Education” Fund:

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Accommodations
There are many hotels in Evpatoria City. The Local Organizing Committee recommends PLANETA Hotel, where the Workshop will be held. A single room costs not more than 100 Euros, including breakfast, lunch, and dinner.

Address of the Local Organizing Committee
MAI, Department 604, Volokolamskoye shosse 4, Moscow Â-80 125993 RUSSIA
Veniamin V. Malyshev, Chairman
E-mail: mai604@online.ru OR VeniaminMalyshev@mail.ru
Phone: 7 495 158 43 55
Fax: 7 495 943 41 83 OR 7 495 158 58 55
FROM NAZIS TO NASA:
The Life of Wernher von Braun
Reviewed by Mark Williamson


Wernher von Braun has been the subject of many books. Given his leading role in German and American rocketry from World War II to the Apollo program, this is understandable. Still, what can another book add to the historical record?

To answer that question, one must first consider the author. Bob Ward covered von Braun’s rocket team for years as a reporter for The Huntsville Times and trade periodical correspondent. He actually met the man, so that’s a good start. Ward writes modestly in his preface: “We became acquainted in a workaday way early on in that span of two decades.”

Noting that the period from the late 1970s to the late 1990s produced “nearly a dozen books … about von Braun and his rocket team,” Ward opines that “none had dealt fully with the total man: not only the professional figure, but also the personality, … the ‘human side’ of this complex man.” Ward began this substantial biographical effort in 1998, believing he could “bring new insights and journalistic objectivity to the story.”

Over one hundred interviews contributed to this book. Ward’s list of interviewees is impressive, including Walter Cronkite, John Glenn, James Van Allen and William Pickering. Interestingly, Ward also acknowledges the “selfless help” of Ernst Stuhlinger and Fred Ordway. The latter pair authored what might be considered a competing publication - Wernher von Braun: Crusader for Space.

Presented in twenty-two chapters with journalistic titles such as “To the Manor Born,” “Encounters with Hitler” and “Peril in Washington,” From Nazis to NASA finds a rare balance for a history book: it boasts solid reference material and the legitimacy of one-on-one interviews, but it is composed by a story writer, rather than a compiler of facts. Those who have attempted to penetrate the texts of some professional space historians will recognize the value of this underrated skill. The book’s anecdote-per-page style makes it easily readable and informative, providing from the first chapter a growing appreciation for its subject.

Ward’s talent, which was developed as editor of The Huntsville Times, is evident in his ability to choose engaging quotes. Following an excerpt during which children in the Yucatan jungle chase von Braun for autographs, Ward quotes von Braun’s “favourite autograph story.” In the late 1950s, an American schoolgirl requested two autographs. “But why do you want two?” von Braun replied. The girl answered sweetly, “Because for two of yours I can [get] one of Elvis Presley’s.”

Although von Braun’s story was intended to be self-effacing, the implication that he was half as famous as Presley speaks volumes. In fact, Hollywood made a film about von Braun for autographs, Ward quotes von Braun’s “favourite autograph story.” In the late 1950s, an American schoolgirl requested two autographs. “But why do you want two?” von Braun replied. The girl answered sweetly, “Because for two of yours I can [get] one of Elvis Presley’s.”

Among von Braun’s story was the implication that he was half as famous as Presley speaks volumes. In fact, Hollywood made a film about von Braun’s life when he was still in his forties. Television featured him in prime time, and von Braun’s face graced magazine covers.

Naturally, the question surfaces regarding von Braun’s wartime involvement and forced labour used during production of the V-2. Ward reports the standard evidence and concludes that von Braun’s “feelings on the moral issue of using slave labour could not later be known with certainty.” As an appendix, Ward includes a letter on “moral responsibility,” written by von Braun in response to a critic. War is, by nature, an event which alienates, brutalizes and isolates ordinary people. In light of this, von Braun gives a reasonable account of himself, especially since he was, at one point, arrested and imprisoned by the SS himself.

Space technology engages the imagination. The people who create such technology can be equally fascinating. There will always be a market for biographies of space pioneers such as von Braun. They help to place technology in historical context and give it human perspective. Although several biographies of von Braun are available, you would do well to read this one before delving into more clinical tomes authored by professional space historians. Once you’ve finished From Nazis to NASA, you’ll doubtless be equipped and eager to read more about this unique character from the Space Age.

Mark Williamson is an independent space technology consultant and author.
NOTES ON NEW BOOKS

CONTACT WITH ALIEN CIVILIZATIONS:
Our Hopes and Fears about Encountering Extraterrestrials
Reviewed by DeWitt Douglas Kilgore


Michael Michaud’s Contact with Alien Civilizations is a well-informed, impressively researched presentation of an often fantastical subject. The book opens with a survey of Western interest in the idea of extraterrestrial beings. It then explores the impact of the Drake Equation in founding modern SETI, and considers what we can suppose about alien intelligence. The book closes with ideas regarding how to prepare for news that humanity may not be alone in the universe.

This brief review does not do justice to Michaud’s densely packed treatment. He cast a broad net, giving attention to ideas and debates that surround detection or contact with extraterrestrial intelligence. SETI advocates such as Frank Drake, Jill Tarter, and Carl Sagan share space with skeptics Ernst Meyer, Peter Ward and Donald Brownlee. The perspectives of hard science are juxtaposed with the contributions of social scientists, historians and literary critics such as Stephen Dick, Jared Diamond, and Mark Rose. Science fiction and popular science writers such as Olaf Stapledon and David Brin are included as well. The resulting interdisciplinary stew is substantial and rewarding.

On the other hand, this book lacks a strong narrative drive which would keep a casual reader interested. There is some repetition and belaboring of points. Perhaps in recognition of this, the book is structured like an introductory textbook. Chapters are divided by informational subheadings. Bold-faced sections entitled “Mind-Stretcher” or “A Mirror Image” interject speculative asides within the more prosaic text. Boxed sections containing a wide variety of information and secondthought breakouts provide counterpoint for the main discussion. Modulating the text in this way often helps illuminate complex and difficult subjects. It can tire or distract the less studious reader, though. Whatever Michaud’s ambition may have been for providing a general introduction to SETI, this is not a book for the absolute beginner.

Michaud is mostly evenhanded in his treatment of the debates and positions he presents. However, anyone who has followed his previous work on the implications of communicating with extraterrestrials will recognize the dominant theme of this book. It is a vigorously mounted argument that Active SETI should not be undertaken by a small group of scientists, no matter how well intentioned. He argues that attempting to communicate with another intelligent species “is a cultural and political act whose consequences are not predictable.” The last quarter of Contact with Alien Civilizations is therefore concerned with arguing for the kinds of interdisciplinary collaborations between the sciences and social sciences that he sees as critical for translating or managing an extraterrestrial message or visit.

What follows from this is Michaud’s contention that no intellectual elite should be allowed to control a contact. Some sort of democratic or international governmental process should be established to set policy for a response in the name of all humanity. He argues, in other words, that the politician, the citizen, and the scientist each have roles to play in any viable contact scenario.

There is certainly much to disagree with. For example, while Michaud does subscribe to the idea that alien encounter would change humanity, his political realism provides no insight as to how such change might unfold. His perspective, however, is earned from long experience as a foreign service diplomat. It is a unique point of view which helps to make this book valuable. Michaud’s experience disciplines his notion of how humans behave, and what we might expect from aliens with enough technological and cultural proximity to easily communicate with us. I’d recommend this book as ideal for anyone interested in a broad but still detailed view of a thought-provoking subject.

DeWitt Douglas Kilgore is Associate Professor of English and Cultural Studies at Indiana University and the author of Astrofuturism: Science, Race and Visions of Utopia in Space.
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Have you recently relocated or changed jobs? We value your membership and do not want you to miss any publications or correspondence. Please notify the AAS Business Office of any changes to your contact information.

CORRECTION: The Abstract Submission Deadline for the 18th AAS/AAIA Space Flight Mechanics Meeting is October 7, 2007. It was listed as October 27 in the May/June 2007 issue of SPACE TIMES (Volume 46:3).
## UPCOMING EVENTS

### AAS Events Schedule

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<td><strong>AAS National Conference and</strong></td>
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<td><strong>54th Annual Meeting</strong></td>
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<td><strong>Celebrating Fifty Years - But, What’s Next?</strong></td>
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<td>Houston, Texas</td>
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<td><strong>January 27-31, 2008</strong></td>
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<td><strong>AAS/AIAA Space Flight Mechanics Winter Meeting</strong></td>
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- General Dynamics AIS
- George Mason University, CAPR
- Honeywell Technology Solutions, Inc.
- Jacobs Technology, Inc.
- Jet Propulsion Laboratory
- KinetX, Inc.
- Lockheed Martin Corporation
- N. Hahn & Co., Inc.
- Noblis
- Northrop Grumman Space Technology
- Orbital Sciences Corporation
- Raytheon
- SAIC
- The Tauri Group
- Technica, Inc.
- Texas A&M University
- Univelt, Inc.
- Universal Space Network
- University of Florida
- Utah State University / Space Dynamics Lab.
- Virginia Tech
- Women in Aerospace
- Wyle Laboratories

### In Memorium

Charles T. Force, AAS Fellow and former Associate Administrator for NASA’s Office of Space Communications, passed away on August 9, 2007, at the age of 72. Charles joined NASA in 1965 as director of the Guam tracking station which was used to support the Apollo lunar landings, and would later go on to help develop, construct, and employ NASA’s Tracking and Data Relay Satellite System, known as TDRSS.