PURDUE Aero & Astro GRAM

A newsletter for alumni & friends of the School of Aeronautics & Astronautics • Fall 2001

covering the 2000 - 2001 academic year

Manned flight to Mars in 2014?

MARS SPOTLIGHT

There will be a time where the planets will align and the heavens will open. The year 2014 will be the best time for the first manned mission to Mars, according to **Professor James Longuski**.

Because of an alignment of Earth, Mars and Venus, a so-called gravitational slingshot maneuver would take the astronauts to Mars and, if needed, bring them safely home. This is because the positions of the planets will provide an escape route back to earth in the event of an accident.

According to Longuski the emergency flight path would only be possible if the spacecraft was launched within a few days of January 14, 2014. "This trajectory is remarkably fortuitous as is does not exist for many years prior to or after the 2014 date," Longuski says in his research paper, which was presented August 15, 2000 during the Astrodynamics Specialist Conference and Exhibit in Denver.

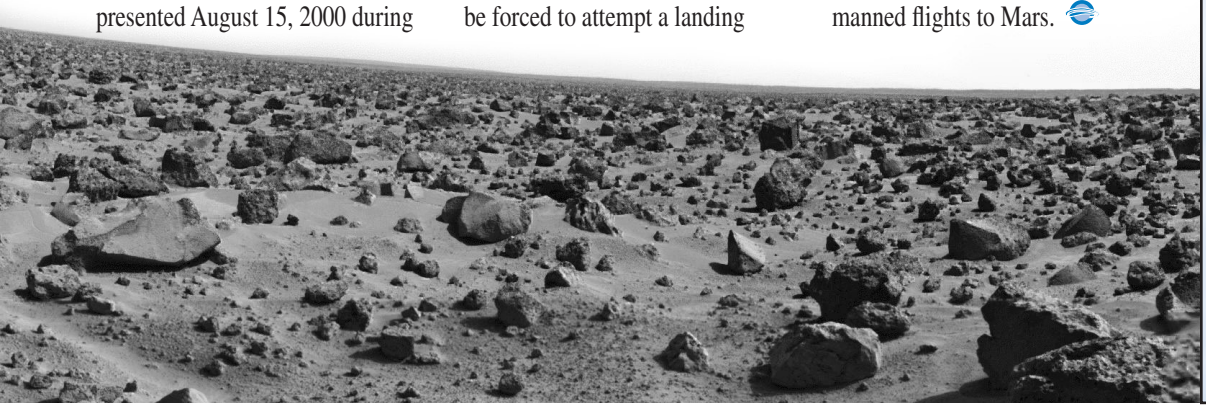
Professor Longuski and graduate student **Masataka Okutsu** discovered that the safest route to take would be one that permitted a quick return trip, via Venus, in case of an Apollo 13 type of accident that would force the Mars landing to be aborted.

If that happened, the Martian gravity would bend the spacecraft's trajectory, hurling it towards Venus, where another gravity assist would return the spacecraft back to earth. Because of the gravity-assisted trajectories, the spacecraft could make the return trip with only attitude adjustments from small thrusters, even if the main rocket engine were disabled.

Orbital calculations show that no similar escape option exists for at least a decade before or after 2014. This means that astronauts might be forced to attempt a landing on Mars even if their spacecraft became crippled in an accident on the way to Mars.

Longuski and Okutsu discovered the Mars option using a software program called STOUR (pronounced Ess Tour) originally developed by engineers at NASA's Jet Propulsion Laboratory but then improved by Longuski and his students, who made it hundreds of times more powerful.

NASA has also identified 2014 as a possible launch date for the first human mission to Mars in a 1997 study. That study Human Exploration of Mars can be accessed on line. Currently, NASA has small-scale studies but no plans for a manned mission to Mars. Many experts say that it is too late to organize a mission in 2014. But the advantages of that date may force NASA to look again at manned flights to Mars.



AAE Headlines

Farris

It is a pleasure to report that the Purdue University Board of Trustees ratified the appointment of Dr. Alten F. (Skip) Grandt, Jr. to The Raisbeck Engineering Distinguished Professorship for Engineering and Technology Integration. I trust that you join me in extending heartfelt congratulations to Skip on this recognition of achievement. Skip has been a great asset to the School as a faculty member and Head of the School as well as a tremendous contributor to the fatigue, fracture, and aerospace structural integrity research and engineering communities. The School extends deep thanks to James D. Raisbeck (BSAE '61, DEA '79, and OAE '99) and his wife, Sherry L. Raisbeck, whose $2,000,000 gift to Purdue established this Distinguished Professorship. This tremendous example of leadership aids in President Jischke's goal to take Purdue to the next level.

The School's undergraduate enrollment increased by 23% to 292 in the fall of 2000. At pres-

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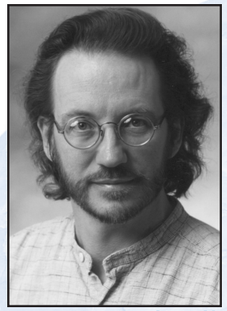
Project PERForM – AAE 450

MARS SPOTLIGHT

Purdue Engineers Ready for Mars


Longuski

Professor James Longuski with teaching assistant **Shin Matsumura,** taught AAE 450 "Space Design-Human Mission to Mars" for the first time this spring. The class of 23 students worked out the details needed to send four astronauts, plus an unmanned unit that would generate methane fuel on the 30 million mile journey. The complex semester-long design project ensured that all aspects of the mission would be covered. The large-scale design project required the students to get the "big picture issues" and simulated the aerospace workplace.

The Purdue team designed the first mission to use gravity from the Earth, Venus and Mars for slingshot maneuvers to safely bring a spacecraft home. Professor Longuski had already calculated the year 2014 (see article on cover) as the time when the planets are in the proper alignment for the slingshot maneuver to be most effective. The mission could even abort or lose power and still make it back to Earth safely. The student team has verified that this plan could be ready for implementation in 10-12 years time. Which brings the goal of 2014 in perfect timing. The next planetary alignment will not occur then until 2046.

The unmanned "Earth Return Assembly" unit would be launched in 2011 and would carry six tons of hydrogen. After landing on Mars, it would combine the hydrogen with carbon dioxide from the Martian atmosphere to manufacture the propellant required for the return trip, plus water and oxygen. The team estimated that it would take the crew 172 days to reach Mars; it would conduct experiments for 540 days and then return to Earth.

A "storm shelter" onboard would protect the crew from harmful Solar Flares. Exhaled oxygen, cleaning water and urine would have to be recycled onboard to save weight and space.

The pressurized Mars Rover Vehicle would be equipped for a 14–day mission, manned by a crew of two. It would run on methanol manufactured on the Mars surface and would have lab and lodging space, plus equipment for collecting specimens. An inflatable greenhouse would allow plants to grow and a passive sonar system would detect the presence of any underground water.

The crew would have to maintain good health during their long mission and long periods of weightlessness can cause a loss of bone density, muscle degeneration and other health problems. To counter that, a tether system was devised, allowing the spacecraft to circle. This would create gravity conditions. From a public relations standpoint, as well as a physical need, the crew should be healthy and mobile when it returns to Earth.

The Mission Directive was as follows:

- Mission should focus on placing Astronauts on Mars while minimizing the cost.
- Crew survival rate should be greater than 95%.
- Mission success should be greater than 80%.
- Artificial gravity should be greater than 0.38 g's if the time of flight exceeds 180 days.
- The crew should include two science personnel.
- The mission should serve as a stepping-stone for future missions to Mars.

There are two web sites that contain all the information on this course: http://fullspeed.to/Mars_or_Bust and http.//expert.cc.purdue.edu/~speneat/AAE450/index.html.

Mars or Bust

MARS SPOTLIGHT

This summer, Jaret Matthews spent time at a simulated Mars base on Devon Island in the Canadian Arctic.

Matthews is a senior engineering student in AAE and is among an elite group chosen from a pool of 250 applicants for the Mars Analog Research Station Project sponsored by the Mars Society. He left for Devon Island in late July and then spent most of August at the station.

The frigid arid landscape of Devon Island is the most likely place on Earth that resembles Mars. Crewmembers live inside a two story, 26-foot wide cylindrical habitat located on the edge of a large crater. In order to get outside, the occupants need to suit up and go through an airlock.

Matthews also brought along his own all-terrain vehicle, which he re-built from a dilapidated farm vehicle. It has been named the Purdue University Rover for Mars Analog Research (PURMA)

Simulating the living conditions on a Mars base, this provides insights for future manned missions to Mars. Scientists also want to study the warm springs and geological characteristics of Haughton Crater, which is located on the island. Mars is littered with craters and researchers would like to know whether the presence of springs might be associated with craters.

Contact Jaret Matthews at matthejb@purdue.edu.

Center for Satellite Engineering

The Center for Satellite Engineering was established on July 1, 1999 with Professors Stephen D. Heister and Mario A. Rotea as Co-Directors. It was awarded a three-year start-up budget through Purdue University's Academic Reinvestment Program.


Heister


Rotea

The primary goal for the first year was to develop a course that would introduce the students to the various subsystems that make up a satellite system. Secondary goals were to recruit industrial partners for the center, and to sponsor a workshop to obtain industrial /government inputs on proposed center activities.

In spring 2001 the course "Introduction to Satellite Systems" was successfully offered for the second time. Professors Heister, Rotea, Crossley, Filmer, Wasynczuk, Sudhoff, Lehnert and our visiting Professor Sanchez Pena all offered lectures in this course. This course has proved the most popular undergraduate elective in the AAE School.

The original proposal called for the development of a second course focusing on satellite design within the second year of the project. Dr. William Crossley of AAE will teach this course in the spring 2002 semester. Bill is a researcher in multi-disciplinary design optimization and the use of genetic algorithms for design optimization. He has conducted research in optimal design of satellite constellations for discontinuous coverage in conjuncture with the Aerospace Corporation. One of his current research projects addresses the conceptual design of satellite systems as a combinational optimization problem.

The recipient of several teaching awards in our school, Prof. Crossley brings many skills to a satellite design course. The center is supporting Prof. Crossley's efforts to improve his skill set for the course by supporting his attendance at a short course on Satellite Design and Technology instructed by the Chief Engineer of the Johns Hopkins Applied Physics Laboratory Space Department and his participation in a correspondence course entitled "Elements of Spacecraft Design" offered by the American Institute for Aeronautics and Astronautics. Four weeks of summer support provided Bill with the opportunity to participate in these courses and prepare course content and materials.

Through use of CSE funds, a satellite tracking system for use by CSE members in both testing and research has been created, and is now up and running. The facility is located in Prof. Heister's lab at the Maurice Zucrow labs. To alleviate problems with the accessing of this remote facility, much effort has been expended to permit remote operation of the station. The International Space Station has been contacted as it has passed overhead. The software is working well and is able to track satellites as they too pass overhead. A LabView interface was developed to remotely display the output from the radio, this is not yet available on the Internet for remote operation. Work continues in this area on order to fully support remote operation. A capability of this type will allow the faculty to demonstrate the operation of the station from class.

The CSE has been successful in cultivating relationships with TRW Space and Electronics in Redondo Beach CA. and Boeing / Hughes Space Systems in El Segundo, CA over the past year.

AAE Headlines • continued

ent, the demand for graduates of the School continues to be strong while the increased enrollment brings with it demand for co-op and internship opportunities. I can assure you that our students are among the best and brightest and employers report stellar performance of Purdue co-ops and interns. The faculty continues their efforts to implement strategic planning goals of broadening student opportunities in astronautics and providing opportunities for hands-on team-based learning experiences. We are pleased that Prof. James L. Garrison has joined the faculty with his experience in astronautics. Your financial contributions are instrumental to enhancing these learning experiences and we thank you for your continued support.

Dean Richard J. Schwartz stepped down as Dean at the end of this academic year. He has contributed much to the Schools of Engineering during his tenure including continued enhancement of our educational laboratories through the engineering differential fee and encouraging faculty, staff and students to ensure that Purdue Engineering welcomes diversity. Also, the Engineering Master Facilities Plan will help us provide students the best possible learning and research environments.

Highlights of the fall included the 2nd William E. Boeing Lecture given by General Roy D. Bridges and the 2nd Annual Outstanding Aerospace Engineer celebration. These events along with Homecoming and Gala Week are wonderful times for you to return to campus. We always welcome you back to campus so that we might show you up-close the educational opportunities that your support provides our students. Having you back on campus gives us the chance to say thank you for your support and, more importantly, connects you with our present students so that you too can know why we make educating Purdue Aeronautical and Astronautical Engineers our life's work. We strive to make the Purdue education live up to the standards that you remember so well. We can't do this without your help.

Thomas J. Harris

Stories Sought

New Book to Feature Purdue People and Flight

They flew in open-cockpit biplanes that buzzed the countryside. They piloted experimental jets, floated to the stratosphere beneath balloons, landed on the moon, and today fly shuttles into space.

Purdue University Graduates have been flying almost since airplanes first successfully lifted off the ground. For all the well-known names - Iven Kincheloe, Gus Grissom, Roger Chaffee, Neil Armstrong, and Eugene Cernan, there are hundreds of less famous Purdue Graduates who have played significant roles in aeronautics and astronautics. They work for NASA, they do research at Purdue, and they work for the companies that have built the United States into its leadership role in flight today.

A book telling the stories of Purdue people and flight is now in the works. John Norberg, Lafayette author and writer at Purdue, and Lafayette Journal and Courier columist, is collecting stories that have made the history of Purdue and flight so rich.

Anyone with personal stories to add to this collection or with suggestions can contact Norberg. Telephone Number (765) 449-4986 Letters can be sent to 610 Shady Creek Drive, Lafayette In 47905. E-mail can be sent to john_norberg@ uns.pudue.edu.

Calendar of Events 2001- 2002

August 15	Faculty retreat held for School Strategic Planning
August	Graduation receptions for graduating Seniors & families
September 5	3rd William E. Boeing Distinguished Lecture 4:00 p.m. in Fowler Hall with reception to follow. The speaker is Dr. Jürgen Weber - Chairman of the Executive Board of Deutsch Lufthansa AG.
September	Parents Day reception for engineering students, faculty & parents
October 27	Homecoming - Schools of Engineering Gathering, Engineering Mall, 8:30 a.m. - 10:00 a.m.
November 9	Fall Space Day 2001, public presentation by guest astronaut, Room 218 Stewart, 8:00 p.m. Center
November 15	3rd Annual Outstanding Aerospace Engineer Banquet, University Inn, West Lafayette, IN.
December	Graduation Reception
April	Distinguished Engineering Alumni Awards Convocations and Receptions
April	Gala Weekend School Events
April	Schools of Engineering Honors Reception
May	Graduation Receptions
May	HDR Receptions

A Taste of Aerospace

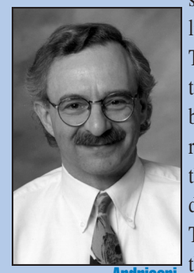
Brown

Former astronaut Mark Brown B.S.'73 was getting children excited about science during demonstrations at the children's Museum of Indianapolis on October 21, 2000.

Professor Dominick Andrisani, director of the Indian Space grant Consortium that sponsors the program and is based at Purdue, developed the demonstration program called "A Taste of Aerospace". The half hour demonstrations were presented at 10:30 a.m. and 2:00 p.m in the Science Works Sewer room.

Andrisani and Brown demonstrated scientific principals ranging from fluid mechanics to the effects of gravity. The demonstrations include heating balloons with a hair dryer, dropping two balls with different masses and the heat absorption and heat dissipation properties of the Space Shuttle Thermal Tiles by heating an actual thermal tile Space shuttle tile with a blow torch, taking the torch away and immediately applying it to his face. The audience thought they would hear a sizzle but as Professor Andirisani aptly demonstrated, the tiles heat dissipation was rapid. These experiments help explain the flight of aircraft and spacecraft. The presentation was part of an overall effort to cultivate children's interest in mathematics, science and the aerospace field.

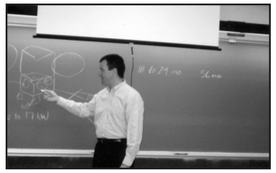
The demonstrations were part of the museum's three month program, **"The Lost Spacecraft: Liberty Bell 7 recovered"** which ran from October 7 to January 7, 2001. The Liberty Bell 7 was a Mercury spacecraft piloted in 1961 by astronaut Virgil "Gus" Grissom, M.E.'50, on a 15-minute suborbital flight, making Grissom the second American in space. Grissom's historic 1961 adventure in the Liberty Bell 7 included more than five minutes of weightlessness. When the spacecraft splashed down three miles from Cape Canaveral, Florida, the hatch cover blew off the capsule before the rescue helicopter could attach a retrieval line. As water poured inside and the spacecraft began to sink, Grissom freed himself and was lifted out of the Atlantic. The Liberty Bell 7 was too heavy with water to be rescued and came to rest three miles below the ocean surface- even deeper than the Titanic. Technological breakthroughs made the recovery of the Liberty Bell possible last year.


Andrisani

In 1959, NASA selected Grissom as one of seven astronauts for the pioneering Project Mercury, the United States' first attempt at manned space flight. As command pilot of Gemini 3 in 1965, he participated in the United States first two-person space flight. Two years later, on January 27, 1967, Grissom and astronauts Ed White and Roger Chaffe, also a Purdue graduate, died at Cape Kennedy, Florida, when a flash fire consumed their Apollo 1 spacecraft.

Indiana Space Grant Consortium is part of the NASA National Space Grant College and Fellowship Program. Indiana members of the consortium include Purdue University, Indiana University, University of Notre Dame, and Ball State University. Funding is received from NASA, corporate sponsors, grant awards and gift-in-kind donations.

Special Seminars


King

The School of Aeronautics and Astronautics proudly hosted the following seminars during the 2000-2001 academic year.

October 27	Aerodynamic Study of Two Business Jets with External Aft Fuselage Lockers	James Raisbeck Raisbeck Engineering
April 16	Macro-Scale Capillary Flows in Complex Geometries in Space, Micro-Scale Capillary Flows on Complex Surfaces on Earth	Mark M. Weislogel TDA Research Inc. Wheat Ridge, CO
April 26	Commercial Communications Satellites	Andrew M.King Program Engineering Director, Boeing Satellite Systems, El Segundo, CA
April 26	An informal discussion on engineering careers and experience in industry and the U.S Navy reserve	Theresa Rodriguez Manager; Supply Planning & Execution Conexant Systems Inc., Newport Beach, CA
May 25	Doppler Global Velocimetery	John Kuhlman West Virginia University, Morgantown, WV
June 8	Development of CFD Algorithms for Industrial Applications	Sanjay R. Mathur Manager, Research & Development Fluent Inc.
June 8	Development of Micro Air Vehicles Fixed Wing and flapping Wing Vehicles	Joel Grameyer AeroVironment Corporation.

ENvision Program Kicks Off

Purdue's first ENvision program, sponsored by the Purdue Engineering Council took place on Saturday April 7 at Purdue's Engineering Mall.

ENvision is an opportunity for elementary school students, prospective and current Purdue students, their parents and the community to learn first-hand about Engineering and Purdue's engineering programs.

The day-long exhibition features interactive events such as a "smart" Lego design/build competition, tours of Purdue's laboratories and Indiana's only nuclear reactor, as well as hands on demonstrations involving items such as the space shuttle thermal insulators. Information booths, live entertainment and food were all available to make the day a success.

The purpose on ENvision is for engineering students and corporations to share the exciting research and technology that they work with every day, and is an opportunity for Purdue's Schools of Engineering and engineering organizations to shed some light on the type of work they are involved in.

ENvision was sponsored by national and local business and took place the Saturday before National Engineers Week, which is a celebration designed to raise public awareness and appreciation of engineers and their work. ENvision's inauguration at Purdue marks the 50th anniversary for Engineers week.

Old Masters Program


McCulley

Ten leaders in various fields visited Purdue University for the 51st annual Old Masters program November 5-7, 2000.

The Old Masters program was established in 1950 so working professionals could share their experiences and observations with students preparing to finish their college careers. During their visit, Old Masters visit classrooms and residence halls and attend dinners to engage in candid discussions with Purdue Students.

The program was sponsored by the ***Office of the Dean of Student's*** with the student–run ***Old Masters Central Committee*** arranging program details.

Out of the Old Masters named for 2000, was veteran shuttle astronaut and Chief Operating Officer of United Space Alliance, **Michael J. McCulley**. He previously served as vice president and associate program manger for USA's ground operations at Kennedy Space Center. McCulley earned both his bachelor's and his masters degrees in metallurgical engineering from Purdue.

McCulley is a retired U.S. Navy captain and former NASA astronaut who logged up more than 119 hours in space. He received the NASA Public Service Medal, NASA Space Flight medal and the National Management Association Silver Knight of Management award. He also received the Legion of Merit Medal for his Naval service.

Fall Space Day 2000

"Shoot for the Moon, if you miss you will still be among the stars"

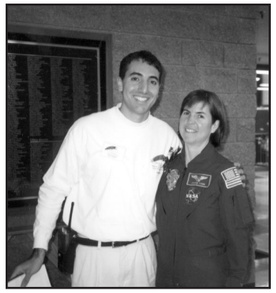
Ann Broughton

The book "A wrinkle in time" by Madeline L'Engle was the inspiration of Purdue astronaut Janice Voss when she was in 6th grade. Janice Voss was now herself going to be the inspiration for 220 Indiana 3-8th graders when they attended the 5th annual Fall Space Day on November 11, 2000.

With four previous successful Fall Space Days to its credit, the students of Purdue's School of Aeronautics and Astronautics and members of the Students for the Exploration and the Development of Space (SEDS) had a lot of experience of draw upon in planning and implementing a fun packed day.

After introductions from the head of the school of Aeronautics and Astronautics, Professor Tom Farris and Director of Fall Space Day, Nicholas Saadah, Dr. Voss started the day off with a presentation about her fifth mission in space entitled "Highlights of STS-99". This mission took place in February 2000 and gathered the most comprehensive three-dimensional map of the Earth's surface to date. She showed a video released by NASA, which a gave a comprehensive study of

life aboard the space shuttle and a more detailed explanation of the mission activities. The lighter moments included shots of Dr. Voss


Saadah and Voss

swing dancing with another crewmember.

Dr. Voss was given a very warm welcome with three standing ovations, her presentation was very well received and she said that the introduction that Nick Saadah had given her was one of the nicest that she had ever received.

SEDS volunteers manned the six activities that each student took part in. The 3rd – 5th graders had the opportunity to try three different activities**:**


SEDS Volunteers

Film canister rockets, the students learned the basics of rocket propulsion; they then built their own rocket using a film canister and dry ice. **Water Rockets –** using nothing but water, the students watched a rocket reach over 100ft, and **Edible Space Station** - where the students built their own space station using candy, graham crackers and other edible substances.

The 6th – 8th graders took part in **Dart Trajectory –** where the students were taught the mathematics behind predicting the trajectory that a dart will follow after being shot out of a gun, they then tried it for themselves. **Egg Drop –** the students had to re-create a spacecraft out of a box and other materials, which would allow an egg to survive a three-story drop. This simulated the splash down of the Apollo spacecraft, which allowed three astronauts to survive a sudden impact with the ocean surface. **Marble Wing –** wings were created out of construction paper, suspended between two supports and then tested the strength of the wing with marbles.

Honeywell, United Technologies and Indiana Space Grant Consortium and the family of the late Michael Burke provided sponsorship. Fall Space Day also received sponsorship from Payless supermarkets, NASA Glen Research, University Bookstore, Wal Mart, Einstein Bagels and Teachers' Delight.

Astronaut Voss enjoyed taking part in Fall Space Day, which she said was "great fun", she enthusiastically took part in making an edible space station. The day was an overwhelming success and students outside of the immediate community were able to take part in a Purdue activity that would otherwise not be open to them at no cost to the participants. We look forward to next year's Fall Space Day 2001.

Women in Engineering Career Day

One hundred twenty six students and one hundred forty parents attended "**Women in Engineering Day"**, which took place on October 30th 2000. Sponsored by the Schools of Engineering and the Society of Women Engineers at Purdue, the day was for all interested high school seniors. A similar day was held on April 9 for high school juniors. The career day provides seniors and junior women and their parents, with information about the Schools of Engineering as well as each student's specific area of interest.

More women have earned engineering degrees at Purdue University than at any other school in the United States. Not only is Purdue home to one of the best engineering schools in the country, its reputation for excellence is worldwide. Opportunities for women engineers have never been better.

The Women in Engineering Career Day gave students the chance to get an overview as well as specific information on various areas of engineering. Professors and students at Purdue offered talks, demonstrations and tours. During the course of the day, there were two panels: one of practicing women engineers and one of women engineering students. This presented an ideal opportunity for questions on the challenges faced by engineering majors and women in the work force.

Out of the engineering sessions in October, a total of seventeen girls showed an interest in Aeronautical and Astronautical Engineering, and seven of the girls said that the AAE session was the one that interested them most.

For further information about Women in Engineering call 765-494-3889 or email puwie@ecn.purdue.edu.

Purdue University Alumni and Faculty Visit El Segundo Site

On August 7, 2000, more than 250 Purdue University alumni and faculty arrived at the Raytheon E4 Event Center in El Segundo, CA for Purdue Night, an evening of networking and information sharing. The gathering, sponsored by Raytheon Electronic Systems, was the second in a series of events to develop closer ties with the Universities. The evening also gave Raytheon employees the opportunity to meet fellow alumni within the company, as well as those from other Los Angeles aerospace companies represented at Purdue Night.

Dean Schwartz, head of the Schools of Engineering, which has 6300 undergraduate and 1900 graduate students, led the Purdue delegation. In attendance to represent the School of Aeronautics and Astronautics was Professor Tom Farris.

The event drew alumni and senior executives from Boeing, TRW, Hughes Space and Communications and Raytheon. Purdue is a strategic school for Raytheon engineering, and typically graduates the largest number of female engineers each year. Raytheon, with engineers from El Segundo, Fullerton and Santa Barbara, had the largest number of alumni in attendance,

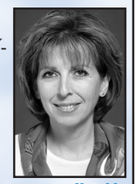
Purdue Night began with an executive session featuring executives from the various companies in attendance. Dean Schwartz shared the University's ongoing initiatives, advances in technology and future plans. After the session, participants adjourned to the Event Center for a presentation given by Purdue University representatives.

The reception that followed the presentation, provided time for the participates to exchange information and to view and discuss the engineering school displays, with the engineering deans, who circulated during the event.

Purdue and Raytheon both consider this event very successful. These events serve to help alumni show their pride in their alma maters, and help the universities establish and maintain contact with their alumni who are scattered across the country. They also encourage dialogue with university staff about industry curriculum needs.

This year ES has hired more than 700 new college engineering graduates and anticipates hiring even more next year.

New Dean of Schools of Engineering


Katehi

Dr. Linda P. Katehi (kuh-TAY-hee) was appointed as Dean of the Schools of Engineering effective January 1, 2002. For the last three years, Katehi has been associate dean for academic affairs in the University of Michigan College of Engineering. She received her doctorate and master's degrees in electrical engineering from the University of California, Los Angeles; she earned her bachelor's degree in electrical engineering from the National Technical University of Athens, Greece. Dr. Richard J. Schwartz, Dean of the Schools of Engineering at Purdue University, who has been dean since 1995, will return to teaching in the school of Electrical and Computing Engineering, where he began his teaching career at Purdue 36 years ago.


Schwartz

Katehi's main area of academic research is in microwave circuitry. She has written or co-written seven chapters in books, is co-author of 165 articles published or submitted to refereed journals and 260 articles published in conference proceedings. She also holds five patents.

Katehi will hold a named chair as the John A. Edwardson Dean of Engineering. Purdue alumnus

continued on next page

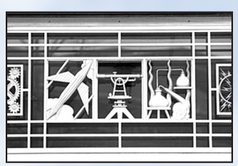
New Dean • continued

and trustee John A. Edwardson pledged $1.5 million to endow the position.

"Dean Katehi brings the leadership qualities we were seeking to move Purdue to the next level of excellence" said Purdue President Martin C. Jischke. "Given Purdue's rich tradition of engineering teaching and research, I am extraordinarily pleased with this addition to our leadership team."

Katehi said " The position of dean of engineering at Purdue provides an exciting program into a future of academic excellence, visionary research and memorable teaching and learning experience for the students. During the search process, I came to understand that Purdue aims at assuming a leadership position in the present environment of economic, technological and social change. I view this as a challenge and an opportunity"

We welcome Dr. Kathehi as Dean of the Schools of Engineering and look forward to working with her to take Purdue to the next level.



Artwork above the entrance to the Engineering Administration Building, home of the Dean of the Schools of Engineering

Colloquium Series 2000 - 2001

The School of Aeronautics and Astronautics were proud to host a fall and spring Colloquium Series:

Date	Topic	Speaker
November 30	NASA's Morphing Project	Anna-Marie Rivas-McGowan NASA Langley Research Center
January 18	Background for Aging Aircraft Structural Aircraft	Dr. John W. Lincoln Technical Advisor WPAFB, OH
February 15	Propulsion Integration: A Key Technology for Future Aircraft	Marvin Grindley WPAFB, OH
February 22	Next Generation Guidance & Control: Where Are We Going?	Andrew J. Staugler C.S. Draper Lab. Cambridge, MA.
March 1	Numerical Simulation of Plasma Aerodynamics Experiments	Graham Candler Univ. of Minnesota
March 29	A Design Reference Mission For the Human Exploration of Mars	David Kaplan NASA
March 30*	Crack Growth Predictions based on Cohesive Zone Models	Prof. Viggo Tvergaard Technical University of Denmark
April 6*	A review of the Mechanical Properties Of Metallic Foams & Lattice-Materials	Prof. Norman A. Fleck Cambridge University, U.K.
April 12	Recent Advances in Air Force Rocket Propulsion Technologies	Michael T. Huggins Air Force Research Lab. Edwards AFB, CA.
April 26	Studies of the Optimum Performance Of Tapered Vortex Flaps	Kenichi Rinoie Dept. of Aeronautics & Astronautics. Univ. of Tokyo
April 27*	Mechanics, Mixing, and Patterns in The Ocean Surface Layer	Sidney Leibovich Professor, Cornell University

* Jointly sponsored by the School of Aeronautics & Astronautics and the Mechanical Engineering Dept.; Midwest Mechanics Seminar

Purdue's Rankings

School on Track to Become No. 1

Purdue University's graduate programs in engineering are among the best in the nation, according to rankings compiled by U.S News and World Report survey released March 30, 2001. When compared to other universities, Purdue's graduate engineering programs ranked third in the country by employers - and among the best in the nation overall.

The School of Aeronautics and Astronautics rank sixth in the country. Purdue engineering enrolled more than 6,200 undergraduates and 1,800 graduates last fall. During the academic year 2000-2001, 58 students earned their Bachelor of Science Degree, 26 earned their Master of Science Degree and 17 earned their Doctor of Philosophy degrees. With a faculty of 270, Purdue's engineering program is one of the largest in the United States. It encompasses 13 schools, departments and divisions.

Purdue still leads the country as the institution that has granted the most engineering degrees to women. Currently about 22 per cent of Purdue engineering undergraduates are women, compared to 19 percent nationwide. Purdue's graduation rate is the highest among public institutions in Indiana.

Purdue is the 10th largest four-year university in the country, based on the 37,762 students enrolled in fall 1999 on its West Lafayette campus. Purdue also offers degrees at four regional campuses and 11 school of Technology sites statewide, bringing it system wide enrollment to 66,455.

Purdue engineers are among the university's graduates making their mark in management. Forbes magazine recently reported that among universities, Purdue has the most graduates serving as chief executive officers among the 800 largest public companies.

Airport Director retires after 39 years of service

Purdue Airport

Robert E. Stroud, director of the Purdue University Airport, retired on December 31, 2000, capping almost 40 years with Purdue – half of those in his present position.

A 1957 graduate of the School of Aeronautics and Astronautics, Stroud went on to serve in the U.S Air force. He began his career at the airport in 1961 as assistant director, gaining promotion to director in 1980. Stroud became Director Emeritus on his retirement.

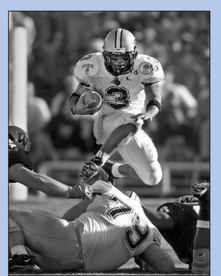
Betty M. Stanbury succeeded Stroud on January 1, 2001. She recently served as assistant airport manager at the Bush Intercontinental Airport in Houston from 1996-2000.

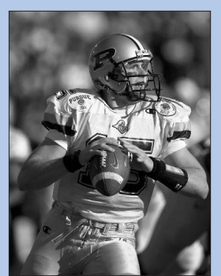
The 87th Annual Rose Bowl

More than 40,000 Boilermaker fans flocked to California and transformed the Los Angeles area to an Indiana community for a few days.

For the first time since 1967, the Boilermakers were playing in the Rose Bowl. Even though they lost a hard–fought game to an outstanding University of Washington Huskies team, the experience of being in southern California for an event which has become one of America's great traditions was one that the Boilermaker fans will long remember.

The incredible demand for tickets for the 2001 Rose Bowl game shows that Purdue was determined to support its local heroes. In addition to the tickets purchased ahead of the game, some fans made the cross-country trip without game tickets.





Left: Montrell Lowe

Right: Drew Brees

Purdue's astronaut alumni showed a strong presence with Neil Armstrong, Mark Brown, Greg Harbaugh, Jerry Ross and Don Williams all making it to the event.

The Parade of Roses started at 8:00 am on New Years Day around the city of Pasadena. Purdue's "All–American" Marching Band took part for the second time in its 114 year history, with the "Worlds Largest Drum" celebrating its 80th birthday year on January 1.

Approximately 55 % of the band department's 700 students come from the schools of engineering and science.

Professor Tom Farris Head of School and Tim Bobillo Director of Development had a chance to meet with alumni and reminisced over fond Purdue memories. A good time was had by all, regardless of the events on the football field.

William E. Boeing Distinguished Lecture

The second William E. Boeing lecture took place on October 26, 2000. Our guest speaker was General Roy D. Bridges, Jr. MSAAE'66, DEA'98, OAE'99. His presentation "**Kennedy Space Center: Constructing a Future**" gave a personal view of NASA's Spaceport Technology Center.

As Director of the John F. Kennedy Space Center, (KSC), General Bridges is responsible for managing all NASA facilities and activities at KSC related to processing and integration of NASA payloads flown on both Shuttle and Expendable Launch Vehicles. Final development and preparation of International Space Station elements to be flown aboard the Shuttle, and for developing spaceport technologies to improve safety and reduce cost of access to space.

As a military officer and pilot for the U.S Air Force he flew 226 combat missions in the F-100 over Vietnam. Following his tour he served in various leadership positions. Among these, General Bridges was appointed commander of the 6510th Test Wing, the Eastern Space and Missile Center, and the Air Force Flight Test Center with duties including all testing and research at the base. His military career was exemplary, culminating in the rank of two-star major general.

General Bridges

In 1981, NASA selected General Bridges to be an astronaut. He was the pilot of the Spacelab-2 mission (STS-51F) in 1985, logging 188 hours in space.

General Bridges continues to serve our country with his administration, management, and leadership skills as the Director of the Kennedy Space Center. In this highly visible position he oversees the direction of our discovery in space.

General Bridges has distinguished himself as few have in these demanding positions. Among his many awards and commendations are the Distinguished Service Medal, Legion of Merit with oak leaf clusters, and the Meritorious Service Medal. He has been honored by Purdue University as a Distinguished Engineering Alumnus in 1998 and an Outstanding Aerospace Engineer in 1999.

With the installation of the Boeing Mach 6 wind tunnel and the new Boeing and Intel Design/Build/Test Laboratory, Boeing continues to help our aeronautical students receive practical "hands-on " experience. They are such an important part of our student's academic program.

The third William E. Boeing Lecture will take place on September 5th at 4:00pm in Fowler Hall with reception to follow. The speaker is Dr. Jürgen Weber, Chairman of the Executive Board of Deutsch Lufthansa AG.

Indiana Space Grant Consortium

The Indiana Space Grant Consortium held their 2001 Annual General meeting on Friday April 6. Hosted by Purdue University Calumet Campus and Challenger Center of Northwest Indiana, the day was packed with presentations and discussions. Following the meeting, the attending ISGC members took part in a 4-hour demonstration. The participants were split into two groups and one group simulated the crew onboard a shuttle, and the second group performed tasks from mission control. The keynote speaker was the Honorable Scott King, Mayor of Gary.

L-R Bottom Row

Fred Berry
Associate Director,
Rose–Hulman Institute of Technology

Diane K. Schafer
Program Administrator,
Purdue University

Razi Nalim
Associate Director,
Indiana University-Purdue University Indianapolis

Monica Bauer
Office Academic Research Sponsored Programs,
Ball State University

L-R Top Row

Bruce J. Hrivnak
Associate Director,
Valparaiso University

Bob Davis
Associate Director
Taylor University

Edward S. Pierson
Associate Director
Purdue University – Calumet

Dominick Andrisani II
Director,
Purdue University

Shane Pickett
Science Central

Not Pictured

Robert C. Nelson
Associate Director,
Notre Dame University

Phillip Gerhart
Associate Director
University of Evansville

Karol Bartlett
Associate Director
The Children's Museum of Indianapolis

Catherine Olmer
Associate Director
Indiana University

Annette Goben
Associate Director,
Imagination Station
West Lafayette

Lisa Austgen
Associate Director,
Challenger Learning Center of Northwest Indiana

Susan Smith
Associate Director,
Brownsburg Challenger Learning Center

AlumniUPDATE

Class Notes

Amy B. Reeb (B.S'95) earned her MS in Mechanical Engineering at Penn State University in August 2000 and accepted an aerospace engineering position with NASA -Marshall Space Flight Center.
E-mail amy.reeb@msfc.nasa.gov.

Jack C. Cox (B.S., M.S. '73) recently assumed the position of Associate Vice President with PBS&J, one of the country's leading civil, transportation and port engineering firms. Mr. Cox is in charge of the company's Coasts and Harbors group, addressing coastal infrastructure needs. Mr. Cox is also chairman of the ASCE technical committee for Coastal Engineering practice and is the US co-Principal to the Permanent International Association of Navigation Congresses Recreational Commission.
E-Mail jccox@pbsj.com.

Artagnan Ayala (B.S.'95) has spent five years working for Allied Signal /Honeywell as a Combustion Engineer, covering a variety of disciplines from industrial power generators to the APU for the JSF/IST aircraft. Mr. Ayala was the official company representative for the Society of Hispanic Professional Engineers at national level and has received his certification as a Six Sigma Black Belt. Mr. Ayala is now a Six Sigma Master Black Belt for the Advanced Integrated Technologies Group, Inc. He has been married for five years with a little girl and a second baby on the way.
E-mail aayala@theaitgroup.com.

Captain Robert W. McCracken (B.S. '94) is currently a FA18 pilot with USMC, stationed at MCA's Beaufort. SC. With VMFA (AW) –224. He is married with one child and another on the way.

Crème de la Crème Honors and Elections

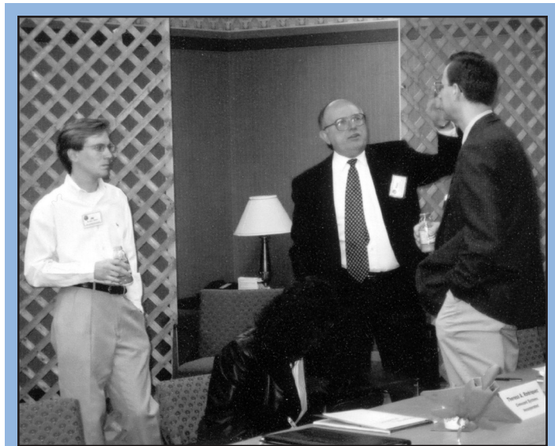
Swain

Dr. David O Swain B.S.A.E '64, DEA'93, OAE '99, HDR'00, senior vice president engineering and technology of the Boeing Co. has been elected **Fellow of the AIAA.**

General Roy D. Bridges Jr. MS'66 director of the Kennedy Space Center has received the **2001 Dr. Kurt H. Debus Award** from the ***Florida Committee of the National Space Club*** in recognition of his "progressive, visionary leadership and contributions to space technology and exploration". The award honors achievements and contributions made in Florida to the U.S aerospace effort and is named for the first KSC director.

Paul M. Bevilaqua, MS '68, Ph.D'73 manager of advanced development projects at the Lockheed Martin Aeronautics Co. has been elected **Fellow of the AIAA.**

Anthony Thornton AAE Ph.D. '92 senior manager for strategy development at the Lockheed Martin Aeronautical Co. in Fort Worth, has received the 2001 **Black Engineer of the Year Award.**



Industrial Advisory Council Meeting

L-R: Jim Garrison, Paul Bevilaqua, Steven Schneider

HDR '01

Gen. Bridges

As part of the May commencement ceremonies **General Roy Bridges** has been honored with the degree **Doctor of Philosophy, Honor's Causa.** This honorary degree is awarded to individuals who have not only reached unparalleled heights in their professional lives, but have been enormously generous in their contributions to Purdue.

Distinguished Engineering Alumni Convocation

Miller

The faculty of the Purdue University Schools of Engineering confers the title Distinguished Engineer Alumnus to Kenneth G. Miller BSAE '66 in recognition for outstanding leadership and service in the U.S. Air Force and his continuing contributions to the field of military flight. The award was presented on April 20, 2001 in a daylong series of programs and events.

Mr. Miller is Vice President, Air Force Programs, Anteon Corp. For 30 years, Miller served in the United States Air Force, retiring in 1995 as a Brigadier General. His career included accelerated advancement through many management and leadership positions, highlighted by his appointment as the director of the C-17 aircraft program. In this position, he executed budgets in excess of $2 billion and instituted a team approach that resulted in major production improvements and the first flight of the C-17. His military decorations include the Defense Superior Service Medal, the Legion of Merit and the Meritorious Service Medal. He also has received the Freedom Foundation's Award of Merit. He currently serves on Purdue's Engineering Visiting committee.

To round off a weekend of recognitions, Mr. Miller was inducted into the ROTC Hall of Fame on Saturday April 21, 2001.

Destiny Rides Again

STS-98 Purdue Astronaut Mark Polansky

After a three-week delay, Purdue alumnus **Mark L. Polansky (BS'78, MS'78)** has made his first flight aboard space shuttle Atlantis. The setting sun and a rising full moon made for a dramatic send off at 6:13 p.m.on February 7, 2001. He was the Pilot of the STS-98 mission, which delivered and installed the U.S Laboratory Destiny to the International Space Station, Alpha. The shuttle spent six days docked to the station while the laboratory was attached and three space walks were conducted to complete its assembly.

Polansky was responsible for Atlantis' key propulsion, hydraulic and guidance systems during launch and landing, and assisted Commander Ken Cockrell during Atlantis' rendezvous with the ISS. Polanksy was also at Atlantis' controls during the post-undocking fly-around of the station. Photographs taken during the fly-around are used to document the current conditions of the Station following the addition of the Destiny module.

In addition, Polansky was the intravehicular crewmember, or choreographer, for the three space walks conducted by Tom Jones and Bob Curbeam to help install Destiny to the Unity module, hook up critical umbilical lines between the newly arrived laboratory and other station components and perform other Station assembly tasks.

Polansky received a Bachelor of Science degree in Aeronautical and Astronautical Engineering and a Master of Science degree in Aeronautics and Astronautics both from

Polansky

Purdue in 1978. He is a former Air Force test pilot who logged over 5,000 flight hours in over 30 different aircraft before he left active duty to join NASA in 1992 as an aerospace engineer and research test pilot. He reported to the Johnson Space Center in August 1996. Completing two years of training and evaluation, he was assigned as a member of the astronaut Support Personnel team at the Kennedy Space Center, supporting the Space shuttle launches and landings prior to becoming an astronaut.

The Boeing Company began construction of the 16-ton state-of-the-art research lab at the Marshall Space Flight Center in Huntsville, AL. in 1995. Destiny was shipped to Kennedy Space Center in Florida in 1998 and was turned over to NASA for pre-launch preparations in August 2000.

Addition of the $1.4 billion lab module has expanded the new station's system capabilities and marks the addition of the central nervous system of the ISS. At 28 feet long and 14 feet wide, Destiny increases ISS volume by 41%. Astronauts will work inside the pressurized facility to conduct research in numerous scientific fields. Scientists throughout the world will use the results to enhance their studies in medicine, engineering, biotechnology, physics, materials science and Earth science.

Following the mission, in March 2001, the crew of STS–98 landed in the West Wing of the White House and spent some time with the President of the United States. It was a Texan reunion with a meeting in the Oval office with President George W. Bush the former Texas Governor. NASA administrator Daniel S. Goldin and the crew presented the President, who is a former fighter jet pilot, with a blue NASA flight jacket. After the visit to the White House, the crew went to Capitol Hill to meet with a number of Congressional leaders.

Pres. Bush meets with the crew of STS-98

On the Threshold of a Dream

Purdue Alumnus chosen for astronaut training.

Purdue University is known as the cradle of astronauts and has produced the twenty-second Purdue graduate to become an astronaut.

Andrew J. Feustel, 35, was among the 17 men and women selected for the astronaut candidate class of 2000, and began his two-year training program August 2000 at NASA's Johnson Space Center in Houston, Texas.

Feustal will be working as a Mission Specialist with NASA; he is the first Purdue astronaut alumnus who is not an engineer. He earned his Bachelor degree in Solid Earth Sciences in 1989 and his Masters in Geophysics in 1991 both from Purdue. He received his Ph.D. in Seismology from Queen's University in Canada in 1995.

The astronaut candidates or "ascans" in NASA–speak, range in age from 29–41. In this class there are seven pilot-astronauts and ten

mission-specialists. It is made up of fourteen men and three women who were selected by NASA from approximately 3,000 other candidates last summer. NASA then chose only 120 to be interviewed. Of those 120, NASA selected 17, one of which was Feustel. This is the 18th class selected since 1959.

Candidates had to meet two basic requirements – a four-year technical degree in science, engineering, technology or math, and at least three years professional experience. The competitive selection process evaluated their education, experience, training and unique qualifications.

The astronauts will lead the way in putting together the international space station after they have completed their two years of training. Training kicked off after Labor Day with survival training trip to Maine to provide a respite from the sweltering 100-degree plus days in Houston. The candidates spent a few days in the woods practicing skills they'll need should they have to bail out of an orbiter and land in a remote area. They then go through the initial training sessions to familiarize themselves with the hardware, the shuttle itself, activities and all the functions of the spacecraft.

Purdue University and the Massachusetts Institute of Technology have had more alumni chosen for space flight than any other non-military institution. Only the U.S. Naval Academy, U.S Naval Postgraduate School and the U.S Air Force Academy have had more than 20 astronaut alumni.

Purdue alumni have flown approximately 37% of all manned U.S space flights, including missions from Project Mercury (Grissom), the Gemini program (Armstrong, Cernan and Grissom) and the Apollo Program (Armstrong and Cernan) Thirty nine flights of the space shuttle have had Purdue alumni as part of the crews. Two of the six Americans who have flown on board the Russian space station Mir, John Blaha and David Wolf, are Purdue Grads.

Before joining NASA, Feustel was working with Exxon Exploration Company in Houston as Senior Petroleum Geophysicist.

In Sympathy

Since the last issue of ***AeroGram,*** Mr. Andrew G. Swanson B.S. '54 M.S '57 of the School of Aeronautics and Astronautics have been reported as deceased. The faculty and staff of the School extend our sympathy to all family member and friends.

William Howard Denny B.S. '50, a retired U.S Navy commander and aeronautical engineer, died September 26, 2000 in Fort Worth. He served 27 years in the U.S Navy and Naval Reserves as a pilot and in numerous classifies positions. He was employed by General Dynamics until his retirement in 1986. Captain Denny belonged to the DFW Purdue Club and the Retired Officers Association.

Joseph L. Freeland B.S '53, a Navy veteran who served in the Pacific during WWII, died June 1, 2001 in Melbourne FL. Mr. Freeland was first employed with Bell Aircraft Co. in Buffalo NY. In 1956, he joined the Naval Research Laboratories in Washington D.C. in the rocket propulsion field. During this time he was sent to Cape Canaveral to help develop and launch the Vanguard satellite. In 1958 he joined Aerojet General Corporation, Liquid Rockets Division, and was involved in the launch of well over 100 rockets, including Delta, Gemini, Titan I, II, & III. For over 20 years he served as the Base Manager for Aerojet General's operation at the Eastern at Cape Canaveral until his retirement in 1990. Mr. Freeland was active in Boy Scouts of America, Cocoa Beach Chamber of Commerce and United Way. Donations may be made in his memory to: The National Parkinson's Foundation Research Center, Bob Hope Blvd. Miami FL. 33136-1494, or to Purdue University, Aeronautics and Astronautics Engineering, West Lafayette, IN. 47907.

Faculty UPDATE

The **John W. Lincoln Award** has been presented to **Professor Alten F. Grandt, Jr.** in an award ceremony held at the December 2000 Aircraft Structural Integrity Program Conference in San Antonio, Texas. This award is presented annually and Prof. Grandt became the 5th recipient of the Medallion.


Grandt

The aircraft structural integrity community, to recognize a distinguished career expert who has made significant contributions towards advancements in flight vehicle structural integrity and safety, established the John W. Lincoln Award in 1996.

Congratulations to Prof. Grandt for the recognition that his accomplishments bring to the School and Purdue.

The **W.A Gustafson Undergraduate Teaching Award 2000** has been presented to **Professor James Longuski.** As in the past, voting for this nomination was accomplished by distributing ballots to all students with Junior and Senior level standing.

Congratulations to these faculty for their student recognition of their teaching activities.

Professor James Longuski is also the School of Aeronautics and Astronautics nominee for **the 2001 Murphy Outstanding Undergraduate Teaching Award.**


Longuski

Congratulations to both **Professors Stephen Heister** and **James Longuski** as recipients of the **2001 Bruhn Best Teaching Award**. Special circumstances this year's balloting called for the designation of both Professors. Additional faculty recognized by the student's include Profs. Howell, Weishaar and Andrisani.

Congratulations to **Professor Steven Schneider** who was elected in Fall 2000 as **Associate Fellow, AIAA.**

Professor Kathleen Howell and Belinda Marchand have been recognized by AIAA for the Best Paper Award sponsored by the Astrodynamics Technical Committee for their paper entitled **"Temporary Satellite Capture of Short –Period Jupiter Family Comets from the Perspective of Dynamical Systems"**


Howell

Professor William A. Crossley has been promoted to Associate Professor of Aeronautics & Astronautics. His appointment was confirmed during the Board of Trustees meeting held on April 6 2001.

Professor James L. Garrison was awarded, along with **Stephen J. Katzberg** of NASA Langley, an "Exceptional Space Act Award" by NASA Headquarters for the patent entitled "***Method and System for Generating Images of an Object***". The award includes $10,400. We congratulate Jim and are delighted to show appreciation for the recognition that his accomplishments bring to the school and Purdue.


Grissom Hall

Professor John Rusek has resigned from his tenure-track assistant professor position at Purdue to become the Research Director at **Swift Enterprises, Ltd**. John was a visiting faculty member for the spring 2001 semester, where he team-taught a propulsion design course with Prof. Heister. Dean Schwartz authorized a search for an assistant professor in the propulsion area. Profs. Steven Collicott, Bill Crossley and Steve Hesiter joined Prof. Farris to serve on the search committee.

Mr. Scott Meyer joined the Propulsion and Power Center for Excellence as a **Senior Engineer** in January 2001. Scott obtained two degrees from the school of Aeronautics and Astronautics. He earned a B.S. in 1990 and M.S. in 1992. He has worked in various aspects of propulsion with U.S. Rocket Works, Sverdup Technology, Inc. and most recently with Beal Aerospace Technologies. We welcome Scott back to Purdue and our school.

Professor James Doyle was named Fellow of Society of Experimental Mechanics and published his 3rd book entitled "***Nonlinear Analysis of Thin-Walled Structures***" with Springer.

Professor Art Frazho spent the fall on sabbatical in Amsterdam.

Professor Tasos Lyrintzis has returned from sabbatical at Rolls Royce.

Professor Tom Farris was General Chair of the 42nd AIAA/ASME/ASCE/AHS Structures, Structural Dynamics and Materials Conference held in Seattle during April 2001.

New Faculty Members for Fall 2001

Dr. Hyonny Kim will join the School of Aeronautics and Astronautics as an Assistant Professor in fall 2001. Hyonny and his wife Ho Jung Yoo will arrive in West Lafayette during the summer 2001, ready to begin his teaching duties in the fall semester.

Hyonny Kim obtained his Ph.D. (1998) and B.S. (1993) degrees at the University of California at Santa Barbara, and his M.S. (1994) degree at Stanford University. He is currently a Postdoctoral Fellow at UCSB working on a project focusing on the use of adhesive bonding in composite airframes in general aviation aircraft.

The arrival of Dr. Kim brings the efforts of the Structures and Materials Search Committee to a successful conclusion.

Dr. William E. Anderson will also join the School of Aeronautics and Astronautics as an Assistant Professor in the fall of 2001. Bill and his family will relocate to the area before the beginning of the fall semester.

Bill obtained his PhD (1996) from Penn State, his M.S (1984) Chemical Engineering from the University of Arizona and his B.S (1978) in Chemistry from Arizona State University. Bill has a wide range of experience in government and industry in the area of rocket propulsion. At present he is Aerospace Systems Technologist at NASA Marshal Space Flight Center.

The hire of Dr. Anderson brings the efforts of the Propulsion Search Committee to a successful conclusion.

We welcome Dr. Hyonny Kim and Dr. Bill Anderson to our School.

School of Aeronautics and Astronautics Welcomes New Professor - President Martin C. Jischke.


Ph.D Aeronautics and Astronautics, MIT 1968

Purdue President Martin C. Jischke has been appointed a professor with tenure in the School of Aeronautics and Astronautics.

Before moving into university administration, Jischke spent 17 years as the director of and a professor in the School of Aerospace, Mechanical and Nuclear Engineering at the University of Oklahoma, where he also served as Dean of the College of Engineering. Prior to his appointment August 14, 2000, Jischke served as president at Iowa State University for nine years and led the University of Missouri-Rolla as chancellor for five years. He also served the University of Oklahoma as interim president.

Welcome to Professor James L. Garrison

The Astronautics search committee is pleased to welcome Professor James L. Garrison as assistant Professor of Aeronautics and Astronautics.

Professor Garrison received his Bachelor of Science from Rensselaer Polytechnic Institute in 1988, Master of Science from Stanford University in 1990, and Ph.D from the University of Colorado, Boulder in 1997.

Prof. Garrison's interests lie in satellite navigation, GPS and remote sensing. His research is primarily involved in finding and developing new applications of the Global Positioning System (GPS).

Prof. Garrison's Awards and Major Appointments include the AETD Science and Technology Advancement Award, Goddard Space Flight Center. First Place: GPS World Applications Contest, 1998.

Faculty Roster

Professors

Martin J. Corless
James F. Doyle
Thomas N. Farris
Head
Art Frazho
Alten F. Grandt
Raisbeck Distinguished Professor
Stephen D. Heister
Kathleen C. Howell
James M. Longuski
John P. Sullivan
C.T.Sun
Armstrong Distinguished Professor
Terrence A.Weisshaar
Marc H.Williams
Associate Head

Associate Professors

Dominick Andrisani ll
Gregory A. Blaisdell
Steven H. Collicott
William A. Crossley
Anastasios S. Lyrintzis
Mario A. Rotea
Steven P. Schneider

Assistant Professor

James L. Garrison

Outstanding Aerospace Engineer's Award

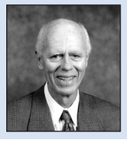
The second annual Outstanding Aerospace Engineer's award ceremony was held on October 26, 2000 at University Inn in West Lafayette. Seven Purdue Alumni share honors for their demonstrated excellence in industry, academia, governmental service or other endeavors, which reflect the value of an aerospace engineering degree.

Following the success of last year's inaugural OAE ceremony, the Faculty of the School of Aeronautics and Astronautics were proud to honor these alumni who have distinguished themselves.

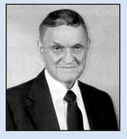
The 2000 Outstanding Aerospace Engineer Awards were presented to….

Mark K. Craig (B.S.A.E.'71) who has been the deputy center director, of NASA's John Stennis Space Center since 1995. Mr. Craig is responsible, with the director, for management of the center and its rocket propulsion test, commercial remote sensing and Earth science programs, and its multi-agency environment. He is a principal advisor on NASA's strategy for the human exploration and development of space. Mr. Craig was on the start up teams of both the Space Shuttle (1969) and Space Station (1983) He has held management positions in Houston and at NASA headquarters in Washington D.C on a variety of space exploration programs. As staff to the NASA Administrator, he was principal architect of the NASA Strategic Plan.

Edward G. Dorsey (B.S.A.E '49) Vice President and General Manager, Space Division, Retired – Thiokol Corporation. Following graduation from Purdue, Mr. Dorsey joined Experiment, Inc in Richmond where the research company performed pioneering work for DoD on propellants, solid fuel ramjets, air turbo rockets, hybrid rockets, liquid propellant guns and weapon system concepts. He joined Thiokol Corporation in 1958 as Manager, Development Programs. He then took a variety of Managerial positions including Director Space Shuttle SRM Project. The Space Shuttle motors are the world's largest solid propellant rocket motors and presented unique requirements in manufacturing, testing, transportation, flight assembly and ocean retrieval for reuse. Mr. Dorsey led this effort from the early stages through design development, and shuttle launches through STS-8. Although he retired in 1983, Mr. Dorsey returned to Thiokol following the tragic loss of the space shuttle Challenger in January 1986, to lead the SRM accident investigation and failure cause redesign. He fully retired in 1987, after ground tests indicated successful results of the SRM design.



Leslie A. Hromas (M.S.A.E. '53, Ph.D. '57) In 1959, Dr. Hromas joined Space Technology Laboratory, which would later become TRW; he has continued this association with TRW spanning 40 years. In 1966, he was named manager of the Engineering Science laboratory of the Fluid Mechanics Department with responsibilities for the Ballistic Missile System Development and Missile Discrimination Technology. From 1969–1988, Dr. Hromas managed the Engineering Science Laboratory. In 1988, Dr. Hromas became Manager, Propulsion and Fluid Mechanics Center, adding responsibility for Liquid Rocket Propulsion and Combustions Systems Development. Although he retired in 1993, Dr. Hromas has continued his association with TRW contracting as a Technical Recruiter of the Space and Technology Division and continuing work with the Ballistic Missile Discrimination System Development. He is a recognized expert in the field of ballistic missiles and has recently completed work as a contributing editor on *Historical Volume on Ballistic Missile Discrimination.*



Kenneth O. Johnson (B.S.A.E. '50) started his career in aeronautics in 1941 working for Curtiss-Wright learning to rivet aluminum aircraft assemblies. Further supporting the war effort, he joined the Army Air Force in January 1943; he flew ground support as a member of the 48th Fighter Group in Germany and graduated as a Second Lieutenant. Mr. Johnson enrolled at Purdue University at the end of the war studying Structural and Aerodynamic Design. Mr. Johnson began his career in 1950, analyzing and designing gas turbines and rocket engines for General Motors Allison Division. He contributed significantly to the design and development of the Minuteman Rocket Engine. In 1966, Mr. Johnson moved to the General Electric Large Gas Turbine Design Operation in Cincinnati, OH. His work at GE led to the development, introduction and patent of the unducted fan (UDF) engine. As this work was a breakthrough in the introduction of ultra-high bypass ratio fans, his work represented a substantial contribution to the world of aeronautics. Although Mr. Johnson retired from GE in 1986, he continues his research and development for Belcan Engineering, where he is working on his latest patent, an infinitely variable gearless transmission.

Photo L-R Tom Farris, Dan Raymer, Ed Dorsey, Charles Saff, K. O. Johnson, & Mark Craig

Top row L-R Ken Miller, Les Hromas

Kenneth G. Miller (B.S.A.E '66) is a retired U.S Air Force Brigadier General who served as Director of Supply, in Washington D.C.; He was a key member in the development and implementation of "lean logistics" for the Air Force. Additional highlights from his military career include, making 23 hurricane penetrations while operating R&D equipment on Hurricane Hunter aircraft, heading the organization that raised the F-16's Mission Capable rate to 92% and putting together the first electronic warfare program for the F-4 aircraft. From 1991- 1993 Mr. Miller was the Director of the C-17 Aircraft Program. He directed first flight, clearance of the flight envelope activation of the first operational squadron and major production improvement efforts. Mr. Miller joined Anteon Corporation in 1999 to develop an integrated strategy for the diverse Air Force activities across the corporation. Prior to joining Anteon, he was senior Vice President for CACI, International; Group Vice President, RJO Enterprises; and Vice President /General Manager, Gulf Operations, BDM International, Inc.

Daniel P. Raymer (B.S.A.E.'76, M.S.A.E. '76) is a recognized expert in the areas of Aerospace Vehicle Design and Configuration Layout, computer –aided Design Methodologies and Design Education. Dr. Raymer was on the faculty of Aerospace Engineering at California State University at Northridge. He directed aircraft design projects in fighter, STOVL, hypersonic, and other areas for Lockheed Aeronautical Systems from 1987 – 1990. Dr Raymer is President of Conceptual Research Corporation, an engineering design and consulting corporation focused upon aerospace and high technology. Dr. Raymer founded CRC in 1990 to offer conceptual design and analysis services, confidential design reviews and methodology consulting. He writes extensively, developing short courses and software related to aircraft conceptual design. He also acts as consultant and conducts engineering research for the RAND Corporation, studying future trends and options in aircraft advanced technology. Dr. Raymer holds patents for "Variable Dihedral Tail Unit of Supersonic Flight" and Reverse-Engine VSTOL Aircraft".

Charles R. Saff (B.S.A.E.'71) leads the Structures Technology Team for Boeing Phantom Works in St. Louis MO. This team is part of a multi-site organization responsible for development and verification of structural technologies for all Boeing products: fighters, transports, bombers, commercial transports, helicopters, missiles and launch vehicles. Mr. Saff also manages Affordable Structures Team, which coordinates development activities across all sites of the Boeing Company. His team focuses on optimization of structural concepts for best value, the best combination of low cost and high performance. Mr. Saff is also editor of the ASTM journal of Composite Research and Technology and of the International journal *Composites.*

Purdue University Rocket Propulsion and Power Lab. (PURPPL)

Prof. Stephen D. Heister

I thought the time was appropriate to give you a brief update on the propulsion program at Purdue, given the changes, which have taken place. The program continues to grow - - at present we have 26 propulsion graduate students, the largest number since I arrived in 1990. As many of you know Prof. Rusek has decided to change his status with Purdue so that he can pursue some of his technologies with his new company, Swift Enterprises. He has rented office space at Purdue Research Park and will continue to work with our department as a Visiting Associate Professor. This second semester, he and I are team teaching a propulsion design course in which we plan to fire solids; liquids and hybrid engines- we plan to fly some of the systems and ground test the others.

In other news, we are very excited to announce that we have been awarded a large grant from the state of Indiana to form a **Propulsion and Power Center of Excellence.** This center is comprised of people from **Allison Advanced Development Company, IUPUI, Purdue Schools of Aeronautics & Astronautics and Mechanical Engineering, and two small businesses – Swift Enterprises and Indy Aerocraft.** We have $2M grant for our group- roughly one half of that comes to Purdue's

continued on next page

Professor Emeriti Honored by the School of Aeronautics and Astronautics

Head of School, Professor Tom Farris presented a new plaque at the Outstanding Aerospace Engineer Award banquet on October 26, 2000. Professor Alten F. Grandt Jr. designed the plaque, which identifies faculty from the School who are Professor Emeritus.

The plaque is situated outside of the faculty lounge - Grissom 390

L-R with plaque

Prof. Gus Gustafson
Prof. Bob Osborne
Prof. George Palmer
Prof. Larry Cargnino
Prof. Paul Kentzer

School of Aeronautics and Astronautics Clerical Staff

These are the smiling faces of our wonderful clerical staff that you will see when you come to visit us on the third floor in Grissom Hall.

L-R top row

Linda Flack, Terri Moore, Debbie Horton, Sharon Wise, Paula Kerkhove, and Jennifer Rosch

L-R bottom row

Joan Jackson, Lisa Crain, Lena Dispennett, and Diane Schaffer

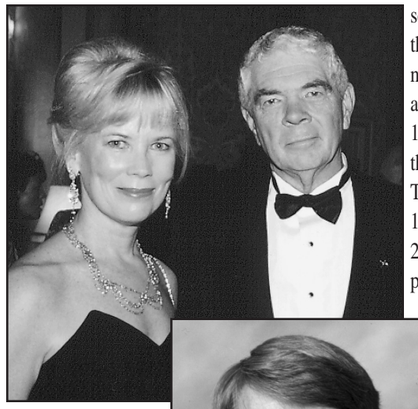
The Raisbeck Engineering Distinguished Professorship for Engineering and Technology Integration

December 2000

Following the announcement of The Raisbeck Engineering Distinguished Professorship for Engineering and Technology Integration last year, The Purdue University Board of Trustees has ratified Dr. Alten F. Grandt as the inaugural recipient of this prestigious award.

James D. Raisbeck (B.S.A.E.'61, DEA '79, OAE '99) and his wife Sherry L. Raisbeck, donated $2,000,000 to Purdue University to establish **"The Raisbeck Engineering Distinguished Professorship for Engineering and Technology Integration"**

James D. Raisbeck earned his degree in aeronautical engineering at Purdue after a tour of duty in the 1950's as a mechanic and then flight engineer in the U. S. Air Force. He was a research aerodynamicist and program manager at the Boeing Company from 1961 to 1969. He left Boeing to become president and CEO of Robertson Aircraft. In 1973, he founded the Raisbeck Group, where he developed the Supercritical Wing for the Sabreliner and the Mark ll and Mark lV Systems for the Learjet 20 series. From there he started Raisbeck Engineering, where he developed and certified a number of aerodynamic improvements for business aircraft, including the Learjet, Sabreliner, and King Air. Raisbeck Enhanced Performance Systems are installed on more than



James and Sherry Raisbeck

30% of all King Airs worldwide.

The School of Aeronautics and Astronautics and the Department of Aviation Technology, with the approval of the Dean of the Schools of Engineering and the Dean of the School of Technology, made the selection of Dr. Grandt, which was made in accordance with the academic standards, policies and procedures of the University for designation of the academic title Distinguished Professor.

Purdue now has 48 distinguished professors and 21 named professors. Grandt spent eight years as a materials research engineer at Wright–Patterson Air Force Base in Dayton Ohio, before joining the Purdue engineering faculty in 1979. He served as head of the School of Aeronautics and astronautics from 1985-1992 and won the E.F Bruhn Best Teacher Award in 1997. In December 2000, he was presented with the US Air Force John W. Lincoln award, which is given annually to a distinguished career expert who has made significant contributions towards the advancements in flight vehicle structural integrity and safety.

Grandt

Grandt is highly respected in the fields of aeronautics and astronautics, applied mechanics and materials science for his work in developing methods to analyze and design damage-tolerant aerospace structures and materials. Grandt's current research is focused on the challenge of ensuring the structural integrity of aging aircraft.

The School looks forward to Dr. Grandt's continued contributions as The Raisbeck Distinguished Professor.

PURPPL • continued

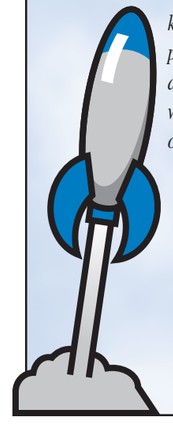
West Lafayette campus. Two major research areas will be developed with these monies.

• A pulse detonation engine facility at the Zucrow High Pressure Laboratory. Professor Gore and I will be the main focal points on this work, which will aim at developing PDE's using liquid hydrocarbon fuels.

• A new rocket propulsion test facility to investigate non-toxic propulsion using hydrogen peroxide as oxidizer. Prof. Rusek and I are the main focal points at Purdue for these efforts.

In connection with this grant, we are also very pleased to be able to hire Scott Meyer as a Senior Engineer in support of this project. Scott, MSAAE '92, has valuable experience with peroxide systems from his three year stint at Beal Aerospace. Scott is tasked with the facility development and we are actively seeking equipment donations, which could aid us in building a first class lab.

Indeed, these are exciting times for us – look for lots of smoke and fire in the future.



Prof. Heister keeps his former propulsion students updated with the progress of his work.

Technique detects when satellites are low on fuel.

Satellites are not able to stop at the gas station, and one pound of rocket fuel translates into $2.5million in revenue. It is therefore of immense importance that the satellite is replaced before they run out of fuel. The satellites, which are maintained in orbit about 22,000 miles above Earth by firing small rockets thrusters, must be replaced shortly before they run out of fuel. Enough fuel must remain to get the satellite out of orbit to make room for their replacement.


Collicott

Associate Professor of Aeronautics and Astronautics **Steven Collicott,** has written a research paper with **Jay Ambrose,** an engineer at Lockheed Martin Corp's Advanced Technology Center, and former Lockheed Martin Engineer **Boris Yendler**. The paper ***"Modeling to Evaluate a Spacecraft Propellant Gauging System"*** was published in the November – December issue of the Journal of Spacecraft and Rockets, published by the American Institute of Aeronautics and Astronautics.

Conventional floats on the top of the gasoline with a gauge in earth bound automobiles, don't work in space, as everything floats. Conventional gauging methods for spacecraft include calculating fuel consumption based on the number and duration for all rocket firings since launch. Because engineers know how much fuel the rockets consume, they can estimate how much is left. Another technique is to use the ideal gas law, in which the temperature and pressure of gas in a container can be used to calculate how much gas is present. This knowledge in turn reveals information about how much liquid fuel is present.

Although these methods have worked in the past, this has not stopped the ongoing quest for improvements; this had led to the new technique. The engineers used a model created in the early 1900's by Kenneth Brakke, a mathematics professor at Susquehanna University, to help improve fuel gauging. The model was initially used to describe the mathematics behind such phenomena as the formation of soap bubbles. It also helped solve the following problem: When a straw is placed inside a glass of water, why does the water level inside the straw rise higher than the level in the glass.

The exact same physics, *the wicking action,* is responsible for positioning fuel inside the tank. Here on Earth, this capillary action is only seen on a very small length scale because gravity overwhelms it. In space, the weight of the liquid is irrelevant, consequently, the effect is exaggerated making it more difficult to predict the liquid's movement and its location inside the tank.

Professor Collicott's application of the model makes it possible to use routine temperature data from the satellite's existing equipment to monitor how much fuel is left in the tank, and is applicable to spacecraft launched before this work began. This data comes from heaters, which are needed to keep the fuel from freezing, and the temperature sensors located on the outside of the fuel tank. The more fuel that is present, the longer it takes to heat, just like a pot of water on the stove, the more water there is in the pot, the longer it takes to heat.

The model uses the temperature information to provide a detailed, three-dimensional understanding of where fuel is located, which is turn can be used to calculate how much fuel remains in the tank. The technique also might be used to help design satellite fuel tanks that better control the position of liquid propellants. An unbalance load can cause a satellite to wobble, which requires a greater use of thrusters to control the spacecraft. More control would lead to less fuel consumption and increased revenue.

The net annual revenue for a single satellite may be in billions of dollars, so the premature retirement of a space vehicle is of considerable importance. More accurate fuel gauging methods are needed so that companies can better determining when to replace a satellite.

Lockheed Martin uses the technique on some commercial satellites, such as those for digital television; the technique may be improved in the future, as researchers gain a better understating on how fluids behave in zero gravity.

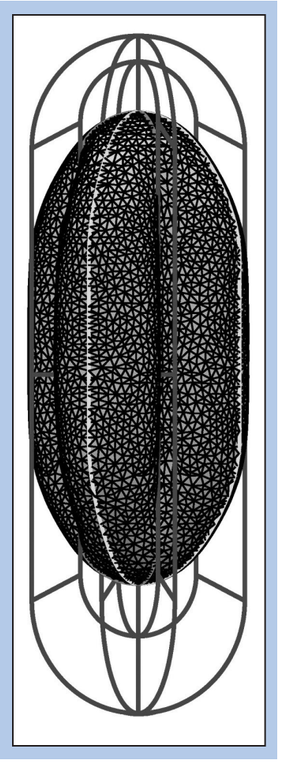


Photo of cross section image of a satellite fuel tank. The cross section shows the distribution of fuel inside the tank and the location of "vanes" structures inside the satellite fuel tank designed to keep fuel in the proper position.

Einstein to the Test

Fischbach and Longuski

Professor James Longuski made news in spring 2001 for pursing his lifelong dream of understanding the general theory of relativity. In 1997, he enrolled in a course on relativity taught by **Professor Ephraim Fischbach**, a Purdue Physics Professor. The class worked to dissect and comprehend relativity, which describes relativity as a manifestation of the curvature of space and time.

The class assignment was to produce a research paper by the end of the semester that could be published. The paper that was subsequently written develops a clever idea which Longuski had in which he proposed a new test of Einstein's Theory of Relativity. Longuski devised a new way of testing the theory by measuring small changes in the position of a spacecraft as it passes near the sun. He developed a new mathematical formula for calculating precisely how much of the spacecrafts changing position would be due to general relativity. The formula makes it easier to test relativity by reducing pages of calculations into a single line of mathematical terms. He credits his findings to a "cross pollination" of ideas from diverse areas of research: physics and astronautics. When Longuski showed Fischbach his formula, the physics professor realized that no one had thought of it before.

The scientific paper entitled **"Deflection of Spacecraft Trajectories as a New Test of General Relativity",** written by **Professor Longuski, Ephraim Fischbach and Daniel Sheeres**, an assistant professor of aerospace engineering at the University of Michigan, was published on April 2, 2001 in **Physical Review Letters.** This is a journal published by the American Physical Society and is considered one of the world's most prestigious physics journals. Most physicists consider it a significant accomplishment when their papers get published in PRL, and consequently an extremely significant achievement for a non-physicist to have a paper accepted on its first attempt.

Experts in the field, while not yet able to independently verify the formula, have read the work and are intrigued. The proposal is that Professor Longuski will either prove that Einstein is correct to another degree of accuracy or he will be proved wrong. Scientists are always looking for new ways of testing general relativity, which is a pillar of modern physics that is critical to learning how the universe evolved. The true test of the formula is yet to come, and that is something that few people, - perhaps as few as 10 – have ever been able to do since Einstein's work was first published in 1916. Numerous experiments have shown its predictions to be correct. A small numerical deviation from the theory's predictions would be earth shattering, controversial, and considered big news in the world of physics.

Longuski, a professor of the School of Aeronautics and Astronautics, specializes in the effects of gravity on a spacecrafts trajectory, or its passage through space. The sun and planets in the solar system are used to help propel and guide spacecraft to their ultimate destinations. These bodies provide "gravity assists" or "slingshot trajectories", which enable spacecraft to achieve the proper speed and heading while minimizing fuel consumption.

Because measuring how gravity bends the paths of moving particles or a beam of light can test general relativity, Longuski reasoned precisely measuring how the sun's gravity could affect a spacecraft's trajectory could test the theory.

By itself, the new formula probably would have been worthy of publication in a scientific journal. But it would be far better to create a realistic experiment using the formula to test general relativity.

Longuski learned about a mission proposed in 1994 by scientists at the California Institute of Technology and the Jet Propulsion Laboratory. It was never launched due to lack of funding. The mission, conceived by Caltech space physicist **Richard Mewaldt** and his colleagues at JPL, would use the sun's gravity as a slingshot to catapult a spacecraft out of the solar system.

The craft would be sent close to the sun, and its rocket would be fired at just the right moment to make for maximum use of the sun's gravity. Longuski would like to "piggy back" on that mission to test his theory. Although the Small Interstellar Probe mission was designed to study the characteristics of space outside the solar system, by precisely tracking the spacecraft's position at its closest approach to the sun, a point in the orbit called its perihelion; researchers could then test general relativity.

Furthermore, Scheeres determined that no additional hardware would be needed to track the spacecraft. A network of NASA antennas known as Deep Space Network, which uses radio waves to communicate with spacecraft, could be used for the experiment. The results could be known in two or three years from the launch date.

Einstein used general relativity in the early 20th century to solve a long–standing mystery about a tiny discrepancy in Mercury's orbit around the sun. Conventional Newtonian physics could not entirely account for the behavior of the planets orbit. Astronomers had even resorted to predicting that an undiscovered planet, which they called Vulcan, must be located between Mercury and the sun, exerting additional gravitational forces on Mercury that affected its orbit.

Einstein precisely calculated Mercury's orbit using general

continued on p.28

Ticket to Europa

Planning a mission to Jupiter, its moons and other destinations in the solar system are now quicker and easier thanks to Professor James Longuski and his students Nathan Strange and Andrew Heaton.

In the 1990's, the Galileo mission to Jupiter found evidence of liquid water under Europa's crust, NASA wants to send an Orbiter to map the ice and maybe find pockets of water. Where there is water, of course, there may also be life and NASA is on the hunt for it.

In 1999 the Jet Propulsion Laboratory (JPL) asked the Purdue group to design trajectories for the middle segment of the new mission, the phase after the orbiter reaches Jupiter and before it begins its 30-day orbit of Europa. In that interim, the orbiter must maneuver among Europa, Ganymede and Callisto and, finally, arrive at Europa.

Clearly, knowing the precise locations of these Jovian moons at any given moment is essential to the groups' work. Identifying a sequence of gravity-assist fly-bys around the moons is the crux. In each fly-by, the spacecraft will come into the proximity of a particular moon and complete an orbit around Jupiter in such a way that the spacecrafts energy is strategically lowered of more rarely boosted.

The Purdue group, which initially included graduate students Anastassios Petropoulos and Gene Bonfiglio, has designed 35 candidate trajectories already. In the process, they created a simple, pen and paper method of identifying promising paths, exceeded JPL's requirements- and earned the labs NOVA award in November 1999 (becoming the only 1999 recipients external to JPL) The orbiter's proposed launch date is 2003.

A faster technique for mapping those trajectories is needed because space missions often require a series of several gravity assists from planetary bodies, precisely strung together in just the right way so that the space raft arrive properly at their final destinations. Engineers highly skilled in celestial mechanics may take month of even years to plan complex tours, only to see the methodical calculations discarded because of launch delays that require entirely new tours to be calculated, possibly with little time to spare.

The new technique provides a graphical representation of the myriad possible paths a spacecraft could take to a given destination. To compute details about each potential path, such as travel time, distance and fuel consumption, Longuski used a software program called STOUR (pronounced Ess Tour) developed at NASA's Jet propulsion Laboratory where he worked in the 1980's. Longusky and his students have now automated that program, making it work faster.

By looking at the graphs, engineers can quickly identify the routes that appear to be the best paths to a given destination: then STOUR is used to confirm whether those paths are practical.

Longuski and his students have used the technique to design trajectories for the Europa Orbiter mission, scheduled tentatively for launch in 2006. Astronomers are excited at the prospect of possibly finding liquid water, and ultimately, perhaps some form of extraterrestrial life below Europa's frozen crust.

The Purdue team discussed the new graphing method in several talks during the Astrodynamics Specialist Conference and Exhibit, which took place in Denver last August. The conference was co-sponsored by the American Institute of Aeronautics and Astronautics and the American Astronomical Society.

Longuski show his theorem to a visiting colleague, Professor Dan Scheeres of the University of Michigan last fall. He looked at it and said, "That's Tisserand's criterion" Longusky and his team has rediscovered it in a totally back door way. Francois Tisserand in 1889 came up with a mathematical formula to identify comets whose orbits had been perturbed by Jupiter. A comet's orbital period and perihelion would be changed, making identification difficult. However a certain quantity was conserved the Jacobi- integral even though the orbit changed.

When the Europa spacecraft reaches Jupiter, which is about 483 millions miles from Earth, a rocket will be fired to prevent it from sailing around the Jovian system and to place it in orbit around the planet. At that point, the spacecraft will begin a complex series of orbits around Jupiter and three of its moons. Before it can be placed into the proper orbit around Europa, it will have to undergo various slingshot maneuvers that gradually adjust its approach to the moon. The trick is to approach Europa at just the right speed and distance to place the spacecraft in orbit around the moon using the least amount of rocket fuel. While the trip from Earth to Jupiter will take about three years, it will take about two additional years before the spacecraft is finally in its proper orbit around Europa. During that time it will be orbiting Jupiter and flying past Europa and the moons Ganymede and Callisto. It will make about a dozen such "flybys" each time coming close to a particular moon while completing an orbit around Jupiter in such a way that the probes speed and position will be strategically adjusted.

Andrew Heaton, an aerospace engineer at NASA was on fellowship at Purdue. Nathan Strange received his Bachelor's Degrees in aeronautical and astronautical engineering and physics form Purdue in 1997. Both students graduated with master's degrees in May 2000. Anastassios Petropoulos is pursuing a doctoral research at Purdue pm Low-Thrust Gravity –Assist Trajectory Design. Gene Bonfiglio (BSAAE '97, MSAAE '99) is now a staff engineer at JPL).

Excerpted from Purdue Engineering Extrapations written by Lisa Hunt Tally and Purdue News service written by Emile Venere.

The Boeing/ AFOSR Mach-6 Quiet Tunnel


Schneider

Located in the Aerospace Sciences Laboratory (ASL) the Boeing compressible flow lab now has two large Ludwieg tubes. The first has a 4-inch Mach-4 test section, and remains quiet to a length Reynolds number of about 400,000. The second has a new 9.5-inch Mach-6 quiet flow test section, and is officially known as the Boeing/AFOSR Mach-6 Quiet Tunnel. It can generate 10-sec. runs once per hour at a cost of only $10/shot.

The tunnels share instrumentation selected for the specialized study of laminar-turbulent instability and transition, including high-speed hot wires, fast response pressure transducers, hot film arrays and anemometers, a high sensitivity laser differential interferometer, a glow-discharge perturber and a pulsed laser perturber.

If the new tunnel achieves quiet flow, it will be the only operational hypersonic quiet tunnel in the world. Researchers will use the new $1 million wind tunnel to help design advanced spacecraft and aircraft that travel at hypersonic speeds. NASA had previously operated the only other wind tunnel capable of similar performance, but the NASA tunnel is not currently in operation.

A team of Purdue engineers led by **Prof. Steven Schneider** finished assembling the wind tunnel in April 2001. At present the wind tunnel runs with conventional levels of noise, but work continues to understand and correct the problem. Successful operation with a laminar nozzle-wall boundary layer would result in a quiet freestream, with between 1/10th to 1/30th of the noise of conventional high-speed wind tunnels. **Craig Skoch** presented a paper about the new wind tunnel on June 11, during a meeting of the American Institute of Aeronautics and Astronautics in Anaheim, CA.

The quiet operation is critical to recreating the smooth, or laminar, flow of air over the surface of aircraft, spacecraft, or missiles when they re-enter the earth's atmosphere. Although a quiet wind tunnel more closely simulates the low noise levels of flight, conventional high-speed wind tunnels produce an airflow that is much noisier than in flight. When this noisy flow passes over models of aircraft or missiles, the results don't always simulate flight very well. Noisy flow interferes with measurements critical to understanding when and how the air flowing over a surface changes from smooth to turbulent.

Engineers must better understand the nature of this transition when designing superior aircraft and missiles. One aim is to design spacecraft that heat up less as they re-enter the atmosphere. As laminar airflows can have eight times less heating than turbulent ones, reduced heating would require less shielding, thus enabling engineers to build lighter weight lower cost vehicles. For example, more laminar flow could be critical to enabling a new re-entry vehicle with a metal skin. This would eliminate the need for the existing tile system used on the space shuttle, which is expensive to maintain.

Another major application is designing a generation of aircraft that will use "scramjets" to travel at more than 7,000 mph., allowing them to leave Earth's atmosphere and travel around the world in a few hours.

A future fleet of space planes using scramjets may be far less expensive to operate than the current space shuttles, making it more affordable to haul payloads into orbit. Unlike rockets, which must carry their own supply of liquid oxygen to combust fuel, scramjets would scoop oxygen out of the atmosphere.

In order for scramjets to work properly, a steady, smooth flowing supply of air must be moving continuously at hypersonic speeds into the engine's combustion chamber. Poor control of turbulence near the aircraft's surface might disrupt this crucial air supply and turbulent flow over the vehicle forebody would cause excessive heating.

The wind tunnel will also be used to gather data needed to design more accurate missiles, including intercontinental ballistic missiles and defensive missiles that shoot down incoming missiles.

Modern computer technology and sensors have made the low cost wind tunnel possible. Although it is relatively inexpensive to operate because each run only lasts for ten seconds, an enormous amount of data can be collected in that time.

First, air is pumped out of a large tank that is connected to one end of the wind tunnel, creating a vacuum inside the tank. Then a valve is opened between the tank and the wind tunnel, sucking a burst of air through the wind tunnel at high velocity. The short run time requires less expensive pumps, avoiding the large compressors needed for other wind tunnels that pump air continuously, thus reducing overall costs.

In order to remain quiet, the wind tunnel must be entirely free of particles, grit or sand. Engineers enlisted the help of **Shin Matsumara** and later **Kyle Hultgren,** two undergraduate students who crawled though a 120 foot section of the wind tunnel wearing a bunny-suit, like the kind worn by technicians in clean rooms, and wiped down the inside of the stainless steel pipe. This would not be a job for anyone suffering from claustrophobia, as the pipe is only 18 inches in diameter.

The Air Force Office of Scientific Research, the Ballistic Missile Defense Organization and The Boeing Company have funded the wind tunnel.

For any further information contact Professor **Steven P. Schneider** steves@ecn.purdue.edu.

StudentUPDATE

Flights of Fancy: Student Planes Take Off

A&AE 451 Aircraft Design, Fall 2000

Students enrolled in the School of Aeronautics and Astronautics 451 aircraft design course test flew their remote controlled aircraft on November 21 in the Mollenkopf Athletic Center.

The three aircraft, designed by student teams, under the guidance of Professor Dominick Andrisani, weigh approximately 9-10 pounds each. One of the aircraft was a monoplane with a wingspan of 11 feet; the others were biplanes with wingspans of six feet.

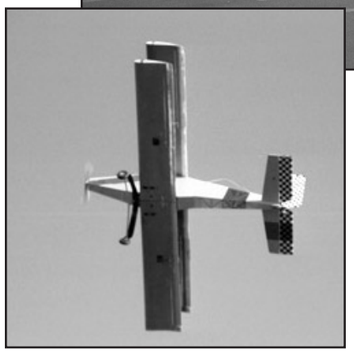
Pretest flights were done using the runway of Delphi Municipal Airport. Each team conducted one flight. The tests were a success and the official flight occurred a few days later in Mollenkopf Athletic Center. Professor Dominick Andrisani is acquainted with Delphi airport manager Brian Stirm who also works in Purdue's Aviation Technology Department.

Flying in Mollenkopf Athletic Center demands that the aircraft possess excellent flying qualities, they must be reliable and precisely turn both left and right. Inability to turn fast enough will result in an immediate crash against the walls of the building. That has happened to student groups in previous years.

The culmination of more than 13 weeks of intensive design and construction for the students, mostly seniors planning to enter the aerospace construction industry upon graduation, the flights also provided about 50 friends and onlookers to see the outcome of years of study and effort.

For students, the true test of their aviation know-how rested not only on the ability of their battery–powered planes to leave the ground, but also to stay aloft long enough to perform a series of tasks. Following a conventional take off, the aircraft must have an endurance of 12 minutes. Take off rate of climb must be sufficient for satisfactory flight in the Athletic Center.

The students in the class broken down into three teams, had to overcome many design hang-ups, from making sure the weight of each wing was balanced to construction of landing gear on which the planes could safely land. It had to be robust to crashes, easy to fly and easily transportable in a compact automobile. In all aspects of design and construction, cost must be minimized. The cost to build the fixed –wing aircraft was not to exceed $200 (excluding radio controlled gear, electric motor, speed controller, rate gyro and data recording system).



Above L-R: Orion Aerospace, Boiler X-press, and DR2

Left: DR2 in flight

For other students, the class presented its greatest challenges in working within the time frame necessary to complete the project while keeping up with work in their other classes.

The teams of students had to design an aircraft that demonstrated the ability on an on-board sensor, or gyro, to change the motion properties of the plane while in flight.

None of the remote-controlled planes had any mishaps during the examination flights; the three teams were as follows:

Orion Aerospace
Leader Patrick Dempsey
Co-leader Keith Hout
Heather Garber, Bridget Fitzpatrick, J.S. Mok

DR2
Leader Christopher Peters
Co-leader Jeff Rodrian
Mark Blanton, Loren Garrison, Chris Curtis

Boiler X-press
Leader Matthew Basiletti,
Co-leader Mike VanMeter
Oneeb Bhutta, Ryan Beech

Student Awards

Congratulations to…

JSC Co-op Special Achievement Award

Paul Brower
Nicholas H. Saadah
Valerie Kost

JSC Co-op Flag Awards

Mihailo Rutovic

AAE 251 Thiokol Space Awards for Fall 2001 First Place Team

Adam Boardley, Andy Foor
Joshua Jung, Gina Pieri
Ke-winn Chan, John Gedmark
Valerie Kost, Ryan Whitley

2001 Elmer F. Bruhn Undergraduate Research Assistantship

Luca F. Bertuccelli
David N. Loffing

2001 William Koerner Scholarships

Sophomore
Josheph Harber
Melanie Silosky

Junior
Douglas Crook
Kevin J. Miller

Senior
Brandon R. Abel
Nicholas H.Saadah

Magoon Award Winners 2001

Yongkang Chen
Daniel Garcia
Jason Helms
Michael Melchior

2001 Gary and Sue Payton Engineering Scholarship

Joshua Jung

2001 John L. & Patricia R. Rich Scholarship/ Fellowship Fund

John McKinnis

2001 Herbert F. Rogers Scholarship

Adam Butt
Nicholas H. Saadah

Zonta International Amelia Earhart Fellowship Awards

Rania Hassan
Belinda Marchand

Our faculty takes great pride in the accomplishments of our students and alumni, and we congratulate our students for these significant honors. We hope that you are proud of your hard work and effort that led you to these awards, and wish you continued success with your studies and future career. We also thank our generous alumni whose contributions make possible some of these awards.

Graduate School Fellowship Programs Fall 2000

Listed below are the new recipients of Purdue University Graduate School fellowship programs for fall 2000. These students are among Purdue's most talented graduate students. We congratulate these students and would like to thank the academic schools, graduate programs, and the Minority Advisory Committee for helping make these selections.

Graduate Opportunities Master's Awards

Raymond Joshua

Frederick N. Andrews Fellowship Awards

Theresa Debban

Purdue Presidential Distinguished Graduate Doctoral Fellowship Awards

Erick Swanson

National Science Foundation Fellowship Awards

Nicole Key

Graduate Student Fellowship Incentive Awards

Gregory Roth

Innovation 101 Puts Engineering and Business on the Same Team

Purdue University and the National Science Foundation are putting engineering and management students together; to produce graduates who have the skills to transform academic research into marketable products.

The Innovation Realization Laboratory will integrate Science and Engineering with Economics and Management. Purdue and the NSF are combining their efforts of more than $4 million in the most rigorous and long-term science/business collaborative education program in the nation.

The project puts doctoral candidates in engineering and the sciences who are in the thesis stage of their academic careers into teams with master's degree management students for two years. AAE student Dan Garcia has been awarded a fellowship through this program.

Study Abroad Opportunities

Since the announcement of the AAE strategic plan concerning exchange programs, AAE has signed exchange programs with Universities in England, France and Australia. Through the study abroad program at Purdue, students are now able to exchange with the University of Bristol in England and with the Ecole Superior des Techniques Aeronautics and Construction Automobile in Paris. (ESTACA)

To date, one AAE student is currently in Paris and we are awaiting the arrival of two French students in the fall of 2001. We have had numerous exchange students from Australia over the last three years from the Royal Melbourne Institute of Technology and the University of New South Wales; the students have spent one year at Purdue. Several Bristol Students have spent a year at Purdue and two Purdue students plan to spend the 2001-2002 academic year in Bristol.

The Purdue study aboard web site is: http://www.ippu.purdue.edu/sa/welcome.cfm

Reduced Gravity Student Flight Opportunity

Purdue teams accepted to fly

Since the autumn of 1996, Purdue's School of Aeronautics and Astronautics has been involved in the NASA Reduced Gravity Student Flight opportunity program run by the Texas Space Grant Consortium. Teams of undergraduate students from all over the country send in proposals for experiments to be performed in a reduced –gravity environment, and the best are chosen to be carried out by the student teams during a flight on NASA's KC-135 (a.k.a "Vomit Comet") aircraft. Teams select reporters to fly along and cover their experiment, as well as conduct educational outreach activities with schools in their communities.

Three AAE teams had proposals accepted by NASA to participate in the flight schedule in spring 2001. One team consists of juniors and seniors in the School, another is a small hybrid team consisting of three freshman led by a senior returning from the March 2000 flight and the third is a team of eleven honors freshman sponsored by Eli Lilly as part of a new initiative by Purdue University. In addition to the AAE activities, the last team comprises of Purdue's Electrical and Computer Engineering student team is flying an experiment entitled Use of Tactile Feedback for Reorientation.

Professor Steven Collicott's spring semester AAE 490G and HONR 1991 classes, "Zero-Gravity Flight Experiment" have both had their experiment proposals selected by the NASA Reduced Gravity Student Flight Opportunities Program (RGSFOP) at NASA Johnson Space flight Center. They will be at NASA –JSC in late August 2001 to conduct their zero-g fluids experiment.

The HONR 1991 team proposed " Fluid Interfaces of Triangular Containers in Reduced Gravity Environments." The AAE 490G team proposed "Venting and Filling of tanks in Reduced Gravity" A total of 24 Purdue undergraduates will have flown in weightlessness with NASA in 2001.

The AAE faculty adviser / coordinator is Professor Steven Collicott:collicott@ecn.purdue.edu

AAE zero-g web site – http://www.roger.ecn.purdue.edu/~zerog

Hyperion Project 2001

Two AAE students **Chris Peters and Jeff Rodrian** have just completed building an all-composite model aircraft for an international radio-controlled modeling world championship competition as part of Prof. Sullivan's AAE 590T course.

The objective of the Hyperion Project 2001 was to design and build a remote controlled aircraft for the F3A World Championships in pattern aerobatics. An aircraft had to be designed for the pilot Jose Eduardo Melville that adapts to his flying characteristics. Additionally, the design is intended to capture the evolution in style changes of F3A aircraft over the last five years with a new design.

The F3A is a category on competition governed by the Federation Aeronautique International (FAI). The competition is comprised of a sequence of roughly 30 preset aerobatic maneuvers and the aircraft constrained in size to a maximum of 2-meter wingspan and 2 meter fuselage length.

This project represents a real world production and manufacturing process starting from customer order to product deliver and customer support. This was quite an amazing effort from two of our students and they are to be commended for their hard work.

Hyperion

Congratulations to Our Graduates

Commencement Ceremonies took place at the West Lafayette Campus on May 11-13 2001. Purdue President Martin C. Jischke and Thomas J. Carroll, president of the Alumni Association delivered commencement addresses in the Elliott Hall of Music. Two large video screens above the Hall of Music Stage displayed a close-up photo of each graduate as they were congratulated.

Approximately 5,355 students graduated – 3,975 were undergraduates, with 720 graduates from the Schools of Engineering.

August 2000

B.S.AAE:

Hafizal Abdul Aziz
Keita Hasebe
Anthony Kuo
Brian Prock

December 2000

B.S.AAE:

Jung Ahn
Genae Barry
Matthew Basiletti
Ryan Beech
Terrance Bryant
Jeremy Church
Christopher Curtis
Bridget Fitzpatrick
Keith Hout
Joong Soo Mok
Shouvanil Mustafi
Brian Patneau
Andrew Peters
Wendy Planck
Matthew Rennells
Shawn Russell
Tyson Struzenberg
Michael Van Meter
Nicholas Wilson

M.S.AAE:

Kyoung Duck Bae
Sung Man Cho
Andrea Cook
Jonathon Epps
Murthy Haradanahalli
Andrew Heaton
Belinda Marchand
Ashers Partouche
German Porras Alonso
Dyan Roberts
Shann Rufer
Vincent Yarnot
Che-Ping Yeh

Ph.D.AAE:

Harish Ganapathy
Chenghua Han
Zhiyong Li
Trent Pancake
Robert Taylor
Zhengwen Yang
Pablo Zavattieri

Spring 2001 Graduates
Undergraduates

B.S.AAE:

Brandon Abel
Matthew Ackerman
Mark Blanton
Brian Bliss
Kacie Burton
Benjamin S.Cardinal
Kuan- Chen
Devin Cummings
Nicholas Czapla
Anne Delion
Partrick Dempsey
Shannon Fitzpatrick
Heather C. Garber
Loren A. Garrison
Jake Grasmick
Stephen Hanna
Christopher Heidelberger
Adam. Irvine
Patrick Kennedy
Casey Kirchner
Debra Klein
Phoi-Tack Lew
Adam Magdziarz
Jeffrey McCormick
Sean McElroy
Bodin Namwong
Michelle Nokes
Wael Haggag
John Pavlicek
Christopher Peters
Jeffrey Rodrian
Nicholas Saadah
Sherri Spreadbury
William Stein
Tanya Tuinstra
Stephanie Vany
Wiyan Wong

Ph.D and Graduate Candidates

Douglas Adams
Parul Agrawal
Jason Anderson
Jose Guzman
Joseph Henderson
Hyuk-Bong Kwon
John Matlik
Richard McKowen
Cholwon Paek
A.E. Petropoulos
Crawford F. Smith III
Qinggang Zeng

Online Alliances

Female engineering and science students are going online to make very special friends.

MentorNet connects students with online mentors in engineering and science, giving them a personal contact with a professional in their field.

MentorNet went into full operation in 1999 after being pilot tested the year before. The University provides a range of mentoring opportunities for some 1,500 women engineering students and 1,400 women in the school of science.

MentorNet is ideal students who don't have time to participate in the formal mentoring programs, which often rely on face-to-face contact. As the program relies in the use of email and other electronic technologies, students may find it an easy way to expand their circle of contacts.

MentorNet is a partnership involving universities, corporations and professional societies around the country. It is headquartered at San Jose State University.

Einstein • continued

relativity, providing critical evidence for the theory's validity and disproving competing theories, such as the existence of Vulcan.

Longuski's technique represents a more controlled method of measuring the same effect seen in Mercury's orbit. Instead of observing a planet, a spacecraft could be used to measure its motion to get the equivalent information, but under more controlled circumstances, in a way that will be a more precise test.

James Longuski
longuski@ecn.purdue.edu

Ephraim Fischbach
ephraim@physics.purdue.edu

With Great Appreciation

The School is tremendously grateful for two deferred gifts received. A Charitable Remainder Unitrust was established for the School through gifts from Mike and Margaret Hua. Dick and Jane Freeman, by gifting to Purdue the Freeman family farm in southern Indiana, have also established a Charitable Remainder Unitrust. These planned gifts will be of terrific value to the School. For information on the benefits of planned giving to the School and/or to the University, contact Gordon Chavers, Director of Planned Giving at Purdue University, 765-494-2730.

Aero Advancement

Tim Bobillo

My education continues. As Director of Advancement for the School it is very important to keep moving. With so many activities going on, if I slow down I'll be swept along. So it's better to stay out front and lead the parade.

That's just about what it feels like to work at the School. A big parade. It's constantly moving and changing, and when you see something that makes your eyes widen, along comes something bigger and brighter.

In the fall of 2000 the School hosted numerous activities and events on campus and off. Our Industrial Advisory Council sponsored the second Industry Day for representatives of the aero industry to meet and mingle with faculty and students. Roy Bridges, Director of Kennedy Space Center, gave the Boeing Distinguished Lecture, sharing NASA's view of the future. Seven of our alumni were honored at the second Outstanding Aerospace Engineer Awards Banquet. And numerous alumni and friends visited campus to speak and listen, an opportunity for our students to understand their chosen field a little better.

These are just a few of the activities the School hosts to provide an environment that will produce the best graduates and the best engineers. We're proud of these efforts, and we hope you are proud of your alma mater. We're trying to make it better. My role is to foster the relationship you have with our School, our faculty, students, staff and alumni. More opportunities will be made for your association with us, both on campus and around the country, as we come to you. Please let me know how I can help you feel connected.

I want to get to know you, to let you know we're moving in the right direction. We're taking the steps necessary to be the best. I want you to know the School and to see our strengths. I believe our goals and vision are similar to yours. We want our School to be the best. That's why you came to Purdue. You're still a part of Purdue, so please stay in touch with us.

Thanks go out to all of the many alumni and friends who supported our mission through financial gifts in the fall of 2001. Your generosity contributes to our success. The real beneficiaries of your gifts are the students. The return on your investment will be the many accomplishments of these students as they enter the workforce, and add to the reputation of Purdue engineers!

Attention must be drawn to two significant gifts received last fall. Coincidentally, both of the gifts are repeat gifts from the fall of 2000.

Mr. John Rich, BSAAE '54, made the second payment of $50,000 toward his pledge of $250,000 to support the John and Patricia Rich Scholarship. This substantial endowment will have a meaningful impact on the lives of many students. Thank you, John.

And Anne E. Belfort, MSIM '76, with a gift of $20,000, added to the Dr. Anne D. Belfort Fund, which she established in 1999 to honor her mother, a former GE executive and a pioneer in the field of space-related technology. Dr. Belfort worked on re-entry for the Gemini and Apollo programs. This fund will support curriculum development and research initiatives in astronautics. Thank you, Anne.

Donor Honor Roll 2000-2001

The need for financial support for our school is great. Your contributions do make a difference to us and help us in achieving our mission in teaching, research and service.

Our annual Donor Honor Roll lists our alumni and friends who have given generously of their financial resources to support the School of Aeronautics and Astronautics.

Many thanks for your investment in us. Listed on the following pages are those alumni and friends who have generously donated to the school during the period July 1, 2000 - June 30, 2001. Many Thanks.

Donor Honor Roll - Corporate

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AC Engineering Incorporated
Akron Rubber Development
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The Boeing Company
CSAS Chinese Family Camp
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TRW Foundation
United Space Alliance
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Donor Honor Roll - Individuals

$25,000 or more

Hsichun Hua
Margaret Hua
Jane Freeman
Richard Freeman
John Rich

$24,999 - $2,500

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Lana Couch
Frances Crain
John Hayhurst
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Marguerite Hobbie
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Chin-Teh Sun

$2,499 - $1,000

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Thomas Wible
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Richard Winkler
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Eldon Knuth
George Komechak
Douglas Kooker
Steven Koontz
Jeffrey Kress
John Kustura
Thomas Lacey
Subir Lahiri
Larry Lakamp
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Mark Langhenry
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Scott Meyer
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William Miller
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Gregory Miller
David Miller
Marvin Miller
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Walter Nencka
Frederick Norton
Allen Novick
Ronald Oard
Tammy O'Keefe
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Ryan Paige
Vaughn Parfitt
Franklin Paris
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Edward Parker
Hossein Parsapour
Stephen Pater
Frank Perry
Timothy Petersen
Craig Peterson
John Petraits
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School of Aeronautics & Astronautics
Purdue University
1282 Grissom Hall
West Lafayette, Indiana
47907-1282

Phone: (765) 494-9124
Fax: (765) 494-0307
E-mail: aae-alumni@ecn.purdue.edu
Web Page: http://aae.www.ecn.purdue.edu

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