Calculated Risk
How Much is too Much?

To the Moon and Back
For one AAE student, space is within our reach

A Soaring Spirit
Scholarship endowment honors young man’s vision
On My Mind

Welcome to the Summer 2008 edition of AAE Impact magazine. The theme of this issue is entrepreneurship and I am happy to report that AAE’s entrepreneurial spirit is involved in some of the most innovative and exciting projects on campus.

The School of Aeronautics & Astronautics is clearly helping to lead the entrepreneurial vision of the university. Our alumni, faculty and students are launching ideas into tangible products and services. From alumni startups… to faculty research with great commercialization potential… to student projects inspired by an entrepreneurial spirit.

We are proud to be a part of Purdue’s entrepreneurship enterprise. Join us as we highlight just some of AAE’s successes in the following pages.

Thomas N. Farris
Professor and Head
School of Aeronautics and Astronautics

Don’t be a stranger. We want to hear from you!

Tell us what you think by sharing your Purdue memories or reacting to a story in this issue. We invite you to write to us via the contact information at right. In doing so, you grant us permission to publish your letter in part or in whole in an upcoming issue. We also reserve the right to edit letters for length and/or clarity.

About the Editor

I am happy to introduce Barbara Leonard, the new editor for AAE Impact magazine. An adopted Boilermaker, Barbara has been at Purdue for five years as a writer and communications coordinator for the Development Office. Barbara has a bachelor’s degree in English from Rutgers University in New Jersey and a master’s degree in English from Purdue. She has hit the ground running with this issue of Impact and I look forward to seeing the magazine flourish under her leadership.

Rwitti Roy
Director of Marketing and Communications
**AROUND AAE**

Student, faculty receive awards  
Alumni achievements  

**IN MY VIEW**

Alumnus James Raisbeck has evolutionized the aviation industry  

**COVER**

A Purdue-based startup calculates risk  

**UP CLOSE: STUDENTS**

AAE graduate student has his eyes on the sky  

**UP CLOSE: FACULTY**

Purdue’s Mach-6 wind tunnel has been well worth the wait  

**UP CLOSE: ALUMNI**

Alum finds math and engineering are keys to success  

**CAMPAIGN IMPACT**

One young man’s vision lives on through a new scholarship endowment  

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**Graduate Student Receives AIAA Wright Brothers Graduate Award**

Martin Ozimek, a graduate student in AAE, has been awarded a 2008 American Institute of Aeronautics and Astronautics Wright Brothers Graduate Award. The AIAA Foundation Orville and Wilbur Wright Graduate Awards have been established by the AIAA Evolution of Flight Campaign and the AIAA Foundation in commemoration of the 100th anniversary of powered flight. The awards recognize the Wright Brothers’ aeronautical achievements and contributions to the evolution of flight. The AIAA Foundation Orville and Wilbur Wright Graduate Awards provide $10,000 awards bestowed annually to four graduate-level students participating in research endeavors as part of their engineering/science graduate studies.

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**Faculty Member Receives NSF CAREER Award**

Professor Inseok Hwang has been chosen for a National Science Foundation (NSF) CAREER Award for his proposal entitled “Hybrid Estimation and Real-Time Computational Algorithms for Networked Embedded Hybrid Systems.” The Faculty Early Career Development (CAREER) Program is a foundation-wide activity that offers the National Science Foundation’s most prestigious awards in support of the early career-development activities of those teacher-scholars who most effectively integrate research and education within the context of the mission of their organization. Such activities should build a firm foundation for a lifetime of integrated contributions to research and education.
Purdue AAE Graduates Inducted into U.S. Astronaut Hall of Fame

More than 40 Hall of Fame astronauts gathered at the Kennedy Space Center May 2–3, 2008, to induct the U.S. Astronaut Hall of Fame Class of 2008. Two of the four astronauts inducted this year are Purdue AAE graduates. They are John Blaha (MSAE ’66), the third American to live aboard the Russian Mir Space Station, and Loren Shriver (MSAE ’68), vice president of engineering and integration chief technology officer at the United Space Alliance and commander of the mission that deployed the Hubble Space Telescope. The Astronaut Scholarship Foundation oversaw the selection of the voting committee and induction process. The committee chose the 2008 inductees based on their achievement during their spaceflights as well as how they contributed to the U.S. space program in other activities.

AAE Alum Leads Mission to International Space Station

Purdue AAE graduate Mike Moses (BS ’89, MSAAE ’95), is the lead shuttle flight director on STS-123, the current Space Shuttle mission to the International Space Station (ISS) flown by Space Shuttle Endeavour. Launched on March 11, 2008, it is the 25th shuttle mission to visit the ISS, and delivered the first module of the Japanese laboratory, Japanese Experiment Module (Kibô), and the Canadian Special Purpose Dexterous Manipulator (SPDM). Moses earned a bachelor of science degree in physics from Purdue in 1989, a master’s in space sciences from Florida Institute of Technology in 1991, and a master’s in aerospace engineering from Purdue in 1995.

2008 AAE Distinguished Engineering Alumnus

Debra Haley, BSAAE ’78
Special Assistant to the Commander, Aeronautical Systems Center
Wright-Patterson Air Force Base

AAE Alumnus Debra Haley recently retired as special assistant to the commander of the Aeronautics Systems Center at Wright-Patterson Air Force Base in Dayton, Ohio. In her 29-year civilian career with the U.S. Air Force, she also served as chief information officer and executive director of Air Force Materiel Command. Her responsibility and accomplishments were recognized with a presidential award for meritorious service from President Bush in 2005. She also holds master’s degrees in management from the Massachusetts Institute of Technology and the Air Force Institute of Technology.
The Big Picture

An icon in the aviation industry, James Raisbeck has seen it all

A: Purdue alumnus and founder of Raisbeck Engineering, James Raisbeck (BSAA ‘61) has played a significant role, over the past 50 years, in revolutionizing the aviation industry. Under his leadership, the company has continually worked to design, develop, and produce advanced and innovative aviation technology. The company’s products are standard equipment on business and airline aircraft worldwide. He attributes his success to a curious spirit, a dedicated work ethic, and an ability to see the “big picture.” Raisbeck shares some of his insights with Impact.

Q: You’ve been in the aviation industry for nearly half a century. How has the business of aviation changed over that time?

A: The first is the introduction of computer-aided technology. Engineers no longer need to understand foundational information, such as Newton’s Law. They can rely on computers to do that work and spit out a configuration. I believe this has great potentially negative ramifications for engineers in terms of what they study and how they apply their knowledge.

The second thing in my opinion is the character of engineers as a whole. I am concerned that with the great potential for financial gain in other recent disciplines such as financial investment management, the lure of wealth may play a role in why students may not pursue engineering as a career. I believe this has great potentially negative ramifications for engineers in terms of what they study and how they apply their knowledge.

Q: As someone who has helped set standards within the aviation industry, what do you see as the biggest challenges facing the industry today?

A: Finding those individuals who truly think and care about engineering is the biggest challenge going into this next century. I can’t stress enough how important it is for the industry to train and hire those individuals who think about problems not just in the office or in the lab, but who take them home and think about them, talk about them, dream about them. Those are the engineers who will be leading the next wave of evolution in the aviation industry.

Q: From an entrepreneur’s standpoint, do you see the aviation industry heading in a positive direction?

A: A professor of mine at Purdue once told me that there are no easy problems left to solve. There are only hard ones ahead. I think the industry will be heading in the right direction as long as graduates are equipped with a broad spectrum of knowledge, exposure and most importantly, interest in engineering to take on tomorrow’s challenges. To keep moving in the right direction, engineers need to learn to view “the big picture” of those challenges.

Q: What have been the key motivating factors for you as an entrepreneur?

A: When I was growing up, because of the way my birthday fell, I was always smaller than the other kids, always younger than my classmates. As a result, I needed to try that much harder to keep up. It feels like I have been running ever since. A quest for large financial gain was never a motivator for me. I have always been driven more by a desire to have my opinions and my contributions respected.

Q: What has been the single most rewarding aspect of your entrepreneurial endeavors?

A: Being recognized for my accomplishments and respected for my contributions is very rewarding. Being successful has also given me the opportunity to help others and that is by far the most rewarding thing about my career. The ability for my wife, Sherry, and I to support cancer research and the arts, as well as institutions like Purdue, is gratifying. It is our goal to give our wealth away and to help others at the same time.
According to James Mann, co-founder of M4 Sciences, a Purdue-based startup, the element of risk is a key factor in any entrepreneurial endeavor. His experience offers some insight into what and how much risk—personal, financial, technological, business—is too much.

M4 Sciences, founded in 2005, is focused on commercializing manufacturing research at Purdue’s Discovery Park Center for Advanced Manufacturing. The company enjoys a close partnership with the university, particularly the cross-disciplinary aspect of Purdue’s research environment. It aims to achieve new breakthroughs in advanced manufacturing while addressing the pervasive challenges in ultra-precision machining.

Having taken the path to success for a startup company, Mann and the team at M4 Sciences know the elements of risk well. To those embarking on the journey, these relatively young veterans would ask, “What would you risk to pursue a dream or vision for the future?”

continued on next page
The type and severity of risk taken by the M4 Sciences team changes with each step of the company’s growth. As a co-founder, Mann assumed significant personal and financial risk by leaving an industry career to pursue a dream of starting an advanced manufacturing technology company. Each of the M4 Sciences team members has taken risks: risk of compromised friendships, strained relationships, career impact, and challenges to family life, as well as financial risks associated with personal equity investment and forgoing an otherwise stable career path. The technology risks include the adoption of the new products and processes by end-users.

Risk can certainly pay off. For the guys at M4 Sciences, creating a successful startup is a balance of planning, execution, and ingenuity. The interdisciplinary aspect of the research is crucial. Mann points to collaboration among Industrial Engineering, Materials Science, and the School of Aeronautics and Astronautics as having laid the foundation for the company.

Key Purdue faculty such as Srinivasan Chandrasekar (IE), W. Dale Compton (IE), Tom Farris (AAE), and Kevin Trumble (MSE) have been conducting research in materials and materials processing for more than 15 years. M4 Sciences now seeks to commercialize their discoveries and develop strategic business plans to take those discoveries to the market.

The M4 Sciences management team is composed of three Indiana natives—Purdue doctoral student and co-founder James Mann (BSAAE ’90, MSE ’94), co-founder Brian Gootee, and Jeffrey Bougher (BSAAE ’96, MSAAE ’97). The extended team includes seven other members, each of whom has at least one or more degrees from Purdue.

With two members who are graduates of Purdue’s School of Aeronautics and Astronautics, the company has particularly strong ties to that school. In return, the school is committed to the success of companies like M4 Sciences, providing the engineering education, technical abilities, and critical thinking skills necessary to succeed.

The interests and risks of the entrepreneur are not always well-aligned with individuals from the larger organization, Mann says. For M4 Sciences, a long-standing relationship with Purdue faculty helped the company maintain a strategic course and is key to M4 Sciences’ ability to identify new products and processes related to the company’s core machining technologies.

Taking the Plunge

For this team, the risk associated with initiating a high-tech startup and taking an idea to commercialization is a long, complex road filled with rewards and challenges. When asked what he enjoys most about his job, Mann immediately points to the satisfaction of pursuing a dream and engaging others to help make it a reality. “Seeing how the customer reacts when our team is able to provide a solution to their problem is very rewarding,” says Mann.

According to Jeffrey Bougher, “Everyone has a different level of tolerance,” for risk. “At some point you are going to have to expose yourself to a level of risk that will keep you up at night, that will make your stomach churn and that will likely make those close to you uncomfortable,” says Bougher. Planning and forethought aside, “When it comes time to make the bet though, the magnitude of the risk becomes more real, more tangible and more meaningful. At that point, the risk you take to build your own business becomes something you must come to terms with if your goal is to be an entrepreneur.”

Realizing the benefits of successfully calculating the risks and getting to the point of delivering on their dream also has its challenges. For M4 Sciences, the most challenging aspects of their efforts include managing technology and product development in parallel with strategic growth and establishing key partnerships and simultaneously directing an unimaginable number of details involved in a startup company. Entrepreneurship, then, seems suited for a particular strong-willed personality.

M4 Sciences co-founder, Brian Gootee, agrees. “The old saying that those who are willing to take the biggest risks are also those who will receive the biggest reward is true...
Central to M4 Sciences’ mission is the development of its first product, TriboMAM™, which introduces a new class of Modulation-Assisted Machining processes (MAM) and machine tool devices with the potential to transform machining performance and capability. “Manufacturers of precision components, ranging from automobile parts to biomedical devices, are under constant pressure to reduce cost while improving quality and delivery,” Mann says. “New, innovative machining technologies are needed to sustain product development and production of the high-performance products that improve quality of life. Examples include ultra-precision orthopedic components and instruments and high-performance fuel injection or hydraulic components for improved automotive and aerospace transportation safety and efficiency.”

Funding is ever a challenge to small startups. For M4 Sciences, licensing technology through Purdue has enabled the company to adopt a strategic financing plan that combines the strengths of successful programs from the National Science Foundation, the Indiana 21st Century Research and Technology Fund, and private investment to commercialize the new MAM technology. Mann believes the products and processes for ultra-precision machining that the company specializes in are demonstrating compelling value to the customer, a value that has the potential for endless business development.

**A Formula for Success**

James Mann of M4 Sciences offers his steps for a successful startup:
- **Start with a dream**
- **Be willing to take risks**
- **Have the ability to identify an opportunity**
- **Understand and clearly communicate the value**
- **Lead the way by building a team**
- **Make a plan and secure financial resources**
- **Execute and accomplish all the details under budget**

**Do You Have an Entrepreneurial Personality?**

Seven traits define the entrepreneurship personality according to the team at M4 Sciences. They are:
- **Relentless work ethic**
- **Passion for success and achievement**
- **Ability to lead the way and convince others**
- **Sincerity in association with others**
- **Integrity**
- **Resilience**
- **Willingness to take risks**
For Joseph Gangestad, doctoral student in astrodynamics, space is something tangible, and he wants you to think so, too. Armed with a passion for space and the rich data it yields, he has already come a long way toward making his mark.

A native of Boston, Gangestad earned his bachelor's in astrophysics from Williams College. Having now completed his master's at Purdue, he enters the doctoral program this fall with a clear idea of where he wants to go.

Gangestad’s activities outside the classroom include serving as president of a space data-mining firm, Orbit Frontiers, LLC, and taking part in the Google Lunar X PRIZE competition. These endeavors, coupled with an entrepreneurial spirit, will inspire others with the idea that space is a concrete reality to which we all have access.

Orbit Frontiers has set its sights on utilizing data gathered routinely on thousands of satellites and making it available to industry partners and small companies. Data such as temperature or moisture level, to some superfluous, might be crucial business for others.

“The object is to shorten the path between space and the user,” Gangestad says, “to bring the benefits and access of space to everyone.”

Admittedly a “big picture” guy, Gangestad’s ideas for bringing space data to the masses are ambitious. By mining a 40-year archive of data, the company makes available information that might otherwise be discarded, but which a wide market—from amateur astronomers to scientists to engineers in academia and industry—can make useful. The vision is to create a global network of relationships for providing turnkey launch services to individuals and companies.

Orbit Frontiers will benefit significantly from the work of Gangestad’s other project, the Google Lunar X PRIZE competition. The competition, requiring teams to be 90% privately funded, inspires participants to literally launch a mission to the Moon. To claim the $30 million prize, teams must land a rover on the Moon, rove 500 meters and send images and video back to Earth.

The team, LunaTrex, is led by entrepreneur Pete Bitar and includes representatives from an alliance of companies including Orbit Frontiers. Gangestad is confident in the team’s strength, which benefits from its members’ varying degrees of experience. Funded by Bitar and corporate sponsorships, the project will cost several million dollars and end by 2012. If LunaTrex succeeds, they will capitalize not only on the publicity and goodwill generated by the competition, but the knowledge they gain will form the foundation for a business model, of which Orbit Frontiers is a central aspect.

More than a potential business model, Gangestad believes his work will benefit humankind significantly and wants to share his passion, specifically with the younger generation.

“There are many things one can do with this finite time on earth, my focus happens to be space,” Gangestad says, “Reaching out to youth is an investment in intellectual capital.” Sponsoring a team in a rocket-building contest last year and participating in Purdue Space Day are just some examples of how they are doing this.

The combination of visionary scientist and entrepreneurial spirit which personalize Gangestad’s passion for space is contagious. Proving that space is accessible to each and every individual is the drive behind both his academic pursuits and his business interests. Indeed, with the possibility of placing a rover on the Moon and igniting an enterprising commerce in space data, the sky is certainly not the limit.

Barbara Leonard

Joseph Gangestad in Armstrong Hall
Slow and Steady Wins the Race

Professor Steven Schneider talks about creating a Mach-6 wind tunnel at Purdue

Steven Schneider has never been one to rush through anything. No, the Purdue University professor and aerospace engineer delights in the long term, undertaking projects that may last years, decades, forever.

He learned this about himself as a college student when he rode his bicycle across the United States in 1980. A simple revelation changed the course of his life. “I discovered I was pretty good at projects that take a long time,” he says. “They don’t bother me if I like what I’m doing along the way.”

That explains his dedication to a career spent imagining and then building a $1 million wind tunnel that runs quietly and effectively at 4,000 miles per hour—six times the speed of sound.

His interests at California Institute of Technology wavered between physics and engineering. Physics was too much work; he opted for engineering. He secured a bachelor’s degree, then went to work in San Diego for the U.S. Navy for two years.

Schneider spent time backpacking in the Sierras, trying to figure out what to do with his life. “I discovered I wasn’t as dumb as I thought I was after four years at Caltech. The more interesting problems were the ones that were harder to do and took a long time to work on, yet you couldn’t get them to give you those tasks without advanced degrees.”

So he left the Navy and went back to Caltech, leaving five years later with a master’s degree and PhD, which he calls “the background and union card” in aeronautics. He was well-educated, had an interest in fluid mechanics, and was itching to get focused on a project that would have real applications and make a difference in the world.

Schneider had been working on laminar-turbulent transition in water flows and wanted to further his research. Being a tenure-track professor was not a priority, but he knew he should link with a university to do his research.

Purdue made an offer in 1989, and Schneider headed to West Lafayette. When he learned the campus had no low-turbulence wind or water tunnel, he decided to find a way to develop a high-speed transition-quality wind tunnel.

The nation’s only other supersonic low-noise tunnel was at NASA Langley Research Center. The experts in the technology were nearing retirement age, and Schneider saw an opportunity to continue their work. He visited Langley, landed some funding, and stayed there for a summer to learn everything he could from the experts who pioneered the technology.

Schneider secured some money from the Air Force Office of Scientific Research (AFOSR) that allowed him and his students to develop a Mach-4 tunnel that was too limited to be of much use but had promise. Then, with encouragement from senior researchers and a half-million dollar grant from Boeing, hard work began to pay off. “I was telling people that I may fail if they stop funding me, but I won’t quit,” he recalls. There would always be work with the government or private industry, but he wanted to make the wind tunnel a reality at Purdue.

“They didn’t stop funding us,” Schneider says, “and we finally got the tunnel to work.” It is instrumental in the process of testing advanced aircraft and collecting data to measure air flow during flight. The wind tunnel, called the Boeing/AFOSR Mach-6 Quiet Tunnel, gives accurate data because it so closely simulates flight.

Schneider was responsible for the design, but it was students who carried out experiments and documented results. All but one of his graduate students has been involved, resulting in five PhD theses and 13 master’s theses about the project.

Schneider says he could never have developed the wind tunnel were it not for the backing of a research university. Such an environment, he says, is “the place to work on really tough long-term problems, taking risks to try to do really new and difficult things in areas that have a significant payoff to the United States, if you are fortunate enough to be successful.”

Laura Lane
Campbell’s Success All in the Numbers

AAE degree fuels alum’s 25-year career in computer analysis, decision making

I found a whole new stratosphere. Things that used to be easy were hard. Purdue upped my game.

Michael Campbell
BSAEE '83

Mastering complex math and problem-solving skills in aeronautical and astronautical engineering gave Michael Campbell (BSAEE ’83) the ideal launch pad for a career centered on new ventures, computers, and math. It earned him recognition as a pioneer in applying mathematical optimization to complex management tasks.

In Business as a Student

Campbell took his first flight into the business world as a sophomore, the year IBM debuted its personal computer. At Purdue, “I found a whole new stratosphere. Things that used to be easy were hard. Purdue upped my game,” he says. He and a partner started a microcomputer company to help small businesses. Working with entrepreneurs, “I realized it wasn’t that hard,” he says.

For electives, he headed to Purdue’s Krannert School of Management. “I did my first business plan as an independent study course while I was learning mathematical optimization in aerospace. My whole career since then has been to blur the line between the mathematician and the person with business smarts.”

In 1983, his venture “morphed into” General Optimization Inc., a software developer. In 1989, he founded Campbell Software in Chicago, which developed workforce management tools for retailers, including the scheduling software used by Starbucks.

After a decade, Campbell sold to SAP America Inc., staying a few years in leadership, and in 2002 took the helm at TempoSoft. Three years later he joined Fair Isaac Corp., a company that applies high-level math to study fraud, determine credit worthiness and explain consumer behavior. There, he’s chief operating officer in its Minneapolis headquarters.

“It’s been a straight trajectory,” Campbell says. A defining moment was his decision as a student “to play down the middle, take engineering and math and apply them to business.”

Engineering Discipline Key

Throughout, Campbell has relied on the engineering discipline. “I use it every day, handling gnarly problems—technical, business and personal. I remember, ‘Don’t panic. Break the problem down. Solve it in chunks.’ You can do almost anything that way.”

An advocate for launching businesses while young, he says, “If you’re going to make big choices and take big risks, coming out of school is the best time. Take the plunge early, when you have more energy, less to lose, and the willingness to work at all costs to get things done.

What’s ahead is wide open. “There are huge opportunities to apply high-level mathematics to the real world. We’re just starting to scratch the surface. There are important problems to be solved, and new ways of running businesses and helping companies grow faster and smarter.”

Michael Campbell

Life beyond work

When he’s not commuting the 400 miles between Minneapolis and his Winnetka, Ill., home or traveling globally for work, Michael Campbell is with family—his wife, Colleen, also a Purdue alum now starting an apparel company, and three daughters, who drew him into a world he never before experienced: live theatre.

“How that happened to an engineer, I have no idea. But it’s absolutely a blessing. I’m always going to play, concerts and recitals.”

K. M.
From the time he could toddle, Peter Blake Mueller lived life with a dream in his heart and his eyes on the sky.

Passionate about aviation, Peter was fascinated by all aspects of flight: Stopping mid-sentence, or mid-activity, to watch and identify a plane cruising overhead; constructing paper airplanes and flying them around the house; traveling to air shows and aviation museums—and always persuading his parents to stop at every airport along the route.

Although he inherited some aspects of aviation—his father, Rud Mueller, is director of architecture for Tampa International Airport, and his mother, Corinne Mueller, recently retired after 25 years as a reservation agent for Delta Airlines—Peter embraced the field on his own terms, with dreams of earning a pilot’s license and designing airplanes. His career path, Peter often told his parents, would lead from their Tampa, Florida, home to Purdue University, where he planned to study aeronautical engineering.

The journey, however, ended abruptly. While on an instructional flight at Culver Academies Aviation Specialty Camp in August 2005, Peter, then 14, was killed when his plane plunged into Lake Maxinkuckee. His flight instructor, Purdue University senior Brent Bauman, also died in the accident.

While the Muellers were left to cherish memories of a beloved son described as “kind, sensitive, and mature beyond his years,” they also were inspired to ensure his legacy would soar through the accomplishments of students in Purdue’s School of Aeronautics and Astronautics.

“The thought of a scholarship came into my mind the morning after Peter’s accident,” Rud recalls. “Corinne and I considered alternatives, but we always came back to Purdue. We knew that was where Peter wanted to be.”

Impressed by Purdue’s roster of aviator and astronaut alumni, Peter had ranked “attending Purdue” as his top goal in an eighth grade essay. A trip to campus in spring 2004, and the chance to roam Grissom Hall, heightened Peter’s enthusiasm.

“We bought him two Purdue t-shirts,” Corinne says, “and he wore them all the time.”

The Peter Mueller Memorial Scholarship in Aeronautics and Astronautics honors this extraordinary young man, and the vision he exemplified. Beginning in fall 2008, the scholarship will be awarded annually on the basis of merit and financial need and is designated for an undergraduate who is committed to studying aeronautics.

“As funds are added through the years, there may be several scholarships awarded,” says Rud of the endowment. “Purdue also was willing to make contact between us and the recipients, and we look forward to meeting these students.”

Equal in value to the assistance provided is the message this memorial conveys—one that the Muellers witnessed every day of Peter’s life.

“It’s so important to let your children find their passion, and live their dream,” says Corinne. “Peter’s destiny was established early on, and he died doing exactly what he loved most.”

“The school counselor who spoke at his funeral said Peter did more in 14 years than many people do in a lifetime.”

Jan Mathew
This colorful collage consists of work by MSE Professor R. Edwin Garcia. It is actually two superimposed simulations of the nucleation and growth process of an undercooled Nickel melt. The background shows periodic tapestry of Ni nuclei during the initial stages of the solidification process. The superimposed structure in the center corresponds to a single solidified Ni- dendrite. The coloring embodies the degree of crystallinity and the orientation of each nuclei. Simulations were performed by Michael Waters (BSMSE 2008). Garcia's work is featured in the current issue of MSE Impact.