Dear AMEP students and alumni,

It’s that time, when I look back on the past academic year and report to you. Overall, AMEP is now on much sounder footing than just a few years ago: we have a vigorous program that has grown from a low of about a dozen students to about 40. AMEP was never designed to be a “large” program: but, as I keep repeating, it is invaluable both for the students’ unique career preparation, and for the niche it fills in our science and technology economy. Its impact is disproportionate to its size.

We have had our yearly “student-alumni get togethers” (aka The AMEP Taco Party), first with the visit of Dan Koellen (who has tirelessly helped AMEP) in the fall and then, in the spring, with the first visit by Lloyd Hackel (AMEP 1971). There is more inside on Lloyd’s accomplishments, but, to whet your appetite, imagine a piece of technology using high powered pulsed lasers, materials science, and fluid dynamics that extends the lifetime of aircraft engines by a factor of 3 or more! In his talk to the students, I appreciated his advice: to not be daunted if, in your career, the first few projects are not a great success: if one out of 10 of your ideas is a “hit”, you will be very successful.

Another piece of news in the “bragging about AMEP category” is that Nelson Tansu (AMEP 1998) was awarded the Wisconsin Alumni Association’s “Forward Under 40” Award. He was the youngest ever tenured professor at Lehigh, and I plan to highlight his work in a forthcoming issue of the newsletter.

Lastly, I have created an AMEP group on Facebook. I intend this to be an avenue for students and alumni to exchange information and so that we can efficiently spread news, invitations, and the like. If you have a Facebook account, become a member of the AMEP group and post often!

See you next year,

Paul Milewski,
AMEP Coordinator
Faculty Profile

Professor Jean-Luc Thiffeault is a member of the Applied Mathematics group at UW-Madison, and one of the mathematics advisors for AMEP. True to the nature of AMEP, his educational background is actually in the field of physics. Professor Thiffeault received a B.S. in Physics from McGill University in his hometown of Montréal in 1993, and went on to the University of Texas at Austin where he received his master’s and PhD in Physics in 1995 and 1998, respectively. After completing his education, Professor Thiffeault was a post-doc at Columbia University in the Applied Physics and Applied Mathematics department. He then served four years as an applied math lecturer at Imperial College London.

In August of 2007, Professor Thiffeault arrived at UW-Madison and almost immediately became involved in the AMEP program. As an applied mathematician, Professor Thiffeault says that working with the AMEP program seems like a natural fit. He also compliments the program as an optimal choice for students who wish to attend graduate school in some form of science or engineering, but have not yet decided on a specific concentration. Professor Thiffeault is also impressed by the various avenues that AMEP opens outside of the sciences, such as law or business school: “Can you imagine what kind of advantage it is to have a thorough scientific background if you'll be doing patent law or assessing technology startups?” Above all, Professor Thiffeault commends AMEP for allowing students to become multifaceted. “AMEP is a great example of a rule I try to live by: don't see yourself as 'one thing,'” he says. “We are not engineers, mathematicians, or physicists. We are simply trying to understand something about the world, and we'll do whatever it takes.”

Throughout his career, Professor Thiffeault has been interested in fluid mechanics, specifically various methods for mixing. He spent the past academic year on leave at the University of Minnesota, where he worked at the Institute for Mathematics
and its Applications on a year-long program in complex fluids and flows. It was during this time that he became interested in how marine life works to mix ocean water. Professor Thiffeault is very excited about this new direction, citing that “there is very nice mathematics involved in understanding how moving bodies disturb the fluid around them, and how to cumulate this over a large number of swimming creatures.”

When asked to impart wisdom on current students in AMEP, Professor Thiffeault stresses the importance of attending research seminars. He admits that such seminars are not aimed at undergraduates, and that students are often unable to completely understand the material being presented. However, he feels that witnessing the process of a seminar provides great insight into the culture of academia: “How are research results presented by the pros? What kinds of questions are asked? These issues are important in becoming a practitioner.”

Keeping with the tradition of AMEP faculty profiles, Professor Thiffeault says that the equation he would have tattooed to his body is Birkhoff's Ergodic Theorem. For readers that are not familiar with this theorem, Professor Thiffeault explains:

"The theorem basically says that under the right conditions spatial averages are the same as time averages. For example, if you are looking for your friend who is wandering aimlessly in a museum, you can either sit in one place and wait for her, or go and look for her. If her movements are random, you're guaranteed to find her either way."

While certainly an unusual choice, Professor Thiffeault admires how useful it is. “[The theorem is] so useful that it's used even when it doesn't quite apply!”

**Recent Graduates**

**Kyle Mandli** graduated from AMEP in 2004, with an engineering focus in engineering mechanics. He currently attends the University of Washington, where he is pursuing a PhD in Applied Mathematics. Kyle started his undergraduate studies in engineering, but soon began looking for a program that allowed him to enroll in more math and physics courses. In retrospect, Kyle is very happy with his decision: “I think in the end it was the mathematics behind the physics and engineering that I enjoyed the most, so AMEP was a great fit.”

As a graduate student, Kyle studies computational fluid dynamics related to geophysical flows. Kyle points to his AMEP education as a primary reason for his interest in this field of study, as well as applied mathematics as a whole. In fact, Kyle says his two favorite courses at UW-Madison were Math 703-704, Methods of Applied
Mathematics, taught by Professor Milewski and Professor Waleffe. Furthermore, the interdisciplinary nature of the program aids in much of Kyle’s current work. “The breadth of engineering and physics has been essential in my research and communicating with other researchers in a diverse set of fields.”

During his time at UW-Madison, Kyle obtained diverse research experiences. He worked on the Ice Cube/AMANDA project for the Physics department, atomic force microscopy with Professor Carpick of the Engineering Mechanics and Aeronautics department, and image analysis with Professor Milewski. When Kyle was not hard at work on his course work or research, he found time to play ultimate and work as a tutor for GUTS. Kyle still finds time to occasionally visit family and friends in Madison, and will always remember attending football and basketball games, studying at Espresso Royale, and studying late into the night at his lab.

Kyle's most important piece of advice for current AMEP students is “just to pursue what you are most interested and don't worry too much how you get from point A to point B. In fact, where point B is may be unplanned but life has a funny way of guiding you in ways that you would never have foreseen. It can also be quite discouraging sometimes but everyone feels that way at some point and it almost always works out for the better.” He also stresses the ongoing significance of having an AMEP background “as our society becomes more complex and scientists and engineers need people such as AMEP majors to accomplish future research and development.”

**Eric Stava** graduated from AMEP in 2003, and is currently a graduate student at UW-Madison in the Electrical and Computer Engineering (ECE) department. After completing the AMEP program, Eric received a master’s degree in ECE from the University of Florida, before returning to UW-Madison for his doctoral studies. Eric says he first became interested in AMEP because it combines the three areas of study he enjoys most: math, physics, and electrical engineering. “Like most college students starting out, I wasn't sure what I wanted to go into,” Eric says, “so I initially opted for a breadth of coursework over specializing in one particular area.”

Eric’s primary research interest, bioelectrics, certainly encompasses the broad scope of his AMEP background. This interdisciplinary field involves concepts related to semiconductor circuits and devices, as well as biological systems, such as cells, proteins, and ion channels. This field is studied by people from various departments, so the skills Eric acquired from his undergraduate education allows him to communicate better with his colleagues. “Physics and applied mathematics are like a common ground between us,
and having a strong background in these fields is crucial to successful interdisciplinary research.”

Eric has several fond memories of UW-Madison, and continues to make new ones. As an undergraduate, he worked in the Physics department developing undergraduate lab equipment, and was a member of Hoofers Sailing Club. His two favorite courses were Math 415, Applied Dynamical Systems, Chaos, and Modeling, with Professor Milewski and ECE 602, Bioelectrics, taught by Professor Blick, whom Eric currently works for. Above all, Eric says when he leaves Madison, he will miss the overall atmosphere. “It's a weird combination of drive and contentment--everyone seems so intent on bettering themselves and creating a better future, yet everyone is still extremely satisfied with the world in which they are living.”

Eric urges current AMEP students to make the most of the opportunities afforded by the AMEP program to find the most interesting field of study. As with any walk of life, it is important to find research in something that one enjoys, and “the more you enjoy doing what you do, the more successful you will be.” At the same time, Eric wants today’s AMEP students to lead a balanced life, and realize there is more to the university and the city of Madison besides academics.

Alumni News

Congratulations to **Professor Nelson Tansu**, one of the 2010 recipients of the Wisconsin Alumni Association’s Forward Under 40 Award! Professor Tansu graduated from AMEP in 1998, and continued at UW-Madison for his PhD in Electrical Engineering in 2003. Soon after graduation, Professor Tansu moved to Lehigh University as a faculty member
in the Electrical and Computer Engineering department. Just last year, at age 31, Professor Tansu became the youngest tenured professor in the school’s history. Professor Tansu’s research group focuses on improving energy efficiency and renewability using nanotechnology.

Dr. Lloyd Hackel graduated from AMEP in 1971, with an engineering focus in engineering mechanics. Lloyd’s interest in AMEP was realized before he matriculated to UW-Madison. Coming from a family that worked in heavy construction, Lloyd had an appreciation for engineering, but his strong interest in math and physics drew him into applied physics and engineering. Lloyd first learned about AMEP during the summer before his freshman year from a Letters and Science majors catalog, and immediately entered into the program.

During his undergraduate years, Lloyd was active athletically, as a member of the freshman rowing team, an intramural basketball player, a sailor with Hoofers, and a recreational tennis player. He also worked in the physics departments as a technician for Professor Dale Meade, as well as a math tutor for incoming students needing additional help.

After graduating from UW, Lloyd began his graduate education with the Aeronautics and Astronautics Department at MIT in 1971. As a recipient of a three year National Defense Education Act Fellowship, he had a great deal of freedom to focus on his course work and theses. Lloyd was again drawn to an interdisciplinary program at MIT called Instrumentation, similar to AMEP, because it was jointly run by the math, physics, and aeronautics departments. After receiving his MS in 1973, Lloyd completed his PhD in 1974. His work focused on developing a laser with frequency held stable to a few parts in $10^{14}$ such as used for atomic clocks and his PhD thesis involved using the “stable laser to measure precise
wavelength shifts in the hyperfine structure of a sigma to pi electronic transition in molecular iodine, thereby determining a nuclear spin-spin interaction.”

Lloyd continued on as a post-doc at MIT’s Research Laboratory for Electronics for 18 months, then took a job as a physicist at the Lawrence Livermore National Laboratory in Livermore, CA where he worked for 28 years. During his tenure at Livermore, Lloyd developed a three laser photon ionization process for uranium isotope separation, as well as electron beam vaporizers and electrostatic extractors for the separation process. In 1987, he took a two year leave of absence from Livermore to work at Lockheed Missiles and Space Company on a space based laser-antimissile project for the Air Force. After returning to Livermore, Lloyd worked on numerous high power laser applications, including production of x-rays for printing micro-scale IC’s, imaging satellites at the Air Force Starfire Optical Range, developing a high average power laser for mortar and missile defense and optics damage issues and laser technology for the National Ignition Facility, the world’s most powerful laser. A centerpiece of his work was the development a unique high power laser that generates 10^9 Watts peak power at up to 5 Hz pulse repetition rate, a rate twenty times faster than any other system of comparable peak power. He then directed this laser technology into a very successful application called laser peening.

Laser peening is a surface treatment process that uses pressure generated by the laser to plastically deform metal and thereby generate internal residual compressive stress to extend a material’s fatigue life and resistance to stress corrosion cracking. The plastic strain generated can also be engineered to shape components such as wing panels of advanced aircraft. In 2002, Lloyd transitioned laser peening to the private sector and now works at Metal Improvement Company, where he leads the development of new applications of laser peening. This technology is finding use for improving fatigue lifetime of turbine blades such as those on the jet engines for the Boeing 777 and the new 787 Dreamliner as well as for gas and steam turbine blades for electric power generators. It is also being used to improve the fatigue life of medical hip implants and is deployed to improve fatigue life of structural components such as the wing attachment lugs for the F-22 Raptor. As a technique for forming, the technology is used to shape thick sections of the 110 foot long wing panels for the new highly fuel efficient Boeing 747-8.

To this day, Lloyd has many fond memories of his years as a student at UW. On one particular night during the winter of his senior year, he and a friend tried an experiment while walking onto frozen Lake Monona. They tried several times to walk in a straight line while keeping their eyes closed, but invariably kept walking in circles. Lloyd also remembers home Badger football games, at which he was able to get press
passes, thanks to a high school friend who worked for a Green Bay television station. This allowed Lloyd to watch several games on the field from the sidelines. Another poignant memory is when he and a bunch of friends embarked on a spring break road trip to California. In retrospect, that trip is even more remarkable, considering gas cost only 29 cents per gallon!

This past semester, Lloyd returned to campus to talk to AMEP students about his current work in laser peening and how AMEP prepared him in his career. The talk allowed the students to learn about just a few of the vast career opportunities opened up by an undergraduate education in AMEP. Grateful to have had the opportunity to meet with the students, Lloyd offers some advice:

“The first is to study hard, because good grades and the UW education will open up great opportunities for you. Second, as Prof Schalack made sure that I understood, have confidence that you can compete with the very best graduates from any university…You are the future of our country and I have great confidence that you will be the engineering and scientific leaders that we need.”
Mark Bushbeck graduated from AMEP in December of 1986 and started working at the Boeing Company in Seattle about a month later. He also received a master’s degree in Electrical Engineering from the University of Washington in 1992. Continuing his pursuit of education, Mark started doctoral studies in electrical engineering, but has since put that on hold to obtain a Master of Business Administration degree.

Throughout his collegiate career, Mark was fascinated by flight and its many challenges, so he eagerly accepted an offer from Boeing. Mark lauds the career voyage he has embarked on, saying, “[it] has turned out to be more interesting and rewarding than he was able to imagine then, and it's still full of challenges and exciting opportunities.” In his years at Boeing, Mark has worked principally in research and development of aircraft, satellites, radar systems, infrared and laser systems, measurement technologies, computing technologies and communication systems. His vast array of other activities include studying problems in multi-dimensional signal processing, lightning and electromagnetic scattering, publishing over thirty technical articles and reports, serving on the board of directors for the Antenna Measurement Techniques Association, and traveling to a dozen countries. His most recently completed team project was the successful flight demonstration of the Airborne Laser Testbed (ALTB), which has the highest energy laser ever fired from an aircraft, and is the most powerful mobile laser device in the world. This experiment marked the first time a laser weapon engaged and destroyed an in-flight ballistic missile. “It continues to be a great ride,” Mark says, “and there seems to be almost no technical problem where I cannot contribute something towards an effective solution.” Mark attributes much of his professional success to what he learned from his undergraduate experience at UW-Madison.

The AMEP program was a great choice for Mark, who describes himself as “a rather independent, curious and driven person.” As it is today, AMEP was less popular than related programs, so it required additional independence while allowing for more custom tailoring than other programs. Mark relished those characteristics. AMEP was first suggested to Mark by a freshman advisor, based on his interests and desired future. Mark already appreciated mathematics, and saw physics as a way to connect the abstract to real world problems. The engineering focus in ECE allowed Mark to pursue electronic circuits, another passion of his. Overall, the program allowed Mark to explore an optimal balance between breadth and depth in the sciences, and it is this foundation that has served him and his colleagues well. Mark wishes to impart these words onto current and prospective AMEP students:
“AMEP graduates are certain to be equally well prepared for either graduate school, professional employment, or, as in my case, both. Looking back at my UW AMEP experience, I know I would eagerly do it all again, if given the chance. That's a satisfying realization to own. The AMEP program delivers on its promise. Have a great life. You will. I do.”

Dr. Dennis Phillips received his undergraduate AMEP degree in 1967. He completed the first three years of the program in Milwaukee and subsequently came to Madison. He received his PhD in mathematics in 1981 from the University of Maryland in College Park. As an undergraduate, he indulged his enjoyment of mathematics by taking more math courses. He admits that one of his goals in taking courses in numerical analysis, numerical linear algebra, measurement theory, and approximation methods is that he wanted to learn how to calculate. More importantly, he wanted to figure how to do the arithmetic that transformed physical measurements into scientific and engineering models in a way that he understood.

As an undergraduate, he worked at the Space Science and Engineering Center (SSEC). He worked with the satellite images taken by spin-scan cameras in geosynchronous orbits, invented by Professor Verner E. Suomi and Professor Robert Parent. One of his responsibilities was to develop methods that would determine the locations of clouds and other visible weather phenomena. This work culminated in the development and delivery of software to the National Oceanic and Atmospheric Administration (NOAA) in 1981 that determined the orbit and altitude for NOAA's geosynchronous satellites, so that the geographic grids that are seen on televised weather forecasts are accurately located. He delivered versions of the same software to the SSEC and the German Operational Space Center.

These experiences led him to consider other problems in predicting satellite trajectories and weather forecasting. Dennis describes that for any scientific and engineering model, “people regularly have to transform collections of measurements into instances of functions in complex functional spaces. For instance, we transform satellite tracking measurements into predicted satellite trajectories. We transform weather observations conjoined with satellite observations into weather forecasts.” Dennis's current insight is that these transformations can be done more accurately and systematically by combining the underlying measures of these functional spaces with singular value inversion methods. Dennis is currently proposing to apply these techniques to improve weather forecasting.
**AMEP Leadership Prize**

**Yaroslav Vergun** is the recipient of the AMEP Leadership Prize for 2010. Originally from Kiev, Ukraine, he moved to Chicago at age 7 with his family. Following high school, Yaroslav’s college choice was between UW-Madison and the University of Illinois, Urbana-Champaign. Ultimately, Yaroslav chose UW-Madison because “Madison is more exciting than Urbana.”

Yaroslav acquired an early interest in AMEP during his SOAR session. After meeting with Doug Lipinski, a previous AMEP Leadership Prize winner in 2006, he found that AMEP suited his academic interests. Yaroslav was convinced, and immediately started in AMEP as a freshman, with an engineering focus in Nuclear Engineering. In fact, AMEP seems to run in the family, as his twin brother Svyatoslav is also a student in the program.

This summer, Yaroslav is delving into math research opportunities at an REU at Pennsylvania State University. He is not yet sure what his work will be in, but the topics being investigated are Geometry of Polynomials and Elements of Fractal Geometry and Dynamics. Yaroslav has also worked on several exhibits at the L.R. Ingersoll Physics Museum inside Chamberlain Hall. So far, his favorite class is Math 321, Applied Mathematical Analysis, with Professor Waleffe. Despite being very challenging and demanding of his students, Yaroslav appreciates that Professor Waleffe is “devoted to his teaching,” and that the course “was unique in that he taught it his way.” Indeed, several AMEP students consider this course a highlight of their undergraduate education.

When asked for advice to impart on prospective AMEP students, Yaroslav enthusiastically encourages incoming students with even a slight interest in AMEP to check it out. “Go for it,” he exclaims, but also concedes that “if you don’t like it, switch.” In particular, Yaroslav has really enjoyed the vast number of options for courses the AMEP allows, more so than one could possibly have time for. After graduating next year, Yaroslav plans to attend graduate school in either math or applied math.
## Contact Information

For any information regarding the AMEP program, please contact the AMEP coordinator:

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The AMEP website is [www.math.wisc.edu/~amep](http://www.math.wisc.edu/~amep).

### Giving to the AMEP Program

If you would like to make a gift to support the AMEP program at the UW-Madison, please consider giving to Fund number 12553426, The Applied Math, Engineering and Physics (AMEP) Support Fund.

Gifts to this Fund support AMEP, a unique interdisciplinary program. The Fund will support activities designed to improve AMEP's ability to mentor students successfully, to foster a sense of community among students and faculty, and to enhance the visibility of AMEP on campus and to prospective students, corporate recruiters and graduate schools.

You may make your gift online at [http://www.math.wisc.edu](http://www.math.wisc.edu), clicking on “Giving to Mathematics”, and choosing the AMEP Support Fund. Or, you may send your gift to:

University of Wisconsin Foundation
US Bank Lockbox
PO Box 78807
Milwaukee, WI 53278-0807

Mark AMEP and the fund number 12553426 in the memo line of your check.

If you wish to speak with someone about your gift or other giving options, please feel free to contact our representative at the UW Foundation:

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