# ECE Connections

## Newsletter to Graduates and Friends of Electrical and Computer Engineering Fall 2003

Web Page: http://www.ece.ndsu.nodak.edu
Phone 701-231-7019 Fax 701-231-8677

### Faculty:

Dr. Dan Ewert, Professor, Chairman

Dr. David Farden, Professor
Dr. Bapaswara Rao, Professor
Dr. David Rogers, Professor
Dr. Subbaraya Yuvarajan, Professor

Dr. Jacob Glower, Associate Professor
Dr. Joel Jorgenson, Associate Professor
Dr. Rajendra Katti, Associate Professor
Dr. Robert M. Nelson, Associate Professor
Floyd Patterson, M.S. Associate Professor
Val Tareski, M.S. Associate Professor

Dr. Roger Green, Assistant Professor
Dr. Rajesh Kavasseri, Assistant Professor
Dr. Ivan Lima, Assistant Professor
Dr. Mark Schroeder, Assistant Professor

### Staff:

Oscar Blaskowski, Electrical Technician
David DuShane, Computer Technician
Pam Gahner, Administrative Secretary
Priscilla Schlenker, Administrative Secretary

### Table of Contents:



### From the Chairman:

It's been a long time since we've updated the progress of the ECE department and I think you'll be pleased with our work. We have a renewed sense of purpose: to create a scholarly, intellectual, and creative environment where students, staff and faculty can all realize their fullest potential. We believe that a way to achieve this goal is to have our faculty engaged in scholarly work and then communicate these ideas to students and faculty through their classes and seminars. To this end we have begun a number of new initiatives. First, under the leadership of Dr. Dave Farden, our faculty developed a new curriculum that we believe will help the students understand and retain fundamental concepts better. Second, we've instituted weekly assessment meetings on educational improvements for both our undergraduates and graduate students. Third, we now have weekly research seminars where the latest creative thinking is disseminated to the faculty and students. Fourth, we've initiated a "blue-sky" think tank where creative ideas can be generated. Fifth, one of these "blue sky" ideas, the teaching lab, was conceived and later turned into reality. It is where faculty can hold office hours and their students can sit and work in small groups and receive instant feedback from the instructor. Sixth, our students are achieving at or well above the national average on the fundamentals of engineering (FE) exam. Seventh, Dr. Jake Glower is leading the effort to develop quality in our recently approved ECE PhD program.

I urge you to read through this issue and see what each individual professor is doing. There are exciting things taking place in ECE and we hope that you'll feel our optimism too.

*Dr. Dan Ewert*

# Annual Summer Camp held for American Indian Initiative

From It's Happening at State, Aug. 27, 2003

The annual NDSU summer camp that focuses on science, mathematics and engineering opportunities for American Indians drew participants from across the state. The camp was held June 2-13 on campus.

This year, 17 students from three tribal colleges participated. Five additional students from Little Hoop, Turtle Mountain, Fort Berthold and Sitting Bull Colleges presented their research papers at the opening ceremony. Seven tribal college faculty and five reservation high school mathematics/science teachers attended the camp. In addition, two American Indian alumni of NDSU, who are successful professionals, addressed the students at the opening ceremonies.

The Office of Naval Research/Navy-funded project, "An Adaptive Systemic Initiative of Tribal Collaboration for Increasing Native American Participation in Mathematics, Science, and Engineering," is a collaborative effort between North Dakota's five tribally controlled colleges and the NDSU College of Engineering. The educational initiative is designed to attract American Indian youth to careers in mathematics, science and engineering.

The project has several components, including an annual summer camp at NDSU for tribal college students, annual summer camps for high school students at each of the five tribal college sites and monthly one-day academy sessions for reservation high school students. In all of these activities, NDSU and tribal college faculty and reservation high school teachers are involved. The five-year project just completed its fourth year of activities.

Camp activities for the students included laboratory visits and demonstrations in physics; chemistry; computer science; civil, mechanical, electrical, and industrial and manufacturing engineering; industry and field visits; mathematics lessons; and project work. NDSU instructors introduced career prospects in science, mathematics and engineering disciplines to the students.

In addition to providing assistance to students' day-to-day instructional needs during the camp, the teachers and the faculty from NDSU and tribal colleges worked together in developing lesson plans for the high school summer camps that were held June 16-27 at four tribal college sites and for the upcoming 2003-04 Sunday Academy sessions.

G. Padmanabhan, professor of civil engineering; Robert Pieri, professor of mechanical engineering; Wei Lin, assistant professor of civil engineering; Eakalak Khan, assistant professor of civil engineering; Frank Peloubet, lecturer of civil engineering; Floyd Patterson, associate professor of electrical engineering; Sharon Cobb, Group Decision Center director; and William Martin, associate professor of mathematics, were the primary instructional resources for the summer camp. Pieri coordinated the activities of teachers and tribal college faculty, while Cobb coordinated the activities of the students in the camp. Many other faculty members also helped in lab demonstrations and in guiding the students through their projects.

# NDSU Workshop held for Tribal College Faculty and Reservation High School Teachers

From It's Happening at State, Sept. 10, 2003

Seven North Dakota tribal college math and science faculty and four North Dakota reservation high school teachers participated in a workshop held at NDSU Aug. 7-9. The workshop was part of a five-year collaborative project between NDSU and the five tribally controlled colleges designed to attract American Indian high school students into the science, mathematics and engineering fields.

The project, funded by the Office of Naval Research, recently concluded its fourth year of activities. They include a two-week summer camp at NDSU for tribal college students, faculty and reservation high school teachers, and a two-week summer camp at each of the tribal colleges for the reservation high school students.

The purpose of the workshop was to develop lesson plans for a series of seven one-day academies planned for the project's fifth year, which began Sept. 1. The lesson plans included topics such as hypsometry, inclinometers, tessellations, buoyancy, water pressure and flow rates, micro-organisms in water, electrical circuits and flight mechanics. Mathematics, science and engineering concepts relating to each topic at the appropriate level were developed. Hands-on activities were included to kindle and sustain the students' interest. Wherever possible, culturally relevant examples of applications of the topics also were included.

The academies are targeted towards high school students in each reservation. Similar one-day academies also were conducted during the first four years of the project. Last year, 50-60 students were in attendance at the Turtle Mountain site. Standing Rock, Fort Totten and Fort Berthold sites each had 15-20 students in attendance. The United Tribes site had two, but is scheduled to enroll more students this year.

Wei Lin, associate professor of civil engineering, coordinated the workshop. G. Padmanabhan, professor of civil engineering; Robert Pieri, professor of mechanical engineering; and Floyd Patterson, associate professor of electrical and computer engineering; Eakalak Khan, assistant professor of civil engineering; and William Martin, associate professor of mathematics, contributed to the workshop.

# Our Newest Faculty:

**Rajesh Kavasseri** is an Assistant Professor of Electrical Engineering at North Dakota State University; he joined the department in August 2002.

Dr. Kavasseri received his BSEE from Visvesvaraya Regional College of Engineering in 1995, his, MSEE in 1998 from Indian Institute of Science, Bangalore, India and Ph.D. from Washington State University, Pullman in August 2002.

Dr. Kavasseri is an active member of the IEEE Power Engineering Society. Dr. Kavasseri's research interests include power systems: dynamics, stability, control, nonlinear dynamics and chaos. In 1998, he received the Gold medal from the Indian Institute of Science for the best Master's thesis. Currently, he is involved with research in the field of wind energy systems, specifically looking at issues involved with grid integration of such systems

**Mark J. Schroeder** is an Assistant Professor of Electrical and Computer Engineering at North Dakota State University; he joined the department in August 2002.

Dr. Schroeder received his BSEE from North Dakota State University in 1990 and his MSEE also from NDSU in 1994. He received his Ph.D. in Biomedical Engineering from the University of Texas at Austin in 1999. Dr. Schroeder is an active member of IEEE and IEEE EMBS. He is a manuscript reviewer for: Med. & Biol. Eng. & Comput. and Aviat. Space and Environ. Med.

Dr. Schroeder's current research interests are in the areas of brain-computer interface devices, therapeutic effects of electromagnetic fields, neural engineering, and biomedical signal acquisition and analysis. He has performed research in cardiovascular engineering and was part of the research team in Louisville, KY that performed the first totally implantable artificial heart surgery in a human.

**Ivan Lima** is an Assistant Professor of Electrical and Computer Engineering at North Dakota State University; he joined the department in August 2003.

Ivan Lima received his BSEE from the Federal University of Bahia, Brazil, in 1995, his MSEE from the State University of Campinas, Brazil, in 1998. From 1998 to 2003, he worked as a research assistant at the Optical Fiber Communications Laboratory at the University of Maryland, Baltimore County and received his Ph.D. in EE from the UMBC in December 2003.

In 2003, Ivan Lima was awarded the IEEE/LEOS Graduate Student Fellowship Award by the Laser and Electro-Optics Society of IEEE. In 2003, he also co-authored a paper that won the Venice Summer School 2002 Award. That paper was published in the Proceedings of the 29th European Conference on Optical Communication that was held in Italy in 2003. He has authored or co-authored over 18 archival journal papers, 35 conference papers, one book chapter, one US patent, and one software license.

# Faculty Areas of Interest & Research

## Cardiovascular Engineering Lab

At the time of this writing, the Cardiovascular Engineering (CV) lab is staffed by Bruce Wheeler, Jeff Wandler, Matt Anderson, John Totenhagen and Nathan Grenz. We are researching how to measure the visco-elastic properties of the beating heart during ejection. We collaborate with Medtronic, University of Louisville, and Birmingham Children's Hospital (England).

- **Bruce Wheeler:** is working on preparing results for publication of viscoelastic model. Ongoing data analysis and verification of model parameters with custom software developed using Matlab. Also researching historical development of muscle theory. He is currently working with the Center for Nanoscale Science and Engineering (CNSE) to develop small sensors for detection of heart rate.

- **Jeff Wandler:** is working to create a Matlab program to assist with Univentricular heart patient diagnostics with Birmingham Children's Hospital. Create a Simulink Model of the heart using the Hill muscle model to predict HMP, Pelast, and LVP using small volume oscillations. Research creating/using a volume catheter to generate small volume oscillations and extract the heart model parameters.

- **Matt Anderson**: Preparation of Medtronic hemodynamic data sets for analysis of the visco-elastic properties of the beating heart during ejection. Specifically, this entails the examination of aortic flow waves, left ventricular pressure waves and aortic pressure waves of specimens introduced to calcium stimulation (a supplement known to cause stronger muscle contractions). The preparation includes separating the data sets into a beat-by-beat basis using MATLAB software, as well as assisting with visco-elastic model calculations.

- **John Totenhagen**: is researching the effects of exposure to a microgravity environment on the cardiovascular system. In particular he is analyzing data from experiments performed on rhesus monkeys in which a prolonged head-down-tilt was used to simulate microgravity. Left ventricular pressure and aortic blood flow were measured using invasive catheters and probes. John is using methods previously developed at the NDSU cardiovascular lab to examine the effects of microgravity on cardiac source parameters Pelast and K.

  Pelast is a pressure generating component which can be thought of as the ability of the heart to generate pressure and flow in a frictionless myocardium. Pelast reflects the changing potential of the ventricle to create pressure and flow as it contracts. K is a term which is calculated from the relationship between left ventricular pressure and Rs. Rs is a viscous loss due to the friction involved with the movement of each individual heart muscle.

  John is analyzing the left ventricular pressure and aortic flow data using MATLAB software tools to obtain Pelast and K. The Pelast and K values for the animals during varying gravity conditions will be compared and the results analyzed to investigate any relationships between Pelast, K, and gravity. This could provide valuable new insight into the operation of the cardiovascular system in microgravity conditions.

- **Nathan Grenz:** is applying the visco-elastic model of cardiac function developed by the Cardiovascular Lab to various data sets. These include the left heart data from calves and right heart data from calves and swine. He also coordinates with Dr. Mohamed Rahman from Meritcare Hospital so that he and other staff can collaborate and perform joint research at NDSU. This collaboration will encourage closer ties between NDSU and the surrounding community. Nathan is also continuing to learn about the theory and practical application of the work that the Cardiovascular Lab is doing.

## Applied Electromagnetics

Dr. Nelson works in the area of applied electromagnetics. He typically teaches the undergraduate course Applied Electromagnetics, and graduate the courses Antenna Theory and Design, Microwave Engineering, Computational Electromagnetics, and Designing for Electromagnetic Compatibility. He is active in the IEEE Electromagnetic Compatibility Society, and currently serves as the Vice-Chairman of the Education Committee. He is also a member of the IEEE Antennas and Propagation Society, the Applied Computational Electromagnetics Society, the Electrostatics Society of America, and the Electrostatic Overstress/Electrostatic Discharge Society, the American Society of Engineering Education, and the American Radio Relay League. Currently funded research projects include "Near Field Antenna Factor: An Oxymoron" (National Science Foundation), "Further Electromagnetic Characterization of High Speed Circuits" (Dakota Technologies, Inc.), "Where Does Current Flow in the Heart?" (NSF EPSCoR), and "Electromagnetic Characterization of Manned and Unmanned Air Vehicles and Weapon Combinations" (Sverdrup Technology, Inc.) Recently completed projects included "Power Line Carrier Research" (Otter Tail Power Company), "Electromagnetic Characterization of High Speed Circuits" (Phase I of work with Dakota Technologies, Inc.), and "Electromagnetic Characterization in Hospital Settings".

## Power Supplies and Power Converters for Renewable Energy

Dr. Yuvarajan conducts research in the general area of power electronics with special emphasis on switching power supplies. Power Factor correction, dc-dc conversion, and resonant boost three-phase conversion are some of the projects he is working on. Some of the conversion concepts are being applied in the field of aircraft power supplies. The More Electric Aircraft is an Air Force initiative where these power supplies will be used.

For the last two years, he has been interested in the conversion of renewable energy like Photo-voltaic (PV) and fuel-cell power. Currently, his research group is working to develop circuit models for the PV panels and PEM fuel cells.

## Using the Undergraduate Optics Education Laboratory In the Optical Signal Transmission Course

Professors Floyd Patterson and Dave Rogers of the ECE Department along with Professor Orv Swenson from Physics have been active in an undergraduate optics teaching laboratory that was developed with NSF support. This lab was used in our course in optical signal transmission in the spring semester of 2003. Students with majors in physics and engineering have learned professional optics techniques for evaluating the characteristics of optical fibers and obtained hands-on experience with optical communications.

The primary objective of the National Science Foundation (NSF) optics education project at North Dakota State University has been the development of an undergraduate optics laboratory to serve the needs of a general optics course (Physics/ECE 411/611) that is the joint responsibility of the Departments of Physics and Electrical and Computer Engineering.

We also used the optics laboratory in the summer North Dakota Governor's School of Science and Mathematics, which is devoted to outstanding high school students. Each summer the lab accepts about 20 students in two sections which each last for four hours. The students begin by doing some basic experimental work to study reflection and refraction of light. They then prepare a fiber to do an audio transmission experiment. The lab goes quite well if the students are given appropriate guidance in the setup of the equipment and components.

The use of the undergraduate optics lab for the optical signal transmission course significantly improved student learning. It breathed new life into a course that was already well established in the curriculum. We expect the experiments used in 457/657 will be improved and expanded. Future optics courses offered at NDSU will have significant laboratory content as a distinguishing feature.

## Cryptography Research at NDSU Electrical and Computer Engineering

Professor Raj Katti is directing research in cryptographic techniques for secure communication in wireless networks. Currently there are four doctoral students and four masters students working on cryptography related projects. One of the projects deals with the design of elliptic curve cryptosystems for sensor networks. Another project deals with the implementation of the Advanced Encryption Standard in hardware. The goal of all these projects is to obtain new ways of implementing cryptographic protocols that result in low cost, high security and low power consumption. Part of this research is funded by the Defense Military Electronics Agency.

## Wireless Sensor Networks

Working with the Sensor Electronics Group (SEG) within the ECE department, Dr. Glower is developing custom small and inexpensive wireless sensor systems. At present, these systems allow the operator to remotely monitor acoustic, motion, and magnetic signals. As well as demonstrating NDSU's capabilities in developing such custom circuits, these devices will be used to demonstrate NDSU's capabilities to produce small runs of custom printed circuit boards.

# PhD Teaching Fellows:

Feng Hou and Jeff Wandler have been PhD Teaching Fellows here in the Electrical & Computer Engineering Department.

### Feng Hou

Feng Hou received his Bachelor degree in Mechanical Engineering from Southwest Jiatong University, China in 1991. In 2001 he received his MS degree in Mathematics from NDSU. His main research interests are numerical analysis, wavelet theory and applications. Feng said "There are two reasons for me to choose math as my MS degree, one is the admiring mathematicians, and the other is the importance of math in high level research in engineering."

In January 2002 he entered the ECE Department as Ph.D. Teaching Fellow. The main research area of interest to him is the theory of filter banks and wavelets and applications in digital communications. Besides working, Feng is very interested in jogging, playing basketball, and fishing – in his spare time.

### Jeff Wandler

Jeff Wandler transferred to NDSU in 1995. He completed two Co-op assignments while attending NDSU, one with Rockwell Collins, and the other with IBM. Jeff also performed two experiments with NASA's Reduced Gravity Program while working in the Cardiovascular lab at NDSU, and graduated in May 2001 with honors from NDSU. He joined IBM in Rochester, MN as a System Manufacturing engineer and piloted a system to reduce scrapped boards, enhancing cost savings.

Jeff returned to NSDU in January 2002 as a PhD teaching fellow, and started coursework and research in Biomedical engineering, under Dr. Ewert. Jeff is an active member of IEEE and Biomedical Engineering societies.

Alumni, Friends and Faculty of the ECE Department have contributed money to the Electrical and Engineering Scholarship Fund or started specific funds to honor friends or relatives. The interest from these funds provides scholarships for ECE students. Contributions should be directed to the NDSU Development Foundation. You can specify which fund you wish your donation to be added. The following funds have been established for Electrical & Computer Engineering scholarships:

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| Eugene Aas | Ernest Hoaby | Garber Trambley |
| Ed and Kay Anderson | Duane Nagle | ECE Development |
| Ernest Anderson | Jordan Saharieff | ECE Research |

If you are interested in starting a specific fund or assisting the department in establishing an endowed fund for research or administrative purposes, please contact James C. Miller, Executive Director or Sherri Schmidt, Associate Executive Director, NDSU Development Foundation, 1120A 28th Avenue North, Fargo, ND 58102. Telephone: 701-271-0296 for information about the requirements and process

# The Blue-Sky Group

No, it is not the Blue Man Group and you won't find us on tour. It is, however, the best place to discuss ideas for improving the Electrical and Computer Engineering department. Developed by Professor Mark Schroeder and teaching fellow Jeff Wandler last year, this informal weekly gathering invites all students, faculty, and staff to discuss issues that the department is facing and brainstorm about how to best address them. After just one year, myriad topics have been discussed and numerous ideas presented. Several ideas that made it past the cutting room floor to the implementation stage include the development and distribution of lab kits, an "Open Lab", a resource library, and a "Teaching Lab".

***Lab Kits***

Lab kits containing a breadboard and numerous electronic components have been developed and are being sold to sophomore students. These kits allow the students to easily obtain basic components that will be used in lab courses so that they can build their circuits prior to class. It is one step towards creating an environment where students can tinker, learn on their own, and perform open-ended labs as opposed to routine, canned lab procedures. A contest using these kits was also established. The contest provided three cash prizes to the students who developed the most creative circuit using the lab kit components.

***Open Lab***

Another step taken towards helping students tinker and learn on their own was the development of an "Open Lab". This involved making one of the normally locked labs open to the students during much of the week. By doing this, the students gained access to equipment that was not available to them outside of their lab hours.

***Resource Library***

A resource library containing over 50 electrical and mathematical handbooks and texts was also created. These specially selected titles include 100's of circuit schematics and information that is not readily available in course textbooks. It is hoped that the library will be useful to all of the electrical and computer engineering students, especially the many students in the Sr. Design courses.

***Teaching Lab***

The most recent implementation is the addition of a "Teaching Lab". Two circuits lab classrooms were combined into one room. The remaining room was then filled with white boards, chairs, and tables to provide a setting more conducive to learning and to help improve the teacher-student relationship. Some of the activities performed in this new multiple purpose room include: 1) faculty office hours, 2) student study area, 3) presentations, and 4) small group teaching sessions. The room is open continuously throughout the week and partially on the weekend. The resource library is housed in this room so that students can have nearly continuous access to the material. The lab also has a station that includes a breadboard, multimeter, oscilloscope, and function generator. After just a few weeks in existence, students and faculty are making good use of the room as one can easily notice when passing by.

Numerous other ideas such as mentoring of underclassmen by upperclassmen have been discussed and implemented as a result of the Blue-Sky group discussions. Additionally, two grant proposals have been submitted based on topics that were discussed. We anxiously await our second year of meetings in anticipation of more fun dialogue and great new ideas!

The Blue-Sky group is just one of the many new and exciting activities taking place in the Electrical and Computer Engineering department at NDSU. Thanks go out to all of the students, faculty, and staff who have participated, especially our mainstay, Professor Val Tareski. You are all helping to shape the face of this rapidly evolving department into an even better place to work, learn, and grow. If you have comments, ideas, or suggestions related to the mission of the Blue-Sky group, please contact Mark Schroeder at mark.j.schroeder@ndsu.nodak.edu.

# 2003 NDSU Alumni Horizon Award Winner
# Amie Allison

On October 9, 2003 Amie (Lorsung) Allison gave a presentation of her work at NASA to faculty and students of the Electrical & Computer Engineering Department. Amie is the recipient of the 2003 NDSU Alumni Horizon Award.

She graduated from Electrical Engineering in 1995. Amie's fascination with space brought her to NDSU to earn a degree in EE. As a freshman in the engineering program, she set her sights on NASA and never turned back. She completed her education and also completed four semesters of cooperative education at NASA's Johnson Space Center in Houston before graduating. With a generous amount of experience and an Electrical Engineering degree Amie joined NASA as a full-time employee after graduation. She quickly became an expert in space shuttle payload mission operations. As a flight controller in the Houston Mission Control Center for three years, Amie gave astronaut and mission control support to seven space shuttle missions.

In 1998 Amie was accepted as a member of the U.S. contingent of International Space Station personnel. Traveling between Houston and Moscow, she helped in the preparation and mission control for the first three space station assembly flights.

In 1999 she was chosen to work with the Japanese Experiment Module flight control team at the Tsukuba Space Center in Japan and at the NASA Johnson Space Center in Houston, helping establish an interactive operation between the United States and Japan.


For now she is busy with the Japanese Experiment Module program, but she looks forward to the possibilities ahead of her. "*After I feel like I've contributed all I can to this program, I'll move on to my next space project. I hope Mars!*"

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North Dakota State University
Electrical & Computer Engineering
P.O. Box 5285
Fargo, ND 58105-5285