Professional Autobiography, R. Alan Cheville

This candidate profile is organized chronologically. The first page and a half thus focuses on technical research. Educational research and experience begin on the second page and continue through the third page. Details on leadership and service activities begin near the bottom of page three.

Education

My initial education, through high school, was in public schools in the Panama Canal Zone. Canal Zone schools were quite diverse, with populations of Panamanian nationals, civilians who worked for the Panama Canal Company, US military dependents, and students of many other nationalities whose parents worked in the banking or shipping industries. I earned my bachelor's degree in electrical engineering at Rice University, and continued at Rice for graduate school. I worked on two major projects in graduate school. The first was designing large electron beam pumped laser systems for submarine communications. My second, and final, project was in ultrafast optics. During both these projects I was fortunate to have the experience of helping to build labs from the ground up, which has given me a broad background in engineering and experimental science. I received my doctorate in electrical engineering in 1994 for investigations studying the dynamics of C_{60} (buckyballs)—at the time a newly discovered form of matter—using ultrafast optical pulses under Dr. Naomi Halas. This research was interdisciplinary, covering topics in physics, chemistry, and electrical engineering.

Postdoctoral Research

Following graduation from Rice I accepted a post-doctoral position at Oklahoma State University working with Dr. Dan Grischkowsky. During this time my research focused on research in the terahertz (1 THz = 10^{12} Hz) spectral region. The THz region of the spectrum falls between the frequencies traditionally (and easily) accessed by the established disciplines of optics and electronics. Generating THz radiation merges optical and electronic technologies by gating micron-scale dipole antennas using ultrafast optical pulses. My work during this time was in the field of THz time-domain spectroscopy, specifically applying THz measurements to the combustion diagnostics of flames and developing techniques of THz impulse ranging. During this period I focused my efforts exclusively on the traditional pre-faculty trajectory of research, journal publications, and conference proceedings. Details can be found in the attached CV.

Faculty Experience- Research

After receiving offers from physics and engineering programs, I accepted a tenure track position in electrical engineering at Oklahoma State University in 1998, and was awarded tenure with promotion to associate professor in 2003. During the first four to six years as a faculty member I followed a fairly traditional path, devoting 80% of my time to research on THz spectroscopy and applications. This was an interesting and rewarding time since the THz explorations my research group pursued were highly interdisciplinary, with applications in chemistry, biology, non-destructive evaluation, imaging, and medicine. During this period I received over $1M in research funding from the Army Research Office, Department of Energy, and National Science Foundation including an NSF CAREER award. Due in part to our success at external fund raising, a collaborative group of three faculty with whom I work built a state-of-the-art photonics laboratory—including a class 1000 cleanroom, full set of semiconductor fabrication equipment, ultrafast lasers and THz spectroscopy systems—from the ground up in a new research building. I led the effort on designing and equipping the cleanroom, working closely with OSU's Physical Plant on necessary infrastructure; I still remain friends with some of the Physical Plant employees who helped on these projects. This experience has led to serving at the college level on several committees examining how to improve OSU's research infrastructure.

One aspect of the research project supported by the NSF Career award was to develop programs to involve undergraduate students in research. At any given time four to eight undergraduate students worked in my research lab on projects in THz spectroscopy. Several of these students presented papers at national conference or had their work published in peer-reviewed journals, please see my CV for details. As part of this effort I managed our department's *Freshman Research Scholar* program which supported small scholarships for incoming freshmen to work in a research lab with faculty members. Approximately half of these students continued to engage in research throughout their undergraduate years and many went on to attend graduate school. Under my supervision the number of students participating in the program tripled in five years; management of this program was turned over to the engineering college several years ago.

More recently I have been involved in several academic-industrial initiatives on commercialization of THz technology through SBIR/STTR programs. While a large part of my professional career has been in academic research, this experience has been quite diverse focusing on research, development, and engaging students in research.

Faculty Experience- Education

Starting around 2000, my professional interests begin to evolve- first towards becoming a better teacher and later to performing research in undergraduate engineering education. As is common with many engineering faculty, this interest first arose as a general dissatisfaction with how successful I was at teaching undergraduate students using the methods by which I had been taught. As I learned more about educating engineers, I became aware of the building crisis in the engineering workforce in this country, recently outlined in National Academy publications such as *The Engineer of 2020* and *Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future*. The problems of engaging and developing the next generation of engineers are, to me, more important and challenging than any problem in more traditional research fields. Rebuilding a strong, technically competent workforce will require innovative and bold experiments by diverse and forward-looking universities.

Due to the conscious choice to steer my career towards research in engineering education, I have had several opportunities in the past decade to develop innovative, interdisciplinary engineering courses and make significant changes to curricula. In creating academic change I follow a strategy of first engaging colleagues and students in discussions of course design, then identifying clear and measurable learning outcomes, and applying—when applicable—for external funding. I try to treat each change effort like a research project by evaluating outcomes, analyzing results, and using data to make midstream modifications. Four current and particularly relevant efforts are outlined below:

- I have recently invested a large amount of time in completely redesigning the first of two electrical engineering capstone design courses. This course teaches students the engineering design *process* by guiding student teams through the development of electronic systems. Projects emphasize system-level rather than component-level design, reflecting changes in the engineering profession over the last decade. As part of this effort, I initiated development of an ambitious and technically sophisticated wearable gaming system as an ongoing project in the course. We are currently seeking external funding for commercial development of this system.
- Through funding from NSF's *Course, Curriculum, and Laboratory Improvement* (CCLI) program I developed four courses that form the backbone of the electromagnetic and photonics "Area of Specialization" in the ECE curriculum. These courses teach students the broad application of electromagnetic and photonic concepts and devices in fields as diverse as forensics, DNA research, and water quality analysis. Pedagogical techniques used include case studies, problem-based learning on small teams, and the use of computer-based formative evaluation. As part of the strategy to support multiple learning styles, I created a substantial library of photonics videos on YouTube, many of which currently have thousands of views.

- I am actively involved as a partner in a 20+ university partnership (via an NSF Phase 3 CCLI project) to develop an innovative course that focuses teaching engineering applications of mathematics. This freshman course is designed to increase retention of students who leave engineering because they fail the introductory calculus course. Along with graduate and undergraduate students I am developing a radio controlled vehicle outfitted with numerous sensors that students can program and control wirelessly. Data from the sensors is used to teach application of mathematics to engineering systems. A colleague in chemical engineering and I used this radio controlled vehicle in an outreach program for middle-school girls.
- I am a co-creator of an inter-disciplinary, inter-university course in nanotechnology, *Introduction to Nanotechnology- From Synthesis to Self Assembly*. This course was taught in conjunction with a chemistry professor at OSU, a chemical engineering professor at University of Oklahoma, and a faculty member in engineering physics at the University of Tulsa. Students were drawn from all three universities and span most engineering disciplines, chemistry, and physics. The course is taught asynchronously using web-based lectures and formative quizzes. Students met face to face four times during the semester when interdisciplinary teams fabricated, characterized, and imaged nanostructures and presented their results in a "mini-conference". Funding for this course came from an NSF EPSCOR grant to Oklahoma.

Beyond developing and teaching engineering courses, I have also led engineering education reform efforts. Over the past seven years I have led a major curriculum reform effort in the School of Electrical and Computer Engineering at Oklahoma State University. This reform effort received nearly $1.5M in external funding through both planning and implementation phase awards from the National Science Foundation's *Department Level Reform* program in engineering. The reform project I directed, *Engineering Students for the 21st Century* (*ES21C*), seeks to give students opportunities to develop as engineers by offering relevant experiences to undergraduate students at all levels. Key to this effort is developing relevant engineering experiences for students and, most importantly, providing the support or scaffolding students need to succeed in these experiences. *ES21C* has developed resources for teamwork, peer evaluation, and tools to assess engineering programs. I and other participants give workshops at the ASEE annual meeting. More detailed information can be found at the project website, http://es21c.okstate.edu.

Engineering Students for the 21st Century has engaged faculty with very diverse interests in both program reform and educational research. *ES21C* has helped support the professional development of faculty across OSU, including the College of Engineering, College of Education, Department of Physics, and the OSU library. This project has also engaged dozens of graduate and undergraduate students. Although reforming a department is a slow and arduous process, there have been several significant impacts. One impact has been sponsorship of an annual "Design Day" at the end of the Fall semester in which we invite high school students, employers, and educators from across the state to visit campus. Student teams in design classes demonstrate their projects to showcase OSU's electrical engineering program. Thanks to the increased emphasis on engineering design stimulated by *ES21C*, my department has recently invested in a complete redesign of the capstone design laboratory. The architecture of this lab reflects the engineering design process; the facility will be open to all engineers who need access to electronic design facilities. My leadership of *ES21C* has given me unique insight on the challenges involved in building and sustaining innovative engineering programs. Although reform can be extremely challenging at times, I have found building undergraduate programs to be the most professionally and personally rewarding work yet in my career.

Faculty Experience- Leadership and Service

Up until one year before I received tenure, I was protected from most departmental service. Following a catastrophic reorganization following the unexpected loss of our department head, I took over as the chair of the ABET accreditation committee for the School of Electrical and Computer Engineering

(ECEN). As chair I developed the objectives and outcomes used in our program, helped to oversee the development of separate "areas of specialization" within the department to make student advising more consistent, and helped to craft a reduction in the number of credit hours required to reduce the time to graduation of our students. All of these required compromise among faculty whose self-interests did not always mesh with the overall goals of the department. In 2003 ECEN passed our first ABET visit under EC-2000; our department was fully accredited for the first time in nearly two decades. We just recently (2009) passed our second full six year accreditation under my leadership. As part of this experience I have developed extensive experience in the evaluation of student learning and degree programs. This experience includes both the application and development of assessment tools such as rubrics, summative and formative examinations, surveys, portfolios, and individual reflective assignments for students.

I devote considerable time to department, university, and professional service. I serve on several college-wide and university-wide accreditation committees, technology and committees, and review for multiple journals and the NSF and NIH. More recently I developed, obtained internal funding for, and steered a new certificate program on college teaching through state regent approval. This program allows doctoral students, post-doctoral researchers, or others interested in becoming faculty members to gain both a theoretical background and practical experience in college teaching. This certificate program will help graduates be more employable since the Bureau of Labor Statistics projects that careers in post-secondary education will grow extremely rapidly in the next decade.

After sixteen years at Oklahoma State I was given an offer to serve in a rotating position as the program director for the engineering education research program in the National Science Foundation's Engineering Education and Centers Division. I have been in this position since June, 2010. As a program director I manage approximately $10M in federal funds that support engineering education research across the nation. During my short time at NSF I have generated two new funding solicitations (here and here) and have gained new perspectives on engineering education in the United States. I am actively involved at a national level with engineering education policy decisions, and am undertaking several projects that I anticipate will have significant impact on the engineering education system should they prove to be successful.

Throughout these leadership and service experiences I have found that meeting individually with faculty to understand their needs and beliefs is critical in creating and managing change. The culture and beliefs of an organization, much more so than physical infrastructure or facilities, impact whether programs will be successful or not. I have learned, painfully at times, to be very pragmatic, and adapt to obstacles by changing strategies rather than proceed in single directions.

Summary

I feel that I have a broad range of experiences across a spectrum that covers traditional academics, research, education, and leadership. I believe that this breadth of experience—and any wisdom earned by the large number of missteps made along the way—will let me to enable the engineering program at Philadelphia University grow into one of the most dynamic and innovative programs in the country.

This is a challenging time for higher education. There are systemic problems that are being driven by changes in both technology and society. The literature on change models in higher education is still sparse, and the diversity of institutions means that one-size-fits-all solutions will not be viable. However these conditions also represent great opportunity for change. Institutions that are willing to experiment with new organizational structures and curricula can emerge as leaders in whatever landscape of higher education emerges by the middle of the 21st century.