An Optical Immersion

Sometimes finding your niche takes a false start or two, as happened with Bradley Duncan (Ph.D. '91), the first Bradley Fellow Ph.D. graduate. Now an associate professor at the University of Dayton, with a thriving research program and an "Engineering Professor of the Year" award, Duncan almost did not go to college. Then he almost quit electrical engineering.

A self-described lackluster high school student, he was not convinced that he should go to college. "I applied only to Virginia Tech, figuring that if they didn't accept me, I just didn't need to go to college. It is amazing that I did so well, then ended up as a professor. I did not blossom until I was in college."

Duncan says that he chose electrical engineering for "all the wrong reasons." When he was in high school, the first personal computers were being developed and he went into EE to build computers. "I then found I hated computers," he said. "I discovered this as a co-op student. I was programming all the time and detested it."

He decided the field was not for him and prepared to drop EE and major in mathematics. "I just couldn't stand the thought of programming computers all my life."

Then he discovered that electrical engineers also work in optics. He completed a bachelor's in EE, and stayed at Tech for a master's, working with Rick Claus in the department's fiber optics program. Optics became a passion and he decided to pursue a Ph.D. "I was interested in rounding out my optics background." He worked with T.-C. Poon, exploring optical image processing.

After earning his Ph.D., Duncan joined the faculty of the University of Dayton (UD) with a joint appointment in electrical and computer engineering department and the graduate program in electro-optics. "UD was one of the few programs in the country that offered a degree in optics. I got in on the ground floor of something that grew fast."

In the 10 years since joining UD's faculty, Duncan's interest in optics has taken him into many areas, including laser radar, liquid crystals, aero-optics, and wireless communications. With Wright-Patterson Air Force Base nearby, much of his work relates to Air Force issues. "As a faculty member, you learn to follow the money," he said.

When he started at UD, he joined an ongoing project in laser radar. "It's just like regular radar," he explained. "We sent a pulse of light, looked at the backscatter return, and obtained information from the target that was illuminated." From there, he branched into different aspects, including optimizing laser radar receivers, and heterodyne and direct detection. "Heterodyne detection allows velocity as well and range information, while direct receivers are easier to build, but do not always give the same amount of information," he explained.

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Another Air Force laser radar project involved exploring methods to overcome the disturbance caused by the turbulent shear layer for airborne laser radar systems. "If the Air Force wants to shoot a laser radar beam out of a portal, the beam tends to break up when passing through the turbulent shear layer. It's like looking at a shimmer on a hot summer day," he explained. "The laser twinkles," he said.

A current project in non-mechanical beam steering explores the best way to send and direct a beam with as much precision and energy as possible. "Conventional mechanical devices do not lend themselves to highly accurate, rapid random pointing," he said. "Optical phased arrays, on the other hand, have the potential to overcome many of those limitations." The team is working on optical phased array technology based on liquid crystal devices.

Duncan has also worked with non-destructive evaluation using interferometric and real-time holographic schemes for detecting and monitoring defect and defect precursors in advanced aluminum and titanium alloys.

In addition to research, Duncan has been active in building the university's optics teaching program. He has developed three new courses in the guided

Duncan photo courtesy of the University of Dayton

Bradley Duncan (Ph.D.'91) is an associate professor working in optics at the University of Dayton. In the background is the electronically addressed spatial light modulator that Duncan worked with as a Ph.D. candidate in Tech's Optical Image Processing Laboratory.

wave optics area at the graduate level. He is also leading UD's effort to bring optics to the undergraduate level and built an NSF-funded Photonics Laboratory, which is used in undergraduate ECE and physics courses. He has several graduate and undergraduate students working on projects in the laboratory this semester, and used the laboratory last semester for projects and demonstrations with the introduction to fiber optics course.

Perhaps if undergraduates at UD can be exposed to the variety and depth of experience in optics, they can appreciate the area of electrical engineering that has captivated Duncan. "A lot of students are trying to figure out what they are doing here and why," he said. "My advice is to find something they love. I have no innate brilliance. I spend the time immersed in optics. And I enjoy it."