Interdisciplinary Training
Common to all Four New Centers

"We are here," said Rashid Bashir, Abel Bliss Professor of Engineering, "to train students. The emphasis is on interdisciplinary graduate student training, in interdisciplinary areas."

Bashir is referring specifically to two centers where he serves as a principal investigator: the Midwest Cancer Nanotechnology Training Center (funded by the National Institutes of Health), and the Cellular and Molecular Mechanics and BioNanotechnology IGERT—or Integrative Graduate Education and Research Traineeship—funded by the National Science Foundation (NSF). But he could just as well be talking about any of the four government-funded centers with a strong graduate-student training component now operating at the College of Engineering.

All four promote cutting-edge research that draws on fields ranging from robotics to oncology. All four recruit doctoral students from departments across campus. (Trainees receive two years of funding from the centers, but earn their degrees from their home departments.) All four work with the campus i-STEM program, led by educational psychology Professor Lizanne Destefano, to continuously evaluate the programs and to improve the student experience based on trainee feedback. And all four offer what Jimmy Hsia, an engineering professor and associate director of the NSF Science and Technology Center on Emergent Behavior of Integrated Cellular Systems, or EBICS, calls "a unique opportunity for a very different experience for students."

Although that experience varies from center to center, each program aims to prepare students for collaborative work that blurs the boundaries between disciplines as diverse as biology, psychology, and engineering. The collaborative, interdisciplinary ethos of the centers is expressed in many ways. Trainees in the cellular mechanics and cancer nanotechnology programs, for example, participate in an intensive summer institute that builds common ground between PhD candidates with vastly different backgrounds.

"It gives the engineers experience in biology experimental methods, and the biologists exposure to engineering lab techniques," explained Laura Miller, program manager for both centers. Similarly, every trainee at the NSF-funded NeuroEngineering IGERT takes an introductory course that gives engineers a dose of neuroscience, and biologists a dose of digital signal processing.

That shared ethos is also manifested in a co-advising system that offers trainees the benefit of not one, but two faculty mentors. For Vincent Chan, a bioengineer and EBICS trainee who has helped develop both a "microvascular stamp" that can direct the growth of blood vessels on a wound, and millimeter-scale bio-bots, or biological machines that can move about with the help of cardiac muscle cells, that's been a boon.

"I have co-advisors from different departments who have different expertise," said Chan, who also gets advice from faculty at affiliated institutions like MIT. "The University of Illinois itself is a greatly interdisciplinary research university, but the centers have really opened up new kinds of opportunities."

The Micro and Nanotechnology Laboratory is a multidisciplinary research facility in the College of Engineering that houses advanced equipment to support research in photonics, microelectronics, nanotechnology, and biotechnology.

Those opportunities include innovations like the Graduate Teaching Consortium, which allows EBICS trainees to take classes with faculty at other institutions via videoconferencing; the commitment to giving cancer nanotechnology trainees clinical experience at places like the Mayo Clinic and the University of Illinois at Chicago; and the requirement that all cellular mechanics trainees spend time at an international lab.

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Heather Huntsman, a trainee from the Department of Kinesiology and Community Health, spent this past summer doing research with German scientists at the Max Planck Institute for Intelligent Systems that could ultimately lead to novel therapies for muscle loss caused by age and disease.

"I am confident," Huntsman wrote in an e-mail from Stuttgart, "that my training is richer and more integrated than most of the students in my field."

But giving trainees a unique combination of scientific and technical skills is only part of the equation. The centers also emphasize broader career development. They host symposia on topics like entrepreneurship, have trainees organize seminars, and encourage them to participate in community outreach programs that hone the communication skills they will need to explain their work to the broader public. "We want them to be able to talk about their research to people who aren't experts in their fields," said J. Patrick Grenda, program coordinator for the NeuroEngineering IGERT.

As Hsia points out, these are not the kinds of things that a graduate student working in a departmental lab supervised by a single faculty advisor might ordinarily experience. They do require a willingness to stretch oneself. But that's the point.

"Our goal is to produce the next generation of leaders in these areas," Bashir remarked. "We want students who are willing to break those traditional departmental barriers and leave their comfort zones."

New AE Master's Program **Cultivates Systems Thinking**

"I want to make this real," explained Steve D'Urso, who recently joined the Department of Aerospace Engineering faculty to administer a new Aerospace Systems Engineering master's degree program, one of the first of its kind offered at a U.S. university.

"We want engineers to embrace total systems thinking—understanding the big picture instead of 'I'll just do my part and pass it on,'" said D'Urso. "Design is not a process; it is a strategy made up of processes and tools."

An Illinois engineering alumnus, D'Urso (BS '78, Mechanical Engineering; MS '89, Aerospace Engineering) draws lessons directly from his 33 years of experience in the aerospace industry, having worked for both The Boeing Company and McDonnell Douglas.

"I deal with the students as though I am an engineering manager and they're the engineers," he remarked. "When they have completed the course, they'll have to have some idea of what requirement analysis is. They need to understand the theory behind why we are doing what we are doing and how to judge what's a good requirement." As per D'Urso's design, the inaugural class was split into two teams, each tasked with producing a set of requirements from fundamental objectives—one was a Mars initial exploration system, and the other was an integrated unmanned aerial critical resupply military system. So, what about grades?

"At each project stage, the students wrote a draft report that I would evaluate and return comments," D'Urso explained. "These could be revised before a final version was submitted. Work good enough to take directly to the VP or Engineering Director is 'A-level' work. You don't pass 'B-' or 'C-level' work to the VP, and it often takes more than one try to get what the boss wants."