One scan pass three optical images

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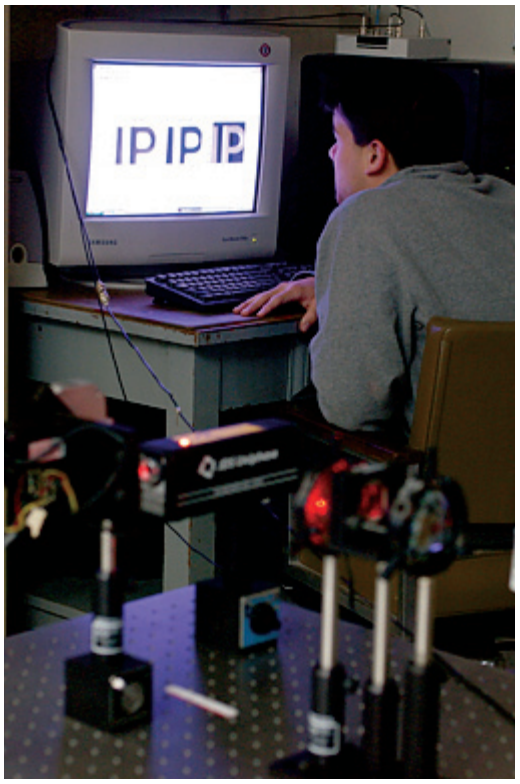
Undergraduate research supports holographic microscopy



Undergraduates Alex Beck (EE '04) and Bill Yoder (EE '02, MSEE '03) have developed a multi-output laser scanning system that will be used in research on holographic microscopy, optical cryptography and optical image recognition of 3-D objects.

Alex Beck (EE '04) is fine tuning a computer-controlled system that produces three separate process images from one pass through an optical laser scan. The multiple images can be separately processed and recombined for image processing and identification.

Beck has been working to extract the edges of the scanned image. "The system processes the output through a low pass filter, which yields a smeared image," he explained. "Then it subtracts the smeared image from the original, using a subtractor, which gives me the edge extractions. Basically, we are doing in hardware what we can do in software," he said.

As images become more complex and large, processing becomes time consuming for digital computers. Optical processing is an alternative to digital processing because it offers greater speed, according to OIP director T.- C. Poon.

Beck built the hybrid hardware/software system from commercial parts, based on earlier work by another undergraduate researcher, Bill Yoder (EE '02, MSEE '03). Yoder designed and tested a two-dimensional scanning system using inexpensive and hand-built parts.

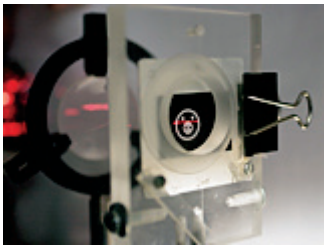
"My job was to design a completely separate scanning system with improved quality and response time," Beck said. "I had much nicer equipment to use and was able to see how to improve on his system." Following earlier work was not like following a cookbook, Beck acknowledged. "I couldn't just redesign and have it work perfectly."

Beck was also charged with designing the system to simultaneously display three separate images from the single scan pass. This required drilling two additional holes into the connection box so that three simultaneous inputs could be processed in parallel.

Poon has had a number of undergraduate researchers in the laboratory. "Getting undergraduates into the laboratory is very important," he said, adding that he structures the projects to meet both educational and research goals. Several recent projects have involved setting up laser scanning systems. "Almost all of our research involves laser scanning. Now, thanks to the undergraduate efforts, we have two complete setups in the lab."

Beck's system will be used in efforts to design and build a multiple-laser microscope that uses an optical scanner, acousto-optic hardware and a computer display. "The microscope will be able to perform a variety of image processing operations simultaneously with a single two-dimensional scan of the specimen," Poon described. "This means the user will have multiple views of the differently processed images of the specimen at the same time."

Multiple views of the image will be helpful in cellular studies, since molecular components at high magnification tend to be transparent with very low contrast. "Not only will it help to obtain the images in real time with the multiple-laser scanning system," he said, "but also processing the images simultaneously will complement digital processing and hence require less memory and digital storage space."



A spare parts scanner – As part of his Research Experience for Undergraduates, Bill Yoder designed and built the above 2-D scanner from inexpensive and hand-built parts. Top right: Undergraduate Alex Beck based his work on Yoder's and, using commercial grade parts, built a laser scanning system that produces three separate images from one pass.