

## THEN & NOW

A reminder of the pace of change, and of timeless truths, from the 1944-45 DMS course bulletin:

The course in Immunology and Epidemiology covered “the topics of immunization, vaccines, antisera, tuberculosis and venereal disease diagnosis and control, water supply protection and purification, sewage disposal, milk supply, dairy inspection, pasteurization, food handling, restaurant and swimming pool sanitation, occupational diseases, general epidemiology, and the relation of the physician in general practice to preventive medicine and public health.”



**\$450**

Annual tuition in 1944-45, compared to \$34,498 in 2005-06

**23**

First-year students in 1944, compared to 82 in 2005

## Separating the real from the realistic

If you’ve ever seen a tabloid at the supermarket and been astonished by an image of an unlikely celebrity couple, you’ve probably been fooled by a phony photograph.

People have been falsifying photographs for decades with dodgy darkroom techniques. But nowadays, most photos are digital, and computers make it even easier to manipulate them in ways that are undetectable to the human eye. When an image is faked for a tabloid, the consequences are rarely more serious than embarrassment. It’s much more significant, however, when a scientific image is called into question.

**Doctored:** But Dartmouth computer scientist Hany Farid has developed algorithms—mathematical equations—that enable computer programs to spot doctored images.

Farid plays forger and tampers with images, then develops algorithms to quantify the changes. In an altered image, he explains, “some underlying mathematical and statistical properties” have been disturbed and are not consistent with the pixel patterns in an original image.

An associate professor of computer science, Farid was recently named a Guggenheim Fellow and has received funding from the FBI for his work in digital forensics.

Bogus images are more likely to be found in tabloids and advertisements, but they’ve turned up in scientific journals, too. Hwang Woo-Suk, a South Kore-

an stem-cell researcher, made headlines last November when it was discovered that two of his papers in *Science* had contained fabricated data and doctored images. Until then, Hwang had been considered a pioneer in studying stem cells—unspecialized cells that are able to differentiate into any cell in the body and that hold promise for curing diseases such as Alzheimer’s and Parkinson’s.

*Science* has since begun applying an image-screening test to submitted materials, and other journals are doing the same. The *Journal of Cell Biology*, which has been using a test it developed in 2002, has found that “25 percent of all accepted manuscripts have had one or more illustrations that were manipulated in ways that violate the journal’s guidelines” according to the *New York Times*.

**Blatant:** However, points out Farid, scientists are more likely to use digital manipulation to “clean up” images than to commit blatant fraud.

Today, many medical images are taken digitally as well—such as MRIs, CAT scans, and x-rays. But Dr. Peter Spiegel, chair of DHMC’s Department of Diagnostic Radiology, says there are many layers of protection in place at most medical centers. At DHMC, he explains, each radiologist is given an individual, confidential access code to the image database. And every image is archived in triplicate—both on-site and off-site locally, as well as in a remote location



JOSEPH MELIANTO

**Dartmouth computer scientist Hany Farid is a national leader in the development of ways to detect whether a digital image has been tampered with.**

elsewhere in the country. “I suppose it’s theoretically possible to hack into the system, but I don’t see that as a risk,” says Spiegel. “I don’t know of any instance where it’s ever happened or come to light that somebody manipulated an image.”

Farid—who frequently testifies in cases involving suspected tampering of digital images, but usually not scientific ones—says one way to guard against fraud is to insert an imperceptible watermark in an image. “If you manipulate the image, you disturb that ‘signature,’” he explains, leaving a trail of tampering for forensic analysts to find.

In addition, Farid’s team is continuing to develop new algorithms. “There is no single algorithm for detecting forgery,” he says. “There are a lot of different ways to create forgeries, and you need at least as many different ways to detect them.” And canny mathematicians like Farid on the case.

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