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## The digital detective

### Computer expert escapes to Santa Cruz in winter

By LISA M. KRIEGER

MediaNews

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A simple hillside patio at his small Santa Cruz home offers the famed digital detective Hany Farid something that the hallowed halls of Dartmouth College cannot: a place to think.

With just a laptop and cup of coffee, Farid writes the computer code that reveals tiny flaws hidden in phony photos. His suite of software tools, which identify statistical differences in an image's lighting, patterns, geometries and other features, tell whether an image is real, or faked. He teaches a computer to see what the human eye can't.

"This is my office. I can come out here and work for 10 hours," said Farid, 42, from his lawnchair. "When I'm stuck on a problem, I go pull some weeds."

Questions everything

A founder of the emerging field of digital forensics, the highly-regarded computer science professor escapes to Santa Cruz during New Hampshire's long gray winters. Free of Ivy League committee meetings and other professorial responsibilities, he can ponder an algorithm and then relax by riding his Harley Davidson V-Rod up the coast.

Here in the sunshine and fresh ocean air, he's studying some of digital's darkest secrets. That image of a young girl engaged in sex, is she a real child, or computer generated? (Real.) That DNA pattern used to verify cancer research findings, has it been fudged? (Yes, probably.) Did North Korea release fake photos of Kim Jong-il to prove that the leader is healthy? (Unlikely.)

The explosion of new digital image technologies has led to a proliferation of fraud, he said. Because tampering has become so widespread, "We are questioning everything. We have gone from trusting images to asking: 'How do we know an image hasn't been manipulated?' There's been a profound shift," he said.

Random fakes

To help detect fakes, government investigative agencies, scientific journals, news organizations and courtrooms increasingly rely on detective software designed by Farid, his students and other researchers. His tools have ended years-long litigation over an intellectual property dispute and verified the size of fish photographed for a Canadian biggest fish contest. They confirmed the authenticity of drawings by Renaissance painter Pieter Bruegel. And they helped put child pornographers behind bars.

Forensics will never stop photographic fakery, it will only make it harder, and more time-

consuming, to create a compelling image, said Farid. He predicts that the forensics vs. Photoshop arms race will continue to evolve, with both sides becoming more sophisticated.

But he finds the challenge riveting, so has tackled it with his trademark energy and irreverence.

"My philosophy in life is, do things that are cool," he said.

Born in Germany to Egyptian parents, Farid grew up in upstate New York, where his father was a chemist for Eastman Kodak. He briefly worked as a low-level programmer

"I had to wear a tie," he said. "I thought: 'I can't keep doing this. I'll kill myself.'"

He then studied at University of Pennsylvania and Massachusetts Institute of Technology.

Farid conceived of the possibilities of digital forensics while at MIT, waiting in the check-out line at the library. Restless, he picked up a copy of the Federal Rules of Evidence, then started randomly reading. What he saw startled him: Film and digital images were equivocal evidence, in the eyes of the court.

"This just seemed like a bad idea," he said. "Not that I'm good at seeing the future," but I could tell this would be a problem."

But how to prove the differences? The problem seemed intractable. Yet it stayed in the back of his mind.

"Two years later, I woke up one morning and I had an idea. I had breakfast, then coffee, then began work on this core of an idea: Could you determine if an image was enlarged or shrunk or rotated?" he said. "Then it was like opening a fire hydrant. One idea came after another."

At Dartmouth, where he leads the Image Science research group, "everything happens on an order of 10 to 15 minutes. Your whole day gets carved into little chunks. I'm at capacity there, just running from one thing to another. By mid-November, it gets cold and I get cranky."

Never really bored

But in Santa Cruz, he's got a girlfriend, a racing bicycle, his cherished Harley, sunshine and solitude. From his Mac Airbook, he can log onto the complex computer in Dartmouth's basement and do vast calculations. Sometimes he visits colleagues at the Valley-based companies Nikon and Adobe. Air travel isn't a frustration. When bored, he does math puzzles in his head ("Given a set of numbers, how do you find a subset of them that sum to a target number?" he asked. "It's a maddeningly simple problem that's intractable, because there are an exponential number of possible subsets to consider.")

His team's approach starts with understanding what statistical or geometric properties of an image are disturbed by a particular kind of tampering. Then they develop a mathematical algorithm to uncover those irregularities. Manipulations leave a statistical trail.

A vanishing point might be off. Or shadows cast from objects may contradict one another. The number of pixels could vary. His team has created a software package consisting of algorithms that search for a dozen types of photo alteration, each with its own data pattern.

Too many ideas

He is now exploring routes to detect child pornography as it travels over the Internet, using pattern recognition software. He is trying to find new ways to detect tampering in heavily compressed images, where few details are visible. Another goal is a technique to generate one single high-quality image\* of a criminal, for instance\* from reams of low-quality video.

"That is what is so great about science. You're in territory where nobody's ever gone before. It's terrifying and exciting at the same time," he said.

"I'll wake up at 4 a.m. with an idea and I have to get up. I don't have a choice."

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