Today, Rusinkiewicz also asserts, NJIT and comparable schools can fill part of a void left by the virtual disappearance of institutions such as Bell Telephone Laboratories, where AT&T supported research that produced technological sea changes stemming from the transistor, the laser and many other breakthroughs. "The parking lots have emptied and the lights have been turned off at institutions that did a lot of basic research."

OPEN, CREATIVE, FLEXIBLE

Companies like Google, Intel and Microsoft do fund internal research, but it is often narrowly focused and very market-driven, Rusinkiewicz says. The big ideas that drive scientific and economic progress must come from elsewhere, and a promising model is the university community collaborating with industry and government. This model is widely accepted in Asia and Europe, and in Rusinkiewicz's estimation it has put other nations on the path to matching and even superseding American preeminence in technological innovation.

In addition to allocating enough money, Rusinkiewicz sees the necessity of adjusting the way this country's stakeholders in research interact. Universities in the United States are forming research consortia to leverage diverse intellectual and financial resources. However, maximizing chances of success may require a less proprietary attitude regarding intellectual property on the part of a school, and greater willingness to share the financial potential of innovation with partners in industry. Government also has a significant role to play, a role that must be acknowledged by all concerned – including government.

"We must be open to new ideas when it comes to alternative models for cooperation in research," Rusinkiewicz says. "We need to be creative and flexible."

TWO KEY DIRECTIONS

Whatever model energizes progress in computing, the field is evolving in two key directions according to Rusinkiewicz. One is the use of increasingly powerful computers to process massive amounts of data and harvest new scientific and social knowledge that could be applied to improving the quality of life. The other is to put ever greater computing power into more and smaller devices, down to nanoscale therapeutic robots that could travel within the human body to cure disease.

Rusinkiewicz speaks enthusiastically about this potential, and the ubiquitous presence of computing technology around us, as reasons to study computing, especially at NJIT. "There is no research without computing, in any field, from biology and finance to sociology and astronomy. It is absolutely central. Computational science has created a new paradigm through which all scientific disciplines ask fundamental questions about the world.

"Computing has also dramatically increased productivity in commerce, industry and management. It is the foundation of our infrastructure for telecommunications, energy, transportation, banking. The world's computer networks are the nervous system of society."

Rusinkiewicz goes on to say that "More and more, we live in cyberspace. We work in cyberspace, we learn in cyberspace, we socialize in cyberspace, we entertain ourselves in cyberspace. A career in computing, or learning how computing is important in any major, puts you at the forefront of life in the 21st century."

The advantages of studying computing at NJIT are substantial in Rusinkiewicz's view. They include a distinctive interdisciplinary and hands-on approach. But he says that there is another particularly significant aspect.

"I feel strongly that our students really value the cultural diversity they experience at NJIT. They value being able to share many different perspectives while working toward their educational goals, and working on projects together. Regardless of background, I see our students helping each other. They care about each other." ■

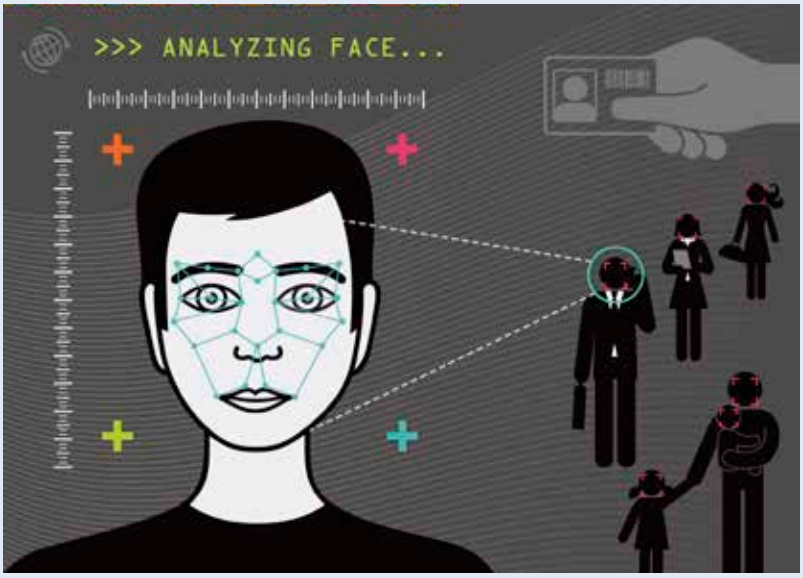
RECOGNIZING FACES, VERIFYING REALITY, ASSESSING CORPORATE SINCERITY

It took nearly 40 years to apprehend James Robert Jones, a convicted murderer who escaped from the military prison at Fort Leavenworth in 1977 and lived for decades under a new name in Florida. But thanks to 21st-century computer-based face recognition, Jones was arrested in March when an automated comparison of the former soldier's service photo with his current Florida driver's license confirmed his true identity for cold-case investigators.

This is technology that Chengjun Liu, associate professor of computer science, is taking to new levels of capability at NJIT. It's technology that, as Liu says, could greatly enhance security in many ways. In addition to serving law enforcement, promising applications include making credit-card transactions more secure and providing a better alternative to passwords for the array of electronic communication devices proliferating in daily life. One day, face-recognition algorithms may literally open doors for us – at home, at work, and even as we approach our cars.

Liu explains that there are many challenges to be overcome in the further development of computer-based face recognition, among them identifying individuals at different angles and under various lighting conditions. However, Liu and colleagues in the field are making progress, even to the point where an algorithm he helped to develop at NJIT proved better than human judgment in deciding if two different photos showed the same person. What's more, the NJIT algorithm performed better than 12 others tested in the Face Recognition Grand Challenge held under the auspices of the U.S. National Institute of Standards and Technology.

The importance and power of computing are evident in every discipline at NJIT, and Liu is among many NJIT researchers developing innovative uses for this indispensable resource.



VERIFYING DIGITAL REALITY

How can we know if a digital photograph has been manipulated so that it no longer mirrors the real world, and how can all forms of digital media be protected from illegal alteration and copying? Professor of Computer Science Frank Shih knows.

Shih's expertise encompasses digital watermarking, steganography and forensics, topics covered in four books he has published and numerous journal articles. He has improved algorithms for digital watermarking that can guarantee the authenticity of digital content and determine whether it has been altered since insertion of the watermark. In the multimedia world, signal information comprising a digital watermark can authenticate pictures, video, audio and text.

Shih also is a foe of "copy-move" forgery, in which part of an image is copied and superimposed on another area to hide something, perhaps to remove a person from sight. Since the copied superimposition will have the same digital properties as the rest of the image, Shih emphasizes that the alteration is especially difficult to detect. However, a new algorithm that he has developed makes it easier to determine where such changes have been made, and to reveal the digital truth.

Steganography, a word derived from ancient Greek, means "covered" or "concealed" writing. In the 21st century, it describes adding information to digital media that is accessible only with the right algorithmic key. Shih's research has focused on both encoding steganographic information in media and keeping such information highly secure.

COMPUTING AND CORPORATE CONFIDENCE

Each quarter, executives at publicly traded companies speak with financial analysts and journalists about the performance of their companies, a verbal complement to what they report in writing. It's communication that can have a pronounced influence on the price of a company's stock and an organization's overall fiscal well-being.

There are various objective ways to analyze the facts and figures released. But subjective assessment of what members of management say in public also factors into trading decisions. Having a tool to evaluate the nuances of what they say more objectively would clearly be useful for the financial community. James Cicon, assistant professor of finance at NJIT, is helping to provide such a tool, as well as other computer-based analytical insights.

The computing power that today is ubiquitous and inexpensive is fundamental to Cicon's research, including recent projects to enhance objective evaluation of a company's financial prospects and governance. For one project, Cicon is working with Professor Ali Akansu, Department of Electrical and Computer Engineering. They are correlating the facial expressions of executives making positive statements about their organizations in YouTube videos with subsequent real-world corporate performance.

Cicon says that being able to assess an executive's confidence in, for example, a proposed merger matters in finance. It is one more piece of knowledge that can be used for making an informed decision about the potential of a company's stock. The NJIT researchers' goal is to develop an algorithmic tool based on expression analysis that will graph executive confidence and provide additional input for trading strategies.

Another project involves examining transcripts of companies' quarterly conference calls with analysts for significant changes between management's prepared statements and answers to the analysts' questions – their cross-examination, so to speak. Quantifying the information content of the prepared statements relative to how management responds to questioning also enriches the store of data available for evaluating a company.

By analyzing some 300,000 conference calls downloaded from the Internet, Cicon has found that top management is often more forthcoming when questioned aggressively. However, he also has noted a tendency for management to reduce the amount of information offered when questioned about complex profit-and-loss issues, possibly due to concern for market reaction and how the company's position might be perceived by its own lower-level managers. And as he reports in an award-winning article prepared for the *Journal of Financial Research*, the degree of certainty and optimism discerned in published earnings forecasts correlates strongly with subsequent stock performance.

These analyses would have been far more difficult, if not impossible, without the Internet. Cicon also says that he was able to complete his conference-call analysis in about a month on a relatively modest budget, something that definitely would not have been possible without the computing power now at nearly everyone's disposal.

Cicon offers an important caveat, however. Tools like facial-expression analysis can be used properly or improperly. Their appropriate and effective use requires education to understand both their limitations and capabilities. Otherwise, the result will just be noise.

A feature about cloud computing follows in this issue, and look for more about the work of NJIT researchers on the computing frontier in future issues.

College of Computing Sciences: http://ccs.njit.edu
School of Management: http://management.njit.edu

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