SFI researchers receive grant for technological evolution study

The National Science Foundation has awarded SFI collaborators $380,000 over three years to study the evolution of technological performance. The project begins Jan. 1, 2008. SFI faculty member Doyne Farmer is principal investigator on the project. Co-PIs are SFI faculty members W. Brian Arthur, Doug Erwin, and Walter Powell and postdoctoral fellow Jessika Trancik. The grant is supported by NSF’s “Science of Science and Innovation Policy” program.

A better understanding of how technology matures can help society make better choices, says Doyne. The project will focus on innovations in the energy sector. The project’s primary outcome will be construction of an empirically based model of technological evolution that will examine new technologies in the context of an ecology of related technologies. Several large data sets will be analyzed.

The work will draw on previous literature regarding technological progress, the rate of performance improvement for technologies, and learning curves. Performance of an individual technology can be measured in a number of ways. Computers, for example, have tended to get faster and cheaper to produce over time. Such performance improvements typically, but not universally, follow a standard power law curve that spans industries and technology types. But history includes some notable exceptions, often attributed to outside factors or market dynamics.

Trancik has suggested that the rate of technological progress, for example, is influenced by the unit scale of the technology; radical innovations may occur more quickly on a small unit scale. The SFI project will examine progress in the context of a multitude of technologies in a market system, each at varying stages of maturity, performance, and investment — and seeks to understand how each technology’s progress is influenced by the others. “We want to know whether we can count on the performance curves for a given technology, and perhaps develop more reliable models,” he says.

Previous studies of renewable energy technology evolution by W. Brian Arthur have characterized an effect called “lock-in,” in which investment in a prior technology can blunt the acceptance of a new technology, even if the newcomer is superior.

The interdisciplinary SFI project team includes economics, engineering, physics, biology, and sociology considerations. The approach will combine empirical data analysis, theoretical work, and simulation.

Doyne says the group hopes an improved model of technology evolution will be useful for making performance forecasts for individual technologies and for suggesting investment strategies for both public and private investors in the energy sector — in particular for low-carbon-emission energy technologies and strategies for mitigating climate change.

“The environment is a particularly pressing issue right now because we as a society are going to be making a massive investment in it in the coming decades,” Doyne says. Technological evolution also is the subject of SFI’s community lecture, “Technology Creating Technology,” by Brian Arthur, scheduled for Nov. 14.
Behavior Discussion Group explores range of human behaviors

A series of informal discussions organized by SFI faculty member Sam Bowles addresses new research on human behaviors. The Behavior Discussion Group met two or three times a week during the summer, drawing 15 to 20 participants, says Sam. “The meetings are freewheeling and range from papers almost ready for publication to the light bulb that went off in somebody’s head last week,” he says.

Some highlights so far:

Trust and cooperation
Former SFI international fellow Juan-Camilo Cardenas (Universidad de Los Andes, Bogota) used games to gauge trust, cooperation, risk, and riskpooling in social groups in six Latin American cities. Cardenas found that social distance inhibited trust between participants.

Valueing money
SFI external faculty member Rob Axtell (Center for Social Complexity, George Mason University) described hyperbolic discounting – the seemingly irrational ways people value current money relative to future money – and commented on some of its societal consequences.

Informal cooperation among the poor
Rohini Somanathan (University of Delhi) described women’s economic self-help groups and small loan lenders in India. She presented data on self-help groups and small loan lenders in India. She presented data on some of its societal consequences.

The biology of economic risk-taking
Anna Dreber (Harvard University Center for Evolutionary Dynamics) presented research on physiological and biological factors that appear to account for economic risk-taking, and suggested that individuals’ economic preferences may be acquired in utero.

Social segregation and racial inequality
Rajiv Sethi (Columbia University) presented joint work with Sam Bowles and Glenn Loury (Brown University) exploring the conditions under which economic, educational, and other inequalities can persist indefinitely even if the discriminatory practices that initially accounted for the group differences are removed.

Games as culture
Jenna Bednar and SFI faculty member Scott Page (both of the University of Michigan’s political science department) found that game players adopt different strategies for some games when they played them in concert with other games. They asked whether these learned behaviors could be classified as culture.

Collective delusions
SFI postdoctoral fellow Charles Efferson discussed an experimental protocol he is crafting in which subjects might produce misinformation and promulgate mistaken beliefs in the face of counter-vailing evidence, without insertion of misinformation by confederates.

The Behavior Discussion Group series will be coordinated by SFI postdoctoral fellow Dan Hruschka, and will continue throughout the year.

Virgil Griffith creates international net stir

WikiScanner, a search tool created by SFI visiting researcher Virgil Griffith, garnered major mainstream news coverage in August, with notable mentions in dozens of media outlets including The New York Times, National Public Radio, and Wired News. The tool uses publicly available records of IP address ownership to trace millions of Wikipedia edits to the institutions doing the editing, essentially holding Wikipedia editors accountable for their changes. Griffith began working on WikiScanner following allegations that the offices of some members of Congress whitewashed their Wikipedia entries. Since its release, WikiScanner users have alleged disingenuity against a number of institutions and candidates.

On his irreverent personal web page, Virgil says he developed WikiScanner “to create a fireworks display of public relations disasters in which everyone brings their own fireworks, and enjoys.” He spent most of the summer at SFI working with SFI professor Doyle Farmer exploring the long-term effects of genetic mutations on organisms of varying complexity. Virgil calls the Institute “a bastion of mad science” and “the greatest place on Earth for doing interdisciplinary scientific research.”

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“Virgil Griffith creates international net stir”
External faculty member Nina Fedoroff, newly appointed science and technology adviser to Secretary of State Condoleezza Rice, was interviewed in the Aug. 16 issue of Nature. “Some of her well-known opinions could cause friction,” the article said. Fedoroff, who is in favor of genetically modified crops and opposed to corn ethanol production, said: “People need to understand that if you grow maize for ethanol, you drive up the price of the maize. Now the World Food Programme can buy less and feed fewer people. Ethanol from maize is not going to solve the world’s energy problems, it is going to exacerbate them.”

Work by Geoffrey West and SFI faculty members James Brown and Brian Enquist to quantify scaling laws in biology were featured on public radio’s Smart City (Aug. 2) and National Public Radio’s “Krulwich on Science” (Aug. 18). Smart City says SFI is “producing important new insights on how cities grow, why they fail, and what we can do about it.” NPR’s Krulwich says, “Though big and little creatures look very different, below the surface there is a surprising unity. Three scientists at the Santa Fe Institute…discovered that heartbeats vary in a precise mathematical way. Here is the heart of it: Nature goes easy on larger creatures so they don’t wear out too quickly.” http://www.smartsycity.com/smartcity.jsp?story_id=867

Nina Fedoroff

SFI faculty member Sam Bowles in the Aug. 7 New York Times commented on University of California, Davis, economic historian Gregory Clark’s finding that the industrial revolution occurred as people gradually embraced the behaviors required to make modern economies succeed. Though Bowles disagreed with some of Clark’s conclusions, he called the work a “great historical sociology and, unlike sociology of the past, is informed by modern economic theory.”

SFI faculty member Scott Page (University of Michigan) in the Aug. 5 Boston Globe commented on Harvard political scientist Robert Putnam’s study of diversity in 41 U.S. communities, which concludes that virtually all measures of civic health — cooperation, trust, political engagement, altruism, and volunteerism — are lower in more diverse settings. The diversity paradox, according to Scott: “Because they see the world and think about the world differently than you, that’s challenging…But by hanging out with people different than you, you’re likely to get more insights. Diverse teams tend to be more productive.”


The Aug. 11 Times (U.K.) reviews Jeffrey Kluger’s book SIMPLEXITY: The Simple Rules of a Complex World: “Simplicity is a travel through the science of complexity and simplicity, much of it based on work carried out at the Santa Fe Institute in New Mexico — a hotbed of blue-sky thinking where scientists from across the disciplines swap ideas about physics, biology, computing, social sciences and much more…SFI spends a lot of time trying to model such systems mathematically.”

Project GUTS

‘Growing Up Thinking Scientifically’ under way in Santa Fe schools

Middle schoolers interested in science, technology, engineering, and math are getting a special opportunity thanks to an SFI program offered through Santa Fe public schools.

Project GUTS — Growing Up Thinking Scientifically — is a summer and after-school educational program that encourages students to look at the world beyond their everyday levels of awareness, ask questions, and develop solutions through scientific inquiry.

The program is free and open to any student entering the seventh or eighth grade who wants to engage in scientific inquiry by investigating topics of interest to their local communities — called place-based inquiry.

Some 52 middle school students participated this summer, and five high school students participated as student mentors.

The program was conceived by SFI educator Irene Lee in the late ’90s after a stint as organizing manager for SFI’s Swarm Program and her participation in Adventures in Modeling (AIM) workshop offered by SFI Science Board member Eric Klopfer of MIT. Like AIM, Project GUTS includes a focus on modeling and simulation of complex systems using the computer modeling program StarLogo.

“I was struck by the intuitiveness of programming in StarLogo and found my niche working with middle and high school teachers and their students,” Irene says.

Project GUTS partners with the Super-computing Challenge, which is aimed at high school students, and, Irene says, “We encourage our middle school students to continue on to the Challenge once they reach high school.”

PEOPLE

Nina Fedoroff receives National Medal of Science, takes State Department post

Nina Fedoroff in July was selected to be Secretary of State Condoleezza Rice’s new science and technology adviser.

Less than two weeks before the announcement of her appointment, Nina was at the White House to receive a 2006 National Medal of Science from President Bush. She is the third person to hold the State Department position, created in 2000 to serve as the department’s chief scientist and principal liaison with the national and international scientific and engineering communities.

SFI faculty member Nina Fedoroff in July was selected to be Secretary of State Condoleezza Rice’s new science and technology adviser. Her duties also include enhancing the department’s science and technology literacy, increasing the number of scientists and engineers working in Washington and missions abroad, and providing advice on current and emerging science and technology issues as they affect foreign policy.

Nina, a leading geneticist and molecular biologist, is the Willaman Professor of Life Sciences and Evan Pugh Professor in the Biology Department and the Huck Institutes of the Life Sciences at Pennsylvania State University.

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