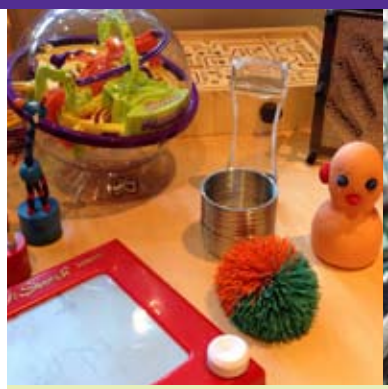
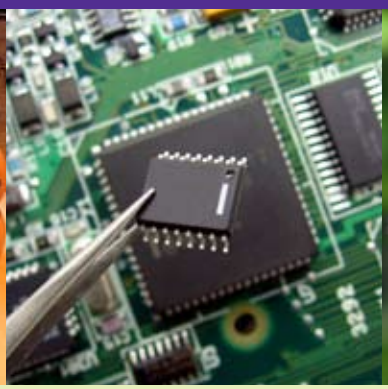
Research News

NYU POLYTECHNIC SCHOOL OF ENGINEERING

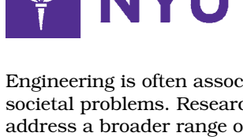



NYU | POLYTECHNIC SCHOOL OF ENGINEERING

Engineering is often associated with finding practical solutions to pressing societal problems. Researchers at the NYU Polytechnic School of Engineering address a broader range of topics, spanning the spectrum from creating new breakthroughs to arriving at the solutions that help make the world a more efficient, sustainable, and safer place. This issue contains just some of the exciting strides being made by our faculty, who frequently engage in opportunities for cross-disciplinary collaboration with their colleagues in other schools of NYU. As part of a world-class research university with myriad global partners, the faculty at the NYU School of Engineering are working with those from every field of human endeavor—from social scientists to dentists to chemists and beyond—to bring their ideas to fruition. Those collaborations are far-ranging in every sense of the word. Read on for news of our partnership with the University of Strathclyde, for example, and our ongoing teamwork on clean energy technologies at the Berlin Cleantech Business Park and Innovation Center in Germany. (It's no surprise that potential partners are coming from as far away as Berlin—the School of Engineering has become an acknowledged global leader in clean-energy-related innovation and entrepreneurship.)

When they're not in the lab or the classroom, our faculty can be found presenting at prestigious conferences, winning best-paper honors, engaging in entrepreneurship at our incubators, and sitting on editorial boards, and you can read more about some of those activities here as well.

Our core areas of focus—Urban Science and Engineering, Bioengineering, and Information Technology—are undergoing a particularly fruitful period of discovery. Thanks to NYU School of Engineering researchers, our coastal areas are going to be more resilient to storm damage, our brains will be better shielded from industrial toxins, and our computer passwords more immune to hacking. And whether they are creating new sensors to detect structural defects in aircraft or shedding light on the complexities of quantum turbulence, NYU School of Engineering faculty are illuminating and bettering the world around them.



Kurt H. Becker, PhD
Vice Dean for Academic Affairs

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Berlin and Brooklyn—Perfect Partners

In early September a Letter of Intent (LOI) to collaborate on clean energy technologies and innovation between the NYU School of Engineering, the German American Chamber of Commerce (GACC), the Borough of Brooklyn, the Berlin Cleantech Business Park and Innovation Center, and the Berlin Senate Department for Economic Affairs, Technology and Research was signed.

The signing occurred at a propitious time given that an ambitious new industrial park and innovation center focused on clean-energy start-ups is opening in Berlin-Marzahn. The CleanTech Business Park Berlin-Marzahn, as it is known, is set on over 200 acres and the adjacent Cleantech Innovation Center is already home to several young entrepreneurs. The new complex in Berlin will provide the tenant companies with access to mentoring programs, guest speakers, a community of entrepreneurs, and a strong partner network of academics and industry leaders.

The School of Engineering will collaborate on research and entrepreneurial support, including workshops and conferences, particularly through PowerBridgeNY, a proof of concept center that takes clean technology from the labs to the startup stage. The agreement expands the international perspective of the school's entrepreneurial initiative, giving faculty, students, and incubator companies deeper understanding and ties to Berlin.

INSTITUTE NEWS

University of Strathclyde and New York University Join in Landmark Research and Academic Partnership

The University of Strathclyde and New York University have cemented a flagship partnership, paving the way for a range of research and collaboration opportunities.

Signed by John Sexton, President of New York University, and Professor Sir Jim McDonald, Principal and Vice-Chancellor of the University of Strathclyde, the agreement focuses on five key themes in which the universities share strengths.

The two universities will work together in the fields of:
- Sustainable and future cities
- Biomedical engineering
- Energy and power systems
- Policy development and engagement
- Incubators and innovation

A programme of work will include research, education, and staff and student exchanges. The partnership will enable the universities to apply their expertize to bring together academia and the public and private sectors to help address global challenges in these important areas.

Sir Jim, who holds a Presidential Fellowship from NYU, said: "We are delighted to sign this agreement with New York University—one of the premier education institutions in North America. As leading international universities, we share a determination to tackle critical global research challenges and make an impact on our communities and the wider world. This formal recognition cements our relationship, and it will allow both Strathclyde and NYU to make great strides in these areas. We look forward to a long and successful partnership."

President John Sexton said: "The NYU community is very excited to launch this new partnership with the University of Strathclyde that offers expanded opportunities for international collaboration and research. We look forward to working with our colleagues in Scotland who share our vision for using applied research to help solve pressing real-world problems. Our agreement also reinforces our commitment to providing students on both sides of the Atlantic with cross-disciplinary, cross-institutional, and cross-cultural opportunities for learning, research, and scholarship."

The initiative will involve schools across NYU, most notably its Polytechnic School of Engineering, which has identified bioengineering and urban systems among its core areas of study and research. New York University is one of the largest private universities in the United States, with more than 50,000 students and nearly 9,000 academic staff. President Sexton was awarded an honorary degree from the University of Strathclyde in 2013 in recognition of his contribution to education.

Along with Harvard, MIT, and Princeton, NYU is a member of the Association of American Universities—an international organisation of leading research universities devoted to maintaining a strong system of academic research and education.

The partnership announcement comes as Strathclyde celebrates the 50th anniversary of the Royal Charter, which gave it University status. It was named the UK's Entrepreneurial University of the Year 2013/14 and UK University of the Year 2012/13 by the *Times Higher Education* magazine.

A recent independent report found Strathclyde's partnerships with business and industry will contribute £1.4 billion to the economy over the next 10 years, with much of this coming from its industrial centers, including the Technology and Innovation Centre being developed in the heart of Scotland's largest city.

The partnership provides a framework for pursuing topical collaborative research and education opportunities and highlights partnership work, the application of knowledge, and the importance of working with industry, government, and the non-profit sector.

APPLIED PHYSICS

Acacdemic Publisher Appoints Kurt Becker to Editor Positions

Springer Science+Business Media, a leading global scientific, technical, and medical publisher, has selected Professor of Applied Physics and Professor of Mechanical and Aerospace Engineering and Vice Dean for Academic Affairs Kurt H. Becker for two editorial positions. He will serve on the Board of Editors of the *European Physical Journal ST* (Special Topics) and will be a series editor for *Graduate Texts in Physics*.

As a board member of the *European Physical Journal* (EPJ ST), he will guide the peer-review process of special topics volumes in plasmas and microplasmas and atomic, molecular and chemical physics, as well as set editorial policy. The *EPJ* merged three traditional physics journals– *Journal de Physique* (EDP Sciences), *Il Nuovo Cimento* (Italian Physical Society) and *Zeitschrift für Physik* (Springer-Verlag) into a single European platform of publications covering all areas of physics. EPJ is co-published by all three.

Graduate Texts in Physics publishes core learning/teaching material for graduate- and advanced-level undergraduate courses in pure and applied physics.

Becker also serves as editor-in-chief of the *European Physical Journal D* (atomic, molecular, optical, and plasma physics). He was recently appointed a fellow of the National Academy of Inventors. His pioneering work with atmospheric-pressure cold plasmas paved the way for new, more effective methods of sterilizing medical instruments and has other biomedical and environmental applications, and he holds numerous patents on his discoveries.

APPLIED PHYSICS

Max Planck Seminar Recognizes the Work of Professors Arnold and Teraoka

The Max Planck Institute for the Science of Light, part of Germany's premier research institution for basic science, held a weeklong seminar on biosensing at the very smallest extremes, during which research developed at the NYU Polytechnic School of Engineering played a key role. Professor Stephen Arnold of the Departments of Applied Physics and Chemical and Biomolecular Engineering, who is shown above, presented his research.

Arnold and collaborators laid the groundwork for the Whispering Gallery Mode Resonator, which senses at the molecular level. Last year, they published the results of experiments that set a record for label-free detection of molecules even below the smallest known virus marker. The ability to detect and measure molecules without attaching "labels" during the process aids accuracy, and last year's accomplishment opens the possibility for detecting nano-scale antibodies—produced by the body in reaction to invading viruses—well before current medical tests could detect the virus itself.

The seminar brought together researchers, particularly students and newcomers, who use the patented Whispering Gallery Mode Resonators for molecular diagnostics, single-molecule analysis, nanoparticle detection, and manipulation, as well as other forms of bio-sensing and various commercial and scientific applications.

Arnold's presentation is entitled, "Taking Microcavity Label-free Single Molecule Detection deep into the Protein Realm." Iwao Teraoka, an associate professor in the Department of Chemical and Biomolecular Engineering who collaborated in early work on the Whispering Gallery Mode Resonator, was invited to present research on a new biosensor that he is developing.

The seminar, "Taking Detection to the Limit: Biosensing with Optical Micro-cavities," held over the week of April 14, was supported by the Wilhem and Else Heraeus Foundation. The Max Planck Institute is a leader in accelerating the transfer of technology to practical applications and commercialization.

CHEMICAL AND BIOMOLECULAR ENGINEERING

Engineering a Protein to Prevent Brain Damage from Toxic Agents

NYU RESEARCHERS ADVANCE THE STABILITY OF A PROTEIN THAT NEUTRALIZES TOXINS IN COMMON PESTICIDES AND CHEMICAL WEAPONS

Research at New York University is paving the way for a breakthrough that may prevent brain damage in civilians and military troops exposed to poisonous chemicals—particularly those in pesticides and chemical weapons.

An article in the current issue of the journal *ChemBioChem* outlines the advancement in detoxifying organophosphates, which are compounds commonly used in pesticides and warfare agents. The patent-pending process was developed by NYU School of Engineering Associate Professor of Chemical and Biological Engineering Jin Kim Montclare, along with Richard Bonneau, an associate professor in NYU's Department of Biology and a member of the computer science faculty at NYU's Courant Institute of Mathematical Sciences.

Their work centers on proteins called phosphotriesterases, which have the unique capability of degrading chemicals in a class known as organophosphates, which are found in everything from industrial pesticides to the sarin gas used in chemical warfare. Organophosphates permanently bond to neurotransmitters in the brain, interfering with their ability to function and causing irreversible damage. The ability of phosphotriesterases to detoxify organophosphates has been previously documented; however, applications using the protein for this purpose have been limited by its short half-life and instability at high temperatures.

Montclare and her colleagues devised a method of re-engineering phosphotriesterases by incorporating an artificial fluorinated amino acid and computational biology. The result: a thermo-stable protein with a longer half-life that retains all the detoxification capabilities of the original version.

"Organophosphates pose tremendous danger to people and wildlife, and sadly it's not unusual for humans to come into contact with these compounds, whether through exposure to pesticides or an intentional chemical warfare attack," explained Montclare. "We've known that phosphotriesterases had the power to detoxify these nerve agents, but they were far too fragile to be used therapeutically," she said. In a process that married computational biology and experimentation,the collaborators used Rosetta computational modeling software to identify sequences in the fluorinated phosphotriesterase protein that could be modified to increase its stability and make therapeutic applications a reality.

The possibilities for this reengineered protein are considerable. Montclare explained that in addition to therapeutic formulations, which could prevent nerve damage in the event of a gas attack or pesticide exposure and would likely be developed first for military use, the proteins could be critical when stores of toxic nerve agents need to be decommissioned.

"Oftentimes, chemical agent stockpiles are decommissioned through processes that involve treatment with heat and caustic chemical reagents for neutralization, followed by hazardous materials disposal," she said. "These proteins could accomplish that same task enzymatically, without the need for reactors and formation of dangerous byproducts."

Plans are under way to begin developing therapeutic applications for this modified phosphotriesterase, and the research team believes that its methodology—using computational biology to identify potentially beneficial modifications to proteins—could point the way to future breakthroughs in engineered proteins.

The initial idea for this work was broached by Michelle Zhang, a co-author of the paper and, at the time, a high school intern in Bonneau's lab. Zhang is now a student at Cornell University. Other collaborators include NYU School of Engineering doctoral students Andrew J. Olsen, Ching-Yao Yang, and Carlo Yuvienco; and P. Douglas Renfrew, a postdoctoral scholar in the Bonneau Laboratory at NYU.

Research was supported by a grant from the U.S. Army Research Office and the National Science Foundation.

CIVIL AND URBAN ENGINEERING

Building Bridges and Calculating Costs

A few years ago, when a disagreement was brewing between two factions—one wanting to outsource New York State Department of Transportation design work to private contractors and one believing that in-house engineers were more efficient and cost effective—Professor of Construction Engineering and Management Bud Griffis knew the solution: conduct an objective study analyzing the costs involved in both scenarios.

The report, which was revised and finalized in January 2011, contained eye-opening information. "It might be anticipated that the cost of an engineer would be the same whether he or she is in the public or private sector," the document stated. "However this study found that because of the generous benefits package provided by the State of New York, the large amount of paid time off, and a reduced work week compared to the private sector, the in-house engineer actual expected cost to the tax payer exceeds the cost of a private engineer by at least 15%. These calculations are based on conservative assumptions and the actual difference considerably exceeds 15%. The total cost of a career NYSDOT employee to taxpayers is in excess of $ 6.4 million over a 30 year career."

Because everyone wants to see tax dollars used wisely, Griffis knew that other states could benefit from similar studies. Under his direction, graduate students Elena Pizzoli and Giulia Luci are now embarking on an ambitious plan to perform similar calculations in all 49 remaining states.

Under the auspices of the American Council of Engineering Companies (ACEC), they are gathering the data required, including direct salaries, benefits, and overhead costs. "We want to make sure we're comparing apples to apples," Pizzoli explained. "It's important that the study be entirely objective."

They admit that collecting that much data can be daunting. "Every state DOT is different, and sometimes it's difficult to reach the correct person," Luci said.

The two, who originally hail from Italy, predict that the entire project will take three years to complete.

The original New York State report concluded, "The Governor's office, the state legislature and all state agencies should take advantage of the lower costs and enhanced benefits that the private sector provides in developing and implementing their design and construction programs. This results in immediate and long term benefits to all New York taxpayers.

Soon, thanks to Pizzoli and Luci, every taxpayer in the nation will have the benefit of a similarly objective look at the costs associated with their bridges and roadways.

CIVIL AND URBAN ENGINEERING

NEW YORK STATE FUNDS STORM RESILIENCY RESEARCH

New York State issued a second grant, of $1.26 million, to the NYU Polytechnic School of Engineering to support a new hub of research and education on emergency preparedness.

The New York State Resiliency Institute for Storms & Emergencies (NYS RISE) launched late in 2013 and brings together academic thought leaders as well as government officials, national experts, and emergency response leaders to conduct research and provide scientific information and intellectual resources to develop comprehensive plans to better protect communities. It also serves as a clearinghouse of information regarding extreme weather and natural disaster.

NYS RISE is led by NYU and Stony Brook University; the co-director for NYU is Professor Fletcher H. (Bud) Griffis, director of the School of Engineering's Center for Construction Management Innovation. Other partners include Columbia University, Cornell University, City University of New York, and Brookhaven National Laboratory.

COMPUTER SCIENCE AND ENGINEERING

Do You Fidget, Fiddle, or Doodle While You Work?

NYU POLYTECHNIC SCHOOL OF ENGINEERING RESEARCHERS SEEK ONLINE PARTICIPANTS

Researchers at the New York University Polytechnic School of Engineering's Game Innovation Lab know that doodling, fiddling, and fidgeting are anything but trivial. The fascinating and powerful interrelation of bodily movement, cognition, and emotional state has been amply demonstrated, and manipulating physical objects with the hand is known to activate the brain in measurable ways.

The NYU School of Engineering researchers aim to take the benefits of these manipulations into the digital age through a project they call "Fidget Widgets," which employs small, playful, programmable devices to marry digital and physical play to enhance work.

"Your word processing software doesn't really support doodling—it's entirely focused on word processing," explains Mike Karlesky, a computer science doctoral candidate. "So we doodle and fiddle with playthings while we work. Our research explores this transitional area between software and physical work spaces."

Fidget Widgets that mimic the experience of popping bubble wrap and playing with the desktop toy known as a Newton's Cradle have already been developed, and the researchers hope to introduce a host of other versions that will help users increase their productivity, enhance creativity, and lessen stress by firing specific areas of the brain.

"For instance, perhaps you need a little boost in creativity or focus, or you need to de-stress a bit. The right electronic widget might help," Karlesky said. "Perhaps your hand interaction can complement the work on your screen—the numbers in a spreadsheet could change the object in your hand so you would very literally play with your ideas. We hope to tap into the powerful connections among thinking, feeling, and the sensory experience."

To gain a better understanding of the playful, tactile experiences in which people engage while at work, the researchers are collecting examples from the public. So far, participants have expressed very strong and widely differing preferences on tactile sensations and materials.

Anyone wishing to participate can simply submit a few lines of text, a photo, or a video to http://fidgetwidgets.tumblr.com/. The entry should answer the questions: What objects do you play with while you work? What are they made of? What do you enjoy about them and how they feel? Do they have special meaning to you? Are there specific times you play with them?

"We'll be analyzing the data for patterns," explained Karlesky, who is working on the project with Katherine Isbister, director of the Game Innovation Lab and associate professor in the Department of Computer Science and Engineering, and Kacie Kinzer, a doctoral candidate in the Administration, Leadership, and Technology Department of NYU's Steinhardt School of Culture, Education, and Human Development. "In order for it to be valuable, we'll need as much input from the public as possible."

A paper on the project, entitled "Designing for the Physical Margins of Digital Workspaces: Fidget Widgets in Support of Productivity and Creativity," was delivered at the TEI 2014 (8th International Conference on Tangible, Embodied and Embedded Interactions). It is available at http://dl.acm.org/citation.cfm?id=2540930.2540978.

The Game Innovation Lab at the NYU School of Engineering brings together faculty and students from the School of Engineering and the greater NYU community. The lab's emphasis is on the technical, engineering, and science elements of games and simulations. Sample projects include user interface innovation (sensor-based tracking, multi-touch), network and video quality research, and research on games for learning.

Buyer Beware: NYU Researchers Uncover Security Breach That Reveals eBay Purchases

PRIVACY FLAW MAKES IT POSSIBLE TO TRACK BUYERS OF GUN ACCESSORIES, MEDICAL TESTS, AND MORE

Buyers and sellers using the online marketplace eBay may be revealing far more than their interest in vintage furniture or video games. Researchers at the New York University Polytechnic School of Engineering and NYU Shanghai have discovered a privacy flaw that allows site visitors to view a buyer's complete purchase history—including sensitive items like gun accessories and at-home medical tests for pregnancy or HIV.

Keith W. Ross, Dean of Engineering and Computer Science at NYU Shanghai, and the Leonard J. Shustek Professor of Computer Science and Engineering at the NYU School of Engineering, presented the paper co-authored with doctoral candidate Tehila Minkus, "I Know What You're Buying: Privacy Breaches on eBay" at the Privacy Enhancing Technology Symposium in Amsterdam.

Minkus and Ross began their inquiry when Minkus, herself an eBay user, was browsing the feedback section of a would-be purchaser's eBay profile following a botched transaction. "Feedback as a Buyer" and "Feedback as a Seller" are essential features of the eBay marketplace, allowing users to leave comments on their purchase experiences to create trust and foster confidence during transactions.

While reviewing this particular buyer's feedback, Minkus noticed that, with very little effort, she was able to obtain a list of all of his previous purchases. Further probing revealed a substantial privacy loophole in the eBay marketplace, one that can expose highly sensitive purchases, such as gun accessories or at-home medical tests.

"This breach can be exploited on a scale ranging from a snooping spouse or an employer investigating an individual's buying habits to a large-scale, automated attack that could quickly link millions of people with their purchases," Ross said. "This is exactly the kind of information that could be very valuable to marketers, cybercriminals, or even law enforcement officials."

The privacy flaw operates as follows: Every eBay user's profile includes a "Feedback as a Buyer" page, where those who have sold items to that person can post comments. An estimated 70 percent of sellers leave feedback for buyers, and this section is entirely public—a user need not even sign into eBay to access this information. Along with their comments, the seller also leaves a record of his or her own username and the time of sale but does not disclose the actual item purchased. By visiting the seller's feedback page, however, it is relatively easy to match the time stamp of the sale and thus identify the item that was purchased.

In the event that more than one sale matches the time stamp, which may happen with automated sales, the researchers still found it fairly straightforward to identify purchase histories. eBay assigns a pseudonym to each username listed in sales records, and that pseudonym follows a formula that makes deriving the username possible in nearly every case: In a test database of 5,580 feedback records, the researchers matched 96 percent of buyers' feedback records to a single seller feedback record, complete with purchase details.

In some cases, the researchers were able to take this attack one step further: Among a database of nearly 131,000 eBay usernames, they were able to link 17 percent to Facebook profiles, thus revealing the users' real names.

"While compiling data on purchasers of pregnancy or at-home HIV tests is useful to a fairly limited group—perhaps advertisers or pharmaceutical companies—assembling a database of those who have purchased gun accessories may have considerably more impact," said Minkus.

She explained that while eBay does not sell firearms, the marketplace does sell a wide array of gun-related accessories. For this study, the researchers searched for those who had purchased gun holsters, presumably an indication of gun ownership. They recovered sales records for more than 292,827 gun holsters purchased by 228,332 individuals. Of those, 35,262 were linked to full names as they appear on Facebook.

"This privacy loophole can provide leads for law enforcement or private investigators looking for unregistered gun owners, but it can also give private information to background-check providers or data aggregators who want to include gun ownership in their records," Minkus added.

The researchers also conducted a survey of about 1,000 eBay users to gauge their expectations of privacy on the site. Surprisingly, when asked where they prefer to make a sensitive or private purchase, a plurality—nearly 39 percent—selected eBay, noting that they believed the site was a more discrete vendor than a physical store. Additionally, 38 percent of those surveyed believed that their purchase histories were visible to no one except them.

Minkus and Ross notified eBay of their findings, offering suggestions to patch the privacy flaw. Among them are changing the default setting of a seller's feedback to buyers in a way such that the comments would be public but the actual item sold would never be linked on either the buyer's or seller's pages. The researchers also advocate generalizing the time stamp accompanying feedback—at present, this includes a date and exact time, which is unnecessary and allows for linkages between buyers and sellers. Finally, they recommended that eBay generate random pseudonyms for buyers listed on a seller's feedback pages rather than using a persistent pseudonym.

They recommend that eBay users maintain two separate accounts, a private profile for buying and a public account for selling.

This research was partially funded by grants from the National Science Foundation.

More Computer Science and Engineering News

METHOD OF OPTIMIZING DIGITAL HISTORY WINS BEST PAPER AWARD

This September, research on persistence by three members of the NYU Polytechnic School of Engineering Computer Science and Engineering faculty will receive the best paper award at the European Symposium on Algorithms in Wroclaw, Poland. Professor John Iacono, Postdoctoral Teaching Fellow Özgür Özkan, and Postdoctoral Researcher Pooya Davoodi authored the paper, along with Jeremy Fineman of Georgetown University. The European Association for Theoretical Computer Science (EATCS) chose their paper, *Cache-Oblivious Persistence*, from more than 250 submissions to the symposium.

STUDENT CO-AUTHORS RESEARCH ON THE PROTEIN UNIVERSE

While scientists now know the sequence of millions of proteins—having deciphered which amino acids comprise the proteins, for example, and in what order—their knowledge is far from complete. The structure—the 3D coordinates of every atom of a protein when it is folded in nature—is known for merely 100,000, because decoding the structure of a protein is costlier and more complex than sequencing it.

Sergey Nepomnyachiy, a doctoral candidate in the Department of Computer Science and Engineering, is helping to make strides in that area. Along with computational biologists Nir Ben-Tal and Rachel Kolodny, he is applying network theory to the task. Their *Proceedings of the National Academy of Sciences* research paper, "Global View of the Protein Universe," prominently features Nepomnyachiy's contribution, which included weeks of running massive amounts of data through a cluster of 32 computers.

NSF GRANT INTRODUCES SECONDARY SCHOOL TEACHERS TO CYBER SECURITY

Aiming to address the shortage of cyber security experts, the NYU Polytechnic School of Engineering has launched a training program for secondary school teachers so that they may engage students at a young age. The program lays the groundwork for teachers to involve their students in the School of Engineering's annual Cyber Security Awareness Week (CSAW) forensics competition. The largest set of student competitions in the world, CSAW gives students the chance to interact with top professionals and older cyber security students, as well as to attend academic conference sessions. Principal investigator for the project is Professor Nasir Memon, head of the Department of Computer Science and Engineering

NSA Names NYU School of Engineering to Exclusive List of Cyber Security Programs

FIRST IN NEW YORK TO BE DESIGNATED AN NSA CENTER OF ACADEMIC EXCELLENCE IN CYBER OPERATIONS

The National Security Agency and the United States Cyber Command have named the NYU Polytechnic School of Engineering as a National Center of Academic Excellence in Cyber Operations, the first in New York earning the designation and one of only a handful in the country to earn all three Center of Excellence designations from the NSA.

The new honor signals that a school maintains a deeply technical, interdisciplinary graduate-level program with extensive opportunities for hands-on learning. Launched in 2012, the Center of Excellence (CAE) in Cyber Operations is the third such program overseen by the agency. The CAE in Information Assurance Education was launched in 2001, and the NYU School of Engineering became one of the first schools in the country to earn that designation. The CAE in Information Assurance Research was initiated in 2007, with the NYU School of Engineering earning that honor, as well, shortly thereafter. All three are designed to cultivate cyber professionals, and the program is an outgrowth of the President's National Initiative for Cybersecurity Education.

"The NYU Polytechnic School of Engineering was one of the first schools in the nation to introduce a cyber security program," said Professor Nasir Memon, head of the Department of Computer Science and Engineering. "We are very proud to have earned the National Center of Excellence designation in all three available areas and will continue to provide the hands-on interdisciplinary education and research support so vital for our country's next generation of cyber security experts."

The school launched its master's program in cyber security in 2009, just weeks after the Pentagon revealed it had spent $100 million over the prior six months to clean up damage from Internet attacks and other network problems. Since then, more than 100 NYU School of Engineering master's degree recipients have gone on to careers as developers of security products, security application programmers, security analysts, penetration testers, vulnerability analysts, and security architects. The school also offers numerous cyber security courses and extra-curricular opportunities for undergraduates.

Its cyber security program was previously singled out by the Sloan Consortium as the outstanding graduate online program.

NYU is also home to the Center for Interdisciplinary Studies in Security and Privacy (CRISSP), which brings together experts in psychology, law, public policy and business from across the university to work alongside computer science and engineering faculty and students for cutting-edge research. CRISSP builds new approaches to security and privacy that recognize that technology alone cannot provide the information security and privacy needed in today's interconnected world.

Among the landmark initiatives of the NYU School of Engineering is Cyber Security Awareness Week (CSAW), the largest student-run cyber security event in the nation, with numerous competitions, a research conference that attracts some of the biggest names in the industry, and a career fair with an impressive list of corporate partners. The Capture the Flag challenge alone at CSAW 2013 drew some 13,500 competitors from 86 countries. To engage more high school students—particularly girls—in the fun of cyber security through CSAW, the school hosts summer bootcamps for teachers and high school girls, supported by the NSA, the National Science Foundation, and the Sloan Foundation. The CSAW competitions include one solely for high school students on digital forensics.

CSAW is supported by the school's Information Systems and Internet Security (ISIS) Laboratory, an offensive security research environment where students gain a unique perspective and a proper foundation that allows them to master any area of cyber security. The lab is run solely by students, advised by hackers-in-residence and industry partners, and is directed by founder Nasir Memon.

The designation certificate was presented during an awards ceremony at the 18th Annual Colloquium for Information Systems Security Education in San Diego, California.

COMPUTER SCIENCE AND ENGINEERING

Crack That Password? Not in a Billion Years

NYU SCHOOL OF ENGINEERING RESEARCHERS' SECURITY SCHEME PROTECTS PASSWORDS FROM HACKERS

In less than an hour, a single computer hacker armed with a laptop can crack a handful of six-character passwords, no matter how cleverly crafted. If those passwords are stored with a new scheme devised by researchers at the New York University Polytechnic School of Engineering, however, that same attack could take every computer in existence longer than the estimated age of the universe.

Assistant Professor of Computer Science and Engineering Justin Cappos has introduced PolyPasswordHasher, an open-source password protection scheme for institutions and corporations that offers an unprecedented level of security for password servers, making it immensely difficult for hackers to decode even small numbers of individual passwords.

Compromising password files is both a lucrative and common attack method for cyber criminals, and dozens of high-profile companies each year fall prey to costly attacks that expose customers' personal information.

The majority of passwords are stored in databases using a method called a salted hash, a one-way encryption technique that considerably reduces the vulnerability of password text in the event that a database is hacked. However, in cases in which attackers gain privileged access to a running system, they can intercept an administrator's password information before such protections are in place. In other instances, password databases are encrypted using a key, but if the key itself is stored on a disk, it too can be quickly compromised and used to decode administrator passwords and thereby obtain information about others on the network.

PolyPasswordHasher takes a completely different approach, never directly storing password information in a database. Instead, the information is used to encode a cryptographic "store" that cannot be validated unless a threshold number of passwords are entered. A would-be attacker would need to crack groups of passwords simultaneously—a task so labor-intensive as to be nearly insurmountable—in order to verify any single hash.

"PolyPasswordHasher divides secret information—in this case, password hashes—into shares, and just like a puzzle that is meaningless unless the pieces are assembled, no individual password can be validated unless a certain number of them are known and entered," explained Cappos. "Even if the password file and all other information on disk were stolen, an attacker could not verify a single correct password without guessing a large number of them correctly."

For example, in the above-referenced plausible scenario of an attacker attempting to crack six-character passwords using a modern laptop, Cappos estimated that at least three passwords could be decoded, one at a time, in less than one hour if the computer was checking roughly a billion password hashes per second. PolyPasswordHasher would require that these three passwords be computed at the same time, increasing the search space by approximately 23 orders of magnitude. In practice, this means that all 900 million computers on Earth would need to work nonstop for longer than 13 billion years—the estimated age of the universe—to accomplish the same task.

In the event that an attacker had prior knowledge of a threshold number of administrator passwords and was able to enter the system, all remaining password data would remain under the same protections offered by today's salted hashing schemes. System administrators can designate which user accounts "count" toward the system threshold of passwords and which do not, allowing them to control for users who may be less diligent about security measures such as password strength.

"In the best case, this is perhaps the safest password data would ever need to be, and at minimum, the protections are the same as the current industry standard," Cappos said.

PolyPasswordHasher is the first security scheme to employ this approach, and the only single-server, software-only system to exponentially increase the search space for attackers. The system creates no noticeable changes in interface or user experience, and it can be integrated quickly and seamlessly into existing systems with a negligible increase in database storage requirements.

Cappos and his collaborators believe PolyPasswordHasher could dramatically reduce or eliminate the impact from password file breaches that routinely plague corporations. They also explained in their paper that while PolyPasswordHasher is not designed for use on an individual smartphone or computer with a single user, "every device that is networked or communicates with a cloud or web-based server—and that's nearly every device in use today—would be safer if servers used this storage method."

PolyPasswordHasher is currently being tested as part of the Password Hashing Competition, a global effort organized by security professionals to identify new password protection schemes and improve security practices in this area. Collaborators on the project are Santiago Torres, an NYU School of Engineering graduate student, and Justin Quick, a senior application developer at the National Geographic Society.

COMPUTER SCIENCE AND ENGINEERING

Visualization Conference Selects 8 NYU School of Engineering Papers

The premiere conference for data visualization will feature eight research papers co-authored by NYU Polytechnic School of Engineering faculty members from the Department of Computer Science and Engineering.

"The selection of so many papers and their wide range of topics—from climate and biological visual analytics to sports visualization—is gratifying and signals the impressive growth of data analysis and visualization at the NYU School of Engineering over the last three years," said Professor Nasir Memon, head of the department.

The papers will be presented at the IEEE VIS 2014, which will be held November 9-14, 2014, in Paris, and includes conferences on Visual Analytics Science and Technology (VAST); Information Visualization (InfoVis), and Scientific Visualization (SciVis). IEEE was founded as the Institute of Electrical and Electronics Engineers.

The department faculty members who co-authored the papers are: Assistant Professor Enrico Bertini, Research Assistant Professor Harish Doraiswamy, Professor Juliana Freire, Research Assistant Professor David Koop, Professor Claudio Silva, Research Assistant Professor Huy T. Vo, and Postdoctoral Fellow Aritra Dasgupta. Freire is also the director of graduate studies for the NYU Center for Data Science and an associated faculty member for the Center for Urban Science & Progress (CUSP). Silva is also the head of disciplines for CUSP and holds faculty member appointments in NYU's Center for Data Science and the Courant Institute of Mathematical Sciences.

Five doctoral students in the department were co-authors: Nivan Ferreira, Josua Krause, Anshul Vikram Pandey, Jorge Poco, and Bowen Yu.

Other NYU professors were among those who co-authored the papers with faculty of the Department of Computer Science and Engineering: Oded Nov, an associate professor in the school's Department of Technology Management and Innovation, and Richard Bonneau, an associate professor in NYU's Department of Biology and a member of the computer science faculty at NYU's Courant Institute of Mathematical Sciences.

GOOGLE FUNDS PROFESSOR TORSTEN SUEL'S QUEST FOR SEARCH EFFICIENCY

Google has granted a Faculty Research Award to Professor Torsten Suel to support his study of new index pruning and index tiering techniques that could significantly reduce hardware and energy costs for large web search engines. "Google receives 5 billion queries a day, and the company indexes trillions of pages. This huge data size and query load mean that running a large, state-of-the-art search engine is now a very expensive undertaking, requiring massive amounts of energy," explained Suel, a professor in the Department of Computer Science and Engineering and an expert on search engine architecture.

Google pulls its search results from an index—think of a massive digital version of the index in the back of a book. Suel's aim is to prune that index by finding ways to eliminate word occurrences that are unlikely to be helpful during a given search. Additionally, he is studying index tiering systems, in which parts of the index that are considered less useful are consulted only on selected queries.

This is the third Google award given to Professor Suel, who holds a Diplom degree from the Technical University of Braunschweig and a doctorate from the University of Texas at Austin. Google, which estimates that its index is now well over 100 million gigabytes, bestows the Faculty Research Award, as the unrestricted grant is known, upon scientists working in areas of key interest to the company as well as to the broader research community. Suel's grant is for $55,500.

ELECTRICAL AND COMPUTER ENGINEERING

Popularity Contest: Student Poster Takes Top Honor

STUDENT POSTER IMPRESSES AT THE ASSOCIATION FOR COMPUTING MACHINERY (ACM) DESIGN AUTOMATION CONFERENCE

Doctoral student Jeyavijayan (JV) Rajendran explains that while reverse engineering—dismantling a piece of technology in order to better understand it—has undeniable benefits, the practice can

easily be misused. "An attacker can reverse engineer a chip in order to steal or pirate the design," he says, pointing out that according to one study conducted by SEMI, a trade association of the micro- and nano-electronics industries, up to $4 billion is lost each year because of intellectual property violations.

While many researchers focus on chip efficiency or reliability, JV, who is advised by Professor Ramesh Karri, has focused his studies on security, with the aim of preventing such losses. (He also works closely with Professor Ozgur Sinanoglu, who directs the Design for Excellence Lab at NYU Abu Dhabi and credits both professors with his success.)

"It used to be assumed that everyone in the supply chain could be trusted," he says. "But now we know that's not always the case." He explains that security breaches can be perpetrated by foundry workers during the manufacturing process, by a chip's end user, or even by both.

JV's doctoral work—generously supported in part by the Semiconductor Research Corporation, as he emphasizes—has resulted in a three-pronged approach to ensuring chip security. One technique, which he terms logic encryption, adds logic gates to the design to "lock" the chip, while camouflaging takes that one step further by calling for a series of logic gates that look identical—despite performing totally different functions—thereby confusing the would-be pirate.

A third security method, split manufacturing, assigns portions of the manufacturing process to multiple foundries, ensuring that no single foundry is privy to the entire design.

The project was also funded by Air Force Research Labs, NSF, CRISSP, and CRISSP-AD.

JV presented his work during a PhD competition hosted by the ACM's Special Interest Group on Design Automation (SIGDA) at the 2014 Design Automation Conference, which was held in early June in San Francisco. Some 4,000 participants from industry and academia attended the event, and when they voted on their favorite presentation, he was the hands-down "People's Choice" award winner.

Patents have been filed, and JV has already received interest from those wishing to license the technology. "I got a great deal of constructive feedback during the conference," he says, "and it was wonderful to be named the favorite of the attendees."

FINANCE AND RISK ENGINEERING

Engineering Researcher Unearths Timely Advice for Portfolio Managers

Economists have long debated the risks and rewards of investing using the momentum strategy, an approach based on the belief that market trends will continue: that further gains will follow large increases in the price of a security and that declining prices will persist in declining. Now, Philip Z. Maymin, an assistant professor of Finance and Risk Engineering at the NYU Polytechnic School of Engineering, and his collaborators have shown that the exact day on which a portfolio manager chooses to begin tracking those trends has a profound impact on whether or not the strategy will ultimately be successful.

"Momentum's Hidden Sensitivity to the Starting Day," co-authored with Zakhar G. Maymin, head of research, and Gregg S. Fisher, chief investment officer, both at Gerstein Fisher in New York, was published in the Summer 2014 issue of the *Journal of Investing*, a periodical that offers analyses and investment strategies used by practitioners.

"Let's say a portfolio manager who wants to plan buys and sells begins looking at monthly reports from past years," Maymin explains. "He might choose to examine the period between February 12 and March 12 for several years running and base his decision on those figures. Now let's say he examines the period between February 13 and March 13 instead. You might think that such a small change wouldn't matter, but it does, even when taken over decades."

Portfolio managers should thus be aware of this latent risk, Maymin writes, and he strongly encourages them to model several different time periods and average the results.

Both Zakhar Maymin and Fisher have taught classes in the Department of Finance and Risk Assessment.

MORE FINANCE AND RISK ENGINEERING NEWS

Research Examines Wealth Divide in Financial Markets

New research in quantitative finance indicates that the wealth divide in financial markets may be both mental and structural—not a matter of large investors' access to faster computers for stock trading or a factor of their personal connections. In a paper to appear in *Quantitative Finance*, NYU Polytechnic School of Engineering Professor Charles S. Tapiero examined a classic financial pricing model in which investors were not financial equals. His analysis showed that investors big enough to affect a market hold an arbitrage advantage.

Zhaoxia Xu Wins Economic Research Grant

The National Bureau of Economic Research Innovation Policy recently selected NYU Polytechnic School of Engineering's Zhaoxia Xu as one of two recipients worldwide of a research grant of $10,000 for the academic year 2014-2015. Xu, an assistant professor in the Department of Finance and Risk Engineering, focuses her research on government economic policy and corporate innovation.

MECHANICAL AND AEROSPACE ENGINEERING

Follow That Fish!

ZEBRAFISH REACT DIFFERENTLY TO ALCOHOL WHEN SHOALMATES ARE CLOSE BY. STUDY REVEALS SURPRISING BEHAVIORAL CHANGES THAT MAY LINK TO LEADERSHIP IN THIS SPECIES

New findings published by researchers at the New York University Polytechnic School of Engineering are helping to unravel the complex interplay between alcohol and social behavior and may lead to new therapies for mitigating the negative impacts of alcohol use and abuse. Their experiments, published in the current issue of *Alcohol: Clinical and Experimental Research*, center not on patrons at a local happy hour, but on far simpler creatures: zebrafish.

A team led by Maurizio Porfiri, associate professor of mechanical and aerospace engineering and director of the school's Dynamical Systems Laboratory, overturned the traditional experimental paradigm for alcohol-related studies, in which all subjects are exposed and their behavior and movements analyzed. Instead, the NYU School of Engineering researchers devised an original method that would allow for detailed tracking of a single, alcohol-exposed zebrafish amid a school of "sober" peers.

The research team comprised NYU School of Engineering Research Scholar Fabrizio Ladu and Postdoctoral Fellow Sachit Butail, along with Visiting Scientist Simone Macrì, PhD, of the Istituto Superiore di Sanità in Rome, Italy. They posited that an individual's response to alcohol would vary based on the presence or absence of unexposed peers. What they did not anticipate, however, was the remarkable effect the alcohol-exposed fish would have on unexposed shoalmates.

Porfiri and his colleagues designed an experimental procedure in which a single zebrafish was exposed to four concentrations of ethanol in water, ranging from zero to high. (This is called acute exposure and poses no harm to the fish.) Following exposure, the fish was released into a group of untreated zebrafish. To the researchers' knowledge, this is the first experiment to allow ethanol-exposed and untreated zebrafish to swim freely together.

A custom tracking algorithm developed by the team allowed the researchers to follow for the first time individual fish throughout the experiment as well as analyze group behavior.

Previous studies show alcohol exposure affects zebrafish locomotion—at low concentrations, fish tend to swim faster, and as the dose increases, swimming typically slows. Alcohol can also negatively impact the school's cohesion.

In Porfiri's trials, the single exposed zebrafish showed changes in locomotion when observed alone consistent to those predicted by independent studies in the past. In a group setting, however, the zebrafish behavior was remarkably different: Fish exposed to intermediate or high alcohol concentrations nearly *doubled* their swimming speeds, suggesting that the presence of peers had a substantial impact on social behavior under the influence of alcohol.

Most remarkably, the unexposed fish also modulated their behavior and swimming speeds differentially in the presence of a shoalmate exposed to different levels of alcohol.

"These results were very surprising," explained Porfiri. "It is clear that the untreated fish were matching the swimming speed of the alcohol-exposed fish, and this correlation was especially strong at an intermediate level of alcohol exposure. At very high or low levels, the influence decreases."

Porfiri believes that one explanation for the high-speed swimming of the exposed individual may be hyper-reactivity to an enriched environment—the tank containing shoalmates. Alcohol has also been shown to decrease inhibitory behavior in zebrafish. The increased speed may therefore also reflect a heightened interest in interacting with shoalmates. Regardless, this deviation from expected behavior is highly significant, as it points to the ability of social stimuli (the untreated shoalmates) to change an individual's response to alcohol.

The ability of alcohol-exposed zebrafish to influence untreated shoalmates may constitute a form of leadership, but researchers caution that aggressive, risk-taking behaviors—common under the disinhibitory effects of alcohol—may resemble leadership behavior patterns in this species.

"This research integrates rigorous principles from engineering and biology to develop an experiment that sheds light on the complex interactions among individuals in a group, their individuality and their collective behavior," said Massimo Ruzzene, NSF program director for the Division of Civil, Mechanical and Manufacturing Innovation. "Analysis of complex dynamical systems is an important area of research. An understanding of complex systems, ranging from smart robots that assist in surgery to manufacturing enterprises and emergency response teams, is integral to our ability to respond effectively to emerging challenges and opportunities."

Porfiri and his team believe that the methodology developed for these experiments holds tremendous promise for future studies on the social determinants of individual responses to alcohol. By dissociating sociality from exposure, the researchers were able to study, for the first time in this species, how the impact of alcohol on behavior can be shaped by social environments. Future studies will focus on determining the degree to which social influence exerted by exposed or unexposed individuals is affected by group size.

Ultimately, the researchers hold that this line of inquiry may advance understanding of how social interactions magnify or mitigate negative effects of alcohol abuse, such as destructive behavior, and could lead to therapies to reduce the same.

This research was supported by grants from the National Science Foundation.

MORE MECHANICAL AND AEROSPACE ENGINEERING NEWS

Grants Advance Research into Composites to Protect Vehicles and Troops

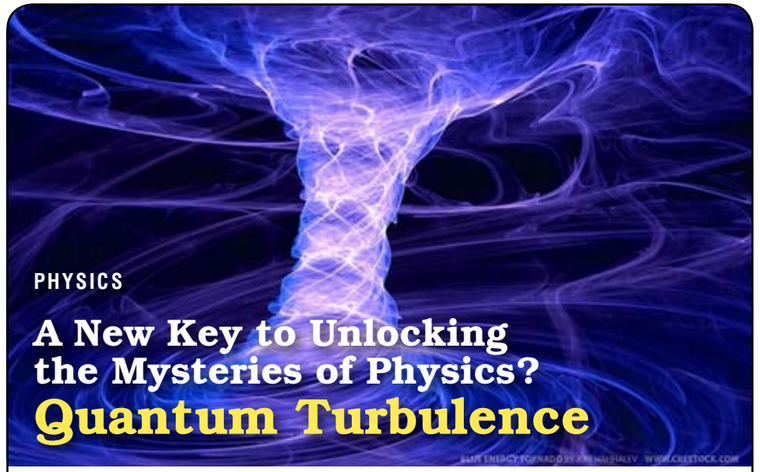
Nikhil Gupta, an associate professor in the Mechanical and Aerospace Engineering Department of the NYU Polytechnic School of Engineering, has won grants from both the U.S. Army and the U.S. Department of Energy (DOE) to study magnesium matrix composites, lightweight materials that hold the potential to revolutionize the production of military vehicles and armor. Gupta's DOE grant, totaling $150,000, comes under the auspices of the Small Business Innovation Research program and will fund collaborative work with the company Materials Modification, Inc.

Novel Computational Approach Aims to Improve Prosthetics and Aid Troops

Assistant Professor of Mechanical Engineering Joo H. Kim of the NYU Polytechnic School of Engineering has won a three-year, $350,000 National Science Foundation grant to develop a novel joint-based method of modeling and computing human metabolic energy expenditure. Kim's computational model takes a novel engineering approach with mathematical rigor to overcome those limitations. It integrates the laws of thermodynamics and the principles of complex system dynamics, and enables real-time calculations of instantaneous metabolic rate. His studies are expected to result in an algorithm (which he intends for open-source release) that will optimize lower-limb prosthetic design and minimize the metabolic cost of walking with a prosthetic limb.

A Safer, Cheaper Way to Track Defects in Aircraft Structures

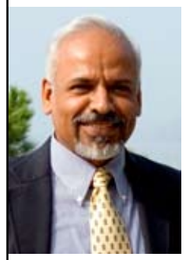
Nikhil Gupta, of the Department of Mechanical and Aerospace Engineering at the NYU Polytechnic School of Engineering, developed a fiber-optic sensor that provides a safe way for engineers to closely monitor the safety and durability of the composite materials used in aircraft and spacecraft. The patented extensometer (so called for its ability to measure the extension of a material) is exceptionally sensitive, able to detect a single micron in displacement. Earlier this year, Gupta earned a second patent for a method of using his device, which works by sending out a beam of light and measuring how much passes through the material being tested.



PHYSICS

A New Key to Unlocking the Mysteries of Physics? Quantum Turbulence

The recent discovery of the Higgs boson has confirmed theories about the origin of mass and, with it, offered the potential to explain other scientific mysteries.



But, scientists are continually studying other, less-understood forces that may also shed light on matters not yet uncovered. Among these is quantum turbulence, writes Katepalli Sreenivasan, an NYU University Professor and Dean of the NYU Polytechnic School of Engineering, in a special issue of *Proceedings of the National Academy of Sciences*.

Sreenivasan's introductory analysis, written with issue co-editors Carlo Barenghi of Newcastle University and Ladislav Skrbek of Prague's Charles University, examines the direction and promise of this phenomenon.

Quantum turbulence is the chaotic motion—at very high rates—of fluids that exist at temperatures close to zero.

Observers as far back as Leonardo da Vinci have studied turbulence—a complex state of fluid motion. The Renaissance artist observed that water falling into a pond creates eddies of motion, thus realizing that the motion of water shaped the landscape.

Today, scientists study much bigger ponds—the universe and beyond—but remain focused on this phenomenon's basic principles.

This is because of its fundamental significance in daily occurrences—for instance, the efficiency of jet engines depends on turbulence—as well as its impact on developments far beyond our observation, such as the generation of galactic magnetic fields.

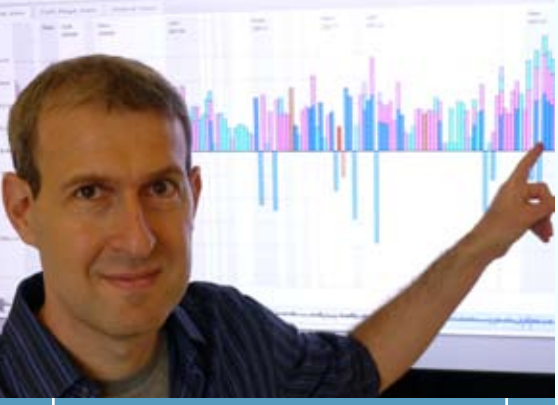
However, many of its workings continue to elude comprehension.

"Turbulence still provides physicists, applied mathematicians, and engineers with a continuing challenge," the authors write.

The PNAS issue focuses on a special form of turbulence, quantum turbulence, which appears in quantum fluids. These fluids differ from ordinary fluids in some fundamental ways—in addition to their vitality at near-zero temperatures. One, they can flow freely because they have no viscosity—or resistance hindering flow. And, two, their rotation is limited to vortex lines—in stark contrast to eddies in ordinary fluids, which vary in size, shape, and strength.

The introductory article co-authored by Sreenivasan, a professor in NYU's Courant Institute of Mathematical Sciences and NYU's Department of Physics as well as the Eugene Kleiner Professor at the Polytechnic School of Engineering, outlines the basic properties of quantum turbulence and considers the differences between quantum and classical turbulence.

"Our aim is to link together the articles of this special issue and to provide a perspective of the future development of a subject that contains aspects of fluid mechanics, atomic physics, condensed matter, and low-temperature physics," the authors write. "Further experimental studies of quantum turbulence, probing physical conditions not known to Nature at temperatures many orders of magnitude lower, may uncover phenomena not yet known to physics."



TECHNOLOGY MANAGEMENT AND INNOVATION

National Academies Selects Oded Nov for Keck Initiative

The annual National Academies Keck Futures Initiative (NAKFI) brings together some of the nation's best researchers from academic, industrial, and government laboratories to explore and discover interdisciplinary connections in important areas of cutting-edge research.

Only about 100 attendees are invited each year, and Associate Professor Oded Nov of the Department of Technology Management and Innovation will be among them in November 2014, when the conference will center on collective behavior. Nov's work focuses on social computing and explores the social dynamics that shape technology-enabled collaborations.

This year marks the second time Nov has been chosen for the honor: He participated in the 2012 NAKFI conference, entitled "The Informed Brain in a Digital World" and was subsequently awarded a grant for his pioneering work in examining the patterns through which individuals collaboratively create large scale repositories of knowledge.

Nov's other laurels include a National Science Foundation CAREER Award and a Google Focused Research Award.

NAKFI—whose mission is to foster cross-disciplinary interactions that transcend traditional borders, connecting otherwise thematically isolated scientists, engineers and doctors—is a program of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine, with support from the W.M. Keck Foundation.

TECHNOLOGY MANAGEMENT AND INNOVATION WITH COMPUTER SCIENCE AND ENGINEERING

NYU School of Engineering Professors Win Grant to Study Phishing Attacks

Internet users have long been warned about phishing scams, in which criminals indiscriminately send out mass emails to trick consumers into revealing sensitive personal data like social security and credit card numbers. Two faculty members at the NYU Polytechnic School of Engineering—Associate Professor Oded Nov of the NYU Polytechnic School of Engineering Department of Technology Management and Innovation and Professor Nasir Memon, head of the school's Department of Computer Science and Engineering—won a National Science Foundation grant of $203,648 to study ways to address the threat.

Using experiments employing realistic phishing attacks, they are examining the psychological, educational, and technical factors that contribute to potential victims' vulnerability and response to attacks, as well as their ability to detect deception.

The researchers anticipate that the cross-disciplinary project will enable them to identify the underlying factors for the success of various phishing attack strategies, develop new cyber-defenses tailored to users' idiosyncratic characteristics, and validate the usefulness of targeted defense in multi-organizational, real-world settings.

The School of Engineering is home to NYU's Center for Interdisciplinary Studies in Security and Privacy (CRISSP), which focuses on new approaches to security and privacy that recognize that technology alone cannot provide complete solutions. CRISSP includes faculty and students of the Stern Business School, Wagner School of Policy, and Courant Institute. A National Science Foundation grant funds approximately 24 doctoral students. CRISSP is supported by a team of 20 researchers.