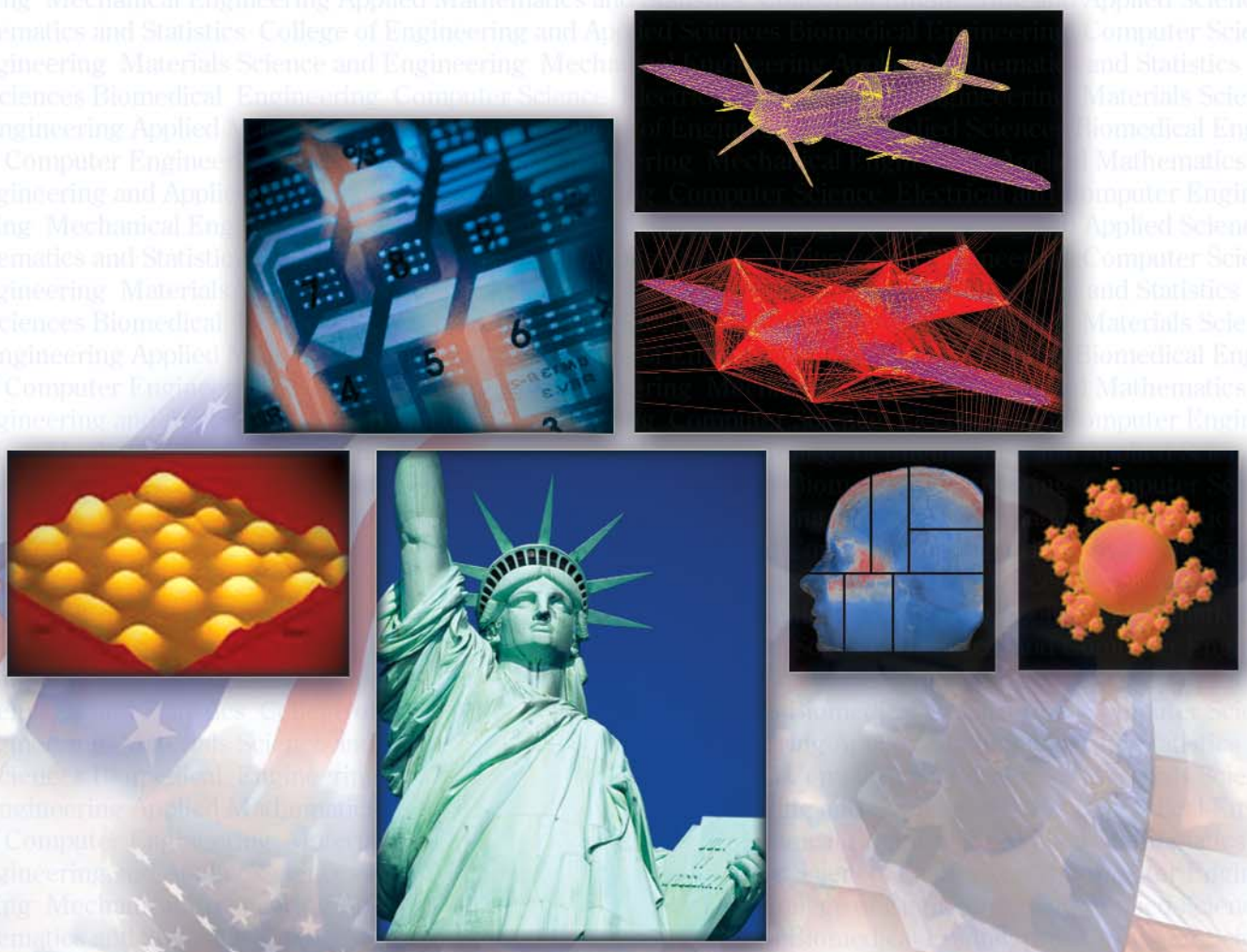
Stony Brook University



Homeland Defense Solutions

Security-related Projects

STONY BROOK
STATE UNIVERSITY OF NEW YORK

Protecting Lives, Preserving the Future

The lives of all of us changed irrevocably on 9/11 but our practice has yet to catch up with the diverse perils around us. The mission of research universities to create new knowledge harnesses the forces of inquiry and imagination to address this complex and multi-faceted need by inventing and innovating in the service of homeland security and national defense. This publication presents a sample of the varied and wide-ranging ventures through which the activities and products of Stony Brook research seek to keep us safer. If you are looking for an R&D partner or an opportunity to support innovation with potentially life-saving impact, or if you just want to be better informed about this most important field of endeavor, please read on.

Using modes of inquiry from biomedicine to engineering to the study of human behavior, University researchers are providing answers and asking new questions. The results of these inquiries range across the broad spectrum of security needs from intelligence and early warning to interdiction at the border and throughout the country to protecting both people and critical infrastructure against catastrophic threats to emergency preparedness, response and remediation. A few examples: developing an easily stored agent, capable of inhibiting anthrax Lethal Toxin, that is orally available and readily administered to large populations; adapting a materials science technique for tracking the deformation of stressed metals to enhance existing biometrics for facial recognition; developing new approaches to automate intrusion responses to cyber attacks to prevent or limit the magnitude of "hacker" attacks; developing a new device to detect contraband plastic explosives with improved effectiveness and dramatically reduced cost, based on innovative instrumentation developed to conduct cutting edge experiments in particle physics; improving response to mass casualty attacks by applying sociological analysis to the challenges of timely mobilization, information dissemination and the "worried well" response to panic.

At the University, this extraordinary scope and volume of work has a positive environment for success. Included by distinguished national and international among the top 150 universities in the world, Stony Brook is the only institution in the country with two National Science Foundation materials centers — in thermal spray and polymers — and the only campus in New York with two State-designated Centers for Advanced Technology — in medical biotechnology and sensor systems — and has on its faculty recipients of both the National Medal of Science and the National Medal of Technology. It leads the 64-campus SUNY system in earning competitively-awarded federal research and originated the only two drugs from any SUNY campus that have been approved by the FDA.

Over the last five years, Stony Brook has also been the SUNY leader in technology transfer, whether measured by licensing fees, invention disclosures, issue patents, or executed licenses. The campus has a complete suite of economic development programs, from R & D collaboration and advanced technology assistance to foster innovation to the nurturing of new enterprises in its three incubator facilities—programs that accelerate the commercialization of new technologies for rapid dissemination to end users in the public and private sectors. The projects and programs described here are a modest representation of the depth and breadth of Stony Brook's commitment to the research disciplines that bear on homeland security. Much more needs to be done and our faculty colleagues are rising to those challenges. We invite you to join us!

Gail S. Habicht
Vice President for Research

Yacov Shamash
Vice President for Economic Development

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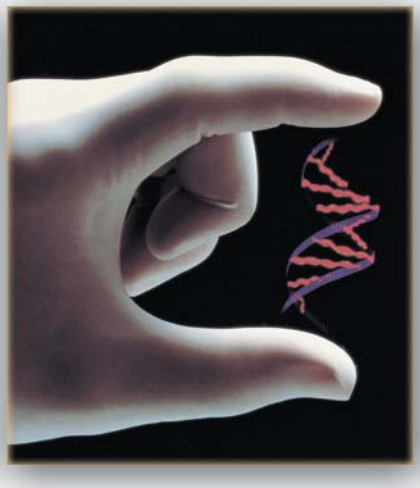
Homeland Defense Security-related Projects



Intelligence and Warning

Resource Control for Surveillance Sensor Systems

PI: Eugene Feinberg
Applied Mathematics and Statistics

Control and scheduling problems are being studied for radar sensor management of an airborne early warning system. The problems are formulated in terms of radar dwell times and revisit time constraints. The projects analyze several methodologies for determining if certain scenarios are feasible. Methods have been developed for computing sensor allocation plans. The investigation includes the descriptions of the structure of optimal schedules, complexity studies, and novel Markov Decision Process applications to surveillance.

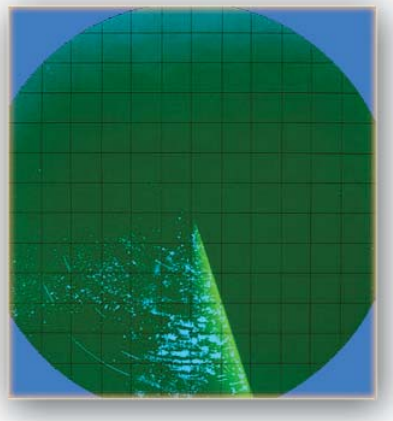
In particular, two basic problems were studied. The first problem is how to allocate the sensor's resource for a system that uses only electronic scanning capabilities. In this case, the antenna dome stays in a fixed position. The second problem deals with the situation when the system utilizes both the mechanical and electronic scanning capabilities. In this case, the dome rotates. Mathematical methodologies were developed for these two problems. The first problem leads to a scheduling problem, which particular case had been studied in the literature on satellite communication under the name Pinwheel Problem. In the case of radar sensor management, the problem becomes more difficult and was studied under the name Generalized Pinwheel Problem. Though this problem is deterministic, efficient methods were found to solve it by utilizing stochastic dynamic programming, also known under the name of the theory of Markov Decision Processes. This approach led to the development of new types of computational algorithms for scheduling problems, the so-called frequency-based algorithms. More traditional methodologies were utilized for the case of a rotating dome.

So far this project resulted in three research papers, a patent application, and prototype for radar sensor management problems. (National Science Foundation [NSF], New York State Office for Science, Technology and Academic Research, and Northrop Grumman Corporation).

Scholarships for Service in Information Assurance

PIs: R. Sekar, T. Chiueh, I.V. Ramakrishnan, S. Stoller, E. Zadok
Computer Science

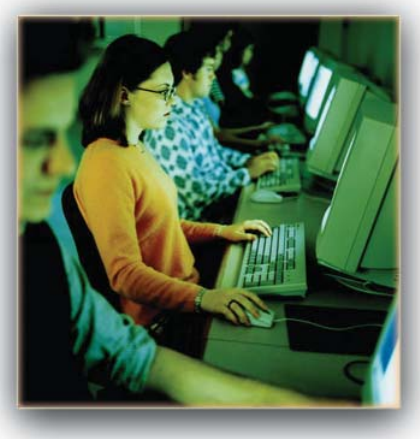
This grant provides scholarships to promote graduate and undergraduate education in Information Assurance, supporting 39 scholarships, each of 2 years duration, split roughly evenly between graduates and undergraduates. The scholarships cover the costs of tuition, room and board, and provide an attractive stipend. Recipients of the scholarship will undertake a specialization in Information Assurance, which includes several courses and a project. This grant will help attract some of the best talent among computer science students and encourage them take up careers in the area of information assurance, where there is a severe shortage of qualified personnel. (NSF)



Capacity Expansion in Information Assurance

PIs: R. Sekar, I.V. Ramakrishnan, S. Stoller, E. Zadok
Computer Science

This is a companion project to the scholarship project mentioned above. It is aimed at (a) further expanding the information assurance curriculum at Stony Brook to meet the growing need for highly trained professionals in information assurance, and (b) helping establish an information assurance program at University of Houston, a minority institution. As part of this project, specializations in information assurance have been developed at the graduate as well as undergraduate levels. In addition, a workshop was conducted at Stony Brook to help community colleges and other smaller educational institutions in the New York area to begin setting up their curricula in information assurance. Finally, the project develops innovative support cost-effective virtual networks for use in projects involving computer and network security. (NSF)



Identification and Isolation of Human Alarm Pheromones

PI: Lillianne Mujica-Parodi
Biomedical Engineering

An impressive amount of recent research demonstrates that humans, like other mammals, show behavioral and neuroendocrine response to unconsciously perceived odors. Alarm or "fear" pheromones rapidly transmit warning of danger to others of the same species, via shared physiological and emotional fear response. Nearly all of the research on human pheromones has concentrated on reproductive pheromones, which have been shown to exist and exert influence on humans in all of the contexts in which they exist for non-human mammals. This strong conservation across species is biologically suggestive, and predicts that human alarm pheromones also exist and assume functional importance. The only indexed studies on human alarm pheromones, both within the past three years, now offer preliminary support for this hypothesis. Our study will test this hypothesis, using improved scientific methodology to evaluate the physiological and cognitive effects of pheromonally-transmitted fear.

Chemically identifying alarm pheromones may improve homeland security capabilities, by complementing existing behavioral and physiological fear-detection used in lie detection and security applications, such as a "risk filter" in contained areas at airports, subways, buses, immigration, and other commercial settings. (DARPA)

Rapid Sensing of Biological Agents

PI: Miriam Rafailovich
Materials Science and Engineering

Rapid response and identification of biological warfare agents is crucial in determining the course of events in case of a suspected outbreak. For example, viral and bacterial agents can be released into the air through an aerosol or deposited as powders on surfaces in crowded areas. Alternatively, diseases can be spread through infected animals smuggled into a shipping container. Waiting till visible symptoms of the various diseases have occurred in either animals or humans is too late for effective control. Continual monitoring of emissions in a vast open setting, such as that found in ports of entry, through laboratory testing is a complicated procedure that is economically not practical and time-consuming. Results are to be utilized ongoing research in nanotechnology at Stony Brook University, CUNY, and Polytechnic University of NY to develop two types of biosensors that can detect trace amounts of viral or bacterial pathogens in situ and provide immediate analysis. Both methods use chip based technology, which requires low voltages and can easily be incorporated into portable, wireless devices. Finally neither requires amplification and is sensitive to just a few virus or bacterial particles. The samples can be either airborne or contained in bodily fluids. (MRSEC)

Border and Transportation Security

RSVP: Pure Science Benefits the National Interest

PI: Michael Marx
Physics and Astronomy

The primary goal of the RSVP KOPIO experiments is to advance the frontiers of our knowledge at the cutting edge of pure science. However, the innovative tools developed specially to out such sensitive experiments have produced practical applications with dramatic impact on society. One of the critical features required for the success of KOPIO is highly imaging of gamma rays. The centerpiece of the experiment is a huge device called a Radiator which converts gamma rays to detectable charged particles and provides an accurate measure of their direction, position, and energy. The gamma ray imaging detector could dramatically reduce the cost while improving the performance of detectors for concealed explosives.. If these developments are brought to fruition, the work of KOPIO could lead to a much safer travel environment. The techniques and theoretical concepts that are being employed, from production of the protons to the detection of the gamma rays, all trace their origins to forefront nuclear and particle physics research projects like KOPIO. (NSF)

Fiber Optic Sensor for "Analytical Triage" of Containerized Cargo

PI: Miriam Rafailovich
Materials Science and Engineering

Millions of containerized cargo units and truck trailers enter this country yearly. The vast majority of the containers serve legitimate trade channels. On the other hand, the large size of these containers also allows for the illegal import of chemicals, weapons, even livestock or humans. The dilemma then becomes, how can one search and monitor the contents of the containers in an efficient and inexpensive manner that won't cripple the smooth flow of traffic, disrupt legitimate commerce, and have adverse economic impact? The research described here focuses on the development of a rapid and inexpensive "analytical triage" method that can be built into new units or retrofitted into existing units, which immediately alerts the custom inspector to a potential threat. The technology, which is based on fiber optic detection, allows for external, in situ interrogation which does not require opening the container or moving it to a special location. Furthermore, since the detection is external, no power source or transmitter is required on the container and monitoring can be done over very long periods of time without recharging. (Sensor CAT)

Micro/Nano Mechanics Studies of Sandwich Foam Composites

PI: Fu-pen Chiang
Mechanical Engineering

Sandwich foam composites are light weight high strength structural materials. They are ideal materials for building high speed coastal patrol boats. This project investigates the micro mechanical properties of foam materials using a unique measuring technique called (Speckle Interferometry with Electron Microscopy) which can provide strain distribution in an area only a few microns in size. By mixing a small portion of nanoparticles into a polymeric foam, the resulting material has a higher stiffness and also retards flame. Studies are being carried out on both the pure and the nanophased foam materials. (Office of Naval Research)

Immigration and Security in Liberal Democracies in a Post-9/11 World

PI: Gallya Lahav
Political Science

This study questions the role of liberal norms, rights-based politics, and democratic values in shaping immigration policy amidst heightened security concerns. It focuses on the proliferation of non-state actors at the local, international and private levels (e.g. airlines, employers, schools, travel companies, and other states), as they now collaborate with centralized state immigration agencies (i. e., Department of Homeland Security) to bolster renewed efforts at migration control. Comparing Europe to the United States, the project considers the implications of these new strategies. Indeed, the proliferation and diversification of instruments used to control immigration are converging throughout Europe and North America, leading some to insinuate evolving images of "police states."Among policies developed for containing immigration and refugee movements in Europe are tighter border controls, increased visa requirements, readmission agreements, carrier sanctions, buffer zones, Eurodoc fingerprinting and Schengen Information System databases, 'safe third country' and accelerated return procedures and coordination. In the United States too, increasing border patrols, employer sanctions, and labor enforcement, work authorization verification procedures, detention and removal of criminal aliens, changing benefits eligibility, and computer registrat ion systems were evident by the late 1980's but activities soared after 9/ll. The Patriot Act of 2001 and the Enhanced Border Security and Visa Entry Reform Act in 2002 paved the way for electronic innovations, visa screening, racial and ethnic profiling, acceleration procedures, and unprecedented security checks as well as the formation of a new Homeland Security to coordinate activities with a reorganized INS. (MacArthur)

Domestic Counterterrorism

Single Molecule Nanotechnologies for Bioseparation and Bioanalysis

PI: H. Strey
Biomedical Engineering

This research will examine how nanostructures can be tailored to (i) enable a new generation of biomolecular separation devices, (ii) provide a compartment of study of biomolecular conformation, compartment for of biomolecular conformation, and (iii) address fundamental physical issues associated with macromolecular confinement. In the proposed work, unique technologies will be developed for the manipulation and study of biomolecules trapped at extremely low concentrations in pore-cavity arrays. The molecules are to be examined dynamically and in situ by single molecule fluorescence imaging.

Such technologies, ultimately allowing the analysis of single cell content in of composition and gene expression, are urgently needed in the fields of molecular cell biology and medicine, especially impacting cancer research and potentially influencing diagnostics and therapy. Applications are also anticipated in homeland security including detection and identification of bacteria and DNA fingerprinting for identification. (NSF-NIRT)

Development of Novel Biosensors Based on Electrostatically Driven Self-assembly

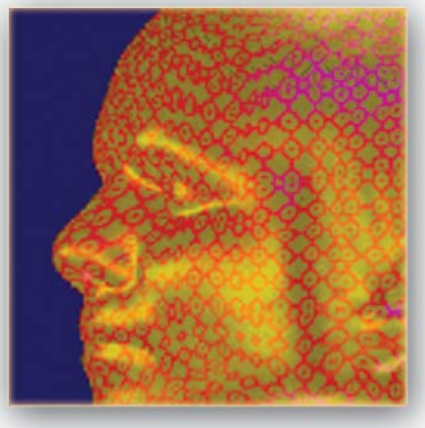
PI: H.Strey
Biomedical Engineering

Better, cheaper and more sensitive biosensors are urgently needed in applications relating to national security, health care, the environment, energy, food safety, and manufacturing. In this proposal biosensors are being developed based on a novel concept utilizing the change in optical properties of biopolymer liquid crystals upon exposure to biological analytes of interest. The concept is quite general and will allow development of biosensors that are able to quantitatively detect almost any biological macromolecule at extremely low levels. To achieve this, microfluidic techniques are being employed to deliver small quantities (from nanoliters to microliters) of complex mixtures of analytes to these liquid crystalline sensors. Applications are envisioned for these sensor arrays in health related fields, homeland security, and the environment. (NSF)

Dynamic Approaches for Facial Recognition Using Digital Image Speckle Correlation

PIs: Klaus Mueller, Computer Science
Miriam Rafailovich, Materials Science and Engineering

This project takes advantage of the fact that the resolution of commercially available digital cameras has become so great that individual pores on a face can now be captured and isolated. By tracking these pores while a face deforms a characteristic vector field can be calculated, using a technique called DISC (Digital Image/Speckle Correlation). DISC has its origin in material science, where it has been traditionally used to track the deformation of metals and other materials under stress or strain. A displacement (vector) field is calculated from at least two successive images by cross-correlating individual image patches, and we have applied this mechanism to track pores in two successive face images. Experiments indicate that the vector field resulting from a smile is unique for each person, making it possible to identify and distinguish individuals even under heavy make-up with high certainty. The research funded under this grant will exploit these findings to create a superior system for biometrics, potentially augumenting existing techniques for greater accuracy. (Center for Port Security).



A New Approach for Securing Systems Using Adaptive Intrusion Response

PI: R. Sekar
Computer Science

Networked information systems play an increasingly important role in critical infrastructures such as power generation and distribution, transportation, commerce, and national security. The continuing spate of security incidents reported by organizations such as the CERT Coordination Center demonstrates that in spite of best efforts of securing systems, "hacker" attacks will penetrate even the best defense mechanisms. To cope with attacks that escape existing prevention mechanisms, new techniques need to be developed that can detect and respond to such attacks. Unfortunately, existing approaches focus primarily on after-the-fact detection of such attacks. Moreover, intrusion response relies primarily on human involvement. These two factors mean that fast-progressing attacks e.g., programmed attacks) can effect significant damage before any protective response is launched. Recovery from such damage is labor-intensive and will render the target system unavailable for hours if not days. This project develops new approaches to automate intrusion responses so that the target system can defend itself from serious damage due to attacks. It will build on our research in specification-based intrusion detection. (NSF)

A Model-Based Approach for Security Software

PI: R. Sekar
Computer Science

Networked software systems are becoming essential to critical services such as commerce, banking and telecommunication. Existing techniques for protecting such systems against intruder attacks are reactive in nature, offering little protection against unknown attacks. Solutions, such as applying security patches, last only until newer attacks emerge. System administrators are thus in a constant struggle to stay ahead of a vast army of resourceful hackers. This project develops a proactive approach to protect systems against known and unknown attacks. It is based on high-level models of security-relevant system behaviors. Actual behaviors are compared against these models to detect deviations, which are deemed to indicate attacks. In order for the approach to work with COTS software, behaviors are modeled in terms of events observable external to the software system, e.g. invocation of system calls and reception/transmission of network packets. In contrast with previous wo rk, which was mainly concerned with post-attack detection, the proposed approach can prevent and/or contain damage due to attacks. Moreover, it addresses a wide range of threats within a single framework, including software errors in trusted programs, untrusted mobile code and malicious (NSF)

Secure Mobile Code Execution Environment

PIs: R. Sekar, I.V. Ramakrishna
Compoter Science

This is a companion project to the Model-Carrying Code project described above. Specifically, this project is concerned with developing the MCC technology to the point where it can be standardized in industry forums, and thus provide a basis for the next generation of industry solutions in the area of mobile code security. Moreover, the project will extend the scope of MCC to support privacy policies, in addition to those aimed at protecting system and data integrity. (Computer Associates, NYSTAR)

Micromechanics Study of Lamella TiAl

PI: Fu-pen Chiang
Mechanical Engineering

Lamella TiAl is a material that is to be used in future high performance engines by the Air Force. The material has high stiffness and strength and performs well in high temperature environments. The aim of this project is to investigate the failure mechanism of this material at micron scales under dynamic as well as static loading; in high temperature as well as room temperature environments. Mechanics of crack initiation and propagation under cycle loading of various frequencies will be investigated by a high temperature fatigue testing machine housed inside an SEM (Scanning Electron Microscope). This special loading device is currently under design and will be built within a year (supported by AFOSR/DURIP)

Girding for Big Nuclear, Biological and Chemical Attacks

PI: Sheldon J. Reaven
Technology and Society

Large NBC attacks require preparedness strategies and tactics that differ fundamentally from those of small NBC attacks or conventional atrocities like those of September 11, 2001. Concentrated study of WMD history and military history generally is the indispensable foundation of preparedness planning and training. For reasons of survivability and deterrence a major program of targeted civil defense practices must be readied for people and infrastructure systems. Prevention and backup or restoration measures need to be designed and readied to guard against unsuspected vulnerabilities. The most powerful analytical tool for planning against big NBC attacks is a life-cycle 'industrial ecologyí approach to logistics of response and survival that connects medical/decontamination, food, water, power, waste, and other dimensions. (NSF)

Mechanical Properties of Nano-Composite Metal Oxides for Electronic Noses

PI: Fu-pen Chiang
Mechanical Engineering

Nano-composite metal oxides respond sensitively to certain chemical vapors. Thus they can be used as "electronic noses" for sniffing harmful chemicals. This is a team project supported by the NSF/NIRT program with four faculty Members led by PI Professor P. Gouma of Materials Science and Engineering. A key part of the effort is to characterize the mechanical properties of metal oxide nanowires manufactured by Prof. Gouma's group. The unique random speckle technique SIEM (Speckle Interferometry with Electron Microscopy) is the major tool for this characterization (supported by NSF/NIRT)

Nanostructured Biosensors for Environmental Monitoring

PI: Pelagia-Irene Gouma
Materials Science and Engineering

The research team has developed highly selective biosensing devices by incorporating bio-recognition elements, such as enzyme receptors, in gas-sensitive transducers (e.g. polymer or metal oxide membranes). The enzyme receptor's function is specifically to recognize the target analyte, whereas the transducer converts the biochemical signal associated with the biorecognition event to an electrical signal that can be easily measured and related to the concentration of the analyte. The principal sensing mode is either electrochemical (enzyme electrodes) or conductimetric (microsensors) detection. Some environmental pollutants inhibit enzyme activity (e.g. the team's urea biosensor that may be used for the detection of mercury (Hg) contamination in this way). For herbicide contamination, bacteria-type biosensors are currently explored. These involve whole microbe cells (rather than enzymes) that metabolize organic compounds resulting in end products such as ammonia and carbon dioxide; the latter gases can be easily detected by the resistive-type transducers (e.g. MoO3 thin film detectors) developed previously by this research team. Enzyme biosensors typically offer faster response and higher specificity while whole cell biosensors have the advantage of higher stability and ability for bioactivity regeneration. Combining these two types of molecular devices in electronic tongue configurations enables multiple contaminants to be sampled and identified at once. (Sensor CAT)

Orally Available Agents for the Treatment of Anthrax

PI: Sanford R. Simon
Biochemistry, Pathology, and Oral Biology

The events in 2001 following exposure of U.S. citizens to spores of Bacillus anthracis, the bacterium which causes anthrax, have emphasized that this agent can be used as a weapon. Antibiotic treatment is effective against inhaled spores of B. anthracis only if administered early and if a weaponized strain of the bacterium already engineered to be resistant to common antibiotics was not employed. There is general agreement that the pivotal event associated with the catastrophic illness and high mortality of anthrax is entry of a bacterial product known as Lethal Toxin into the white blood cells of the victim. The overall objective of this project has been to develop a low molecular weight orally available agent which is capable of inhibiting anthrax Lethal Toxin both prior to and subsequent to its entry into cells. The active portion of Lethal Toxin is a zinc-containing enzyme called Lethal Factor.

On the basis of our preliminary data, it is believed that COL-3 and COL-308, members of a class of orally available nonantimicrobial tetracycline derivatives originally developed in the laboratory of Dr.Golub in the School of Dental Medicine at Stony Brook University and now produced by Collagenex Pharmaceutials, Inc., which are known to be inhibitors of a wide variety of metalloproteases, can be effective in the management of populations exposed to spores of B. anthracis. COL-308 has been successfully employed in parallel with COL-3 in all our preliminary studies on inhibition of the enzymatic and cell-modulatory actions of Lethal Factor in human cell-based models and Collagen has proposed to undertake further efforts to develop this agent for human use. (NIH[NIAID], and Collagen Pharmaceuticals, Inc.)

Theory of Nanocrystals

PI: Philip B. Allen
Physics and Astronomy

Nanocrystals are a natural state of matter that occurs when growth is drastically inhibited, whether naturally or artificially. Natural nanocrystals occur in interstellar space where scarce sources of atoms inhibit growth. New laboratory methods are allowing a vast range of nanocrystals to be assembled and studied. The uses range from simple commercial products (ZnO nanocrystals in sun blocks) to artistic (dyes for staining glass) to technical (gold nanocrystals are a popular label for attachment to subcellular structures for biological study; they also have greatly enhanced catalytic activity; their physical properties change with adsorption of gas species, making sensors.) In large scale matter, properties scale predictably with size. A large cup of coffee does not taste any different from two smaller cups. In nanocrystals, properties scale erratically with size in ways that are potentially predictable by quantum theory using large computers. For example, salt crystals (NaCl) are electrically rather inactive, but NaCl nanocrystals have a fascinating range of electrical activities depending on how many atoms they have. Nanocrystals can be grown in a huge variety of shapes. Long tubes, with diameters to 10 to 100 atoms, are a form which can often be grown in high purity. Their surfaces are chemically active and absorb environmental molecules. Their electrical activity is affected strongly by surface contamination. This allows them to be used as sensors. This research group uses large computer calculations to study the shapes, electrical activity, and surface reactivity of nanocrystalline matter. (NSF-NIRT)

Principles of Domestic Terrorism

PI: Michael Kimmel
Sociology

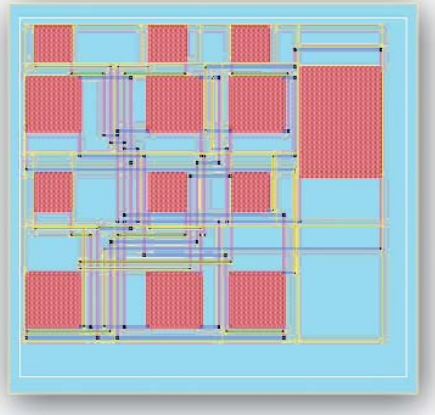
It is possible that the single greatest threat to homeland security comes not from external operatives or foreign-born terrorists but from "home-grown" Indeed, prior to 9/11 the worst acts of terrorism in America had been perpetuated by white supremacist, neo-Nazi White Aryan movements. For the past two decades the extreme right has been mobilizing and has become increasingly violent. This research explores the "gender" dimension of the extreme right, specifically focusing on the way in which shame and humiliation are experienced as threats to masculinity and serve as the emotional foundation of extremist violence. The work examines the way masculinity is mobilized on the extreme right, and how the masculinity of the "other7'—non-white, immigrant, gay, jewish, women, problematized and challenged. It is not argued that by understanding this gender dimension one can filly understand the likelihood of domestic terrorism, but it's argued that one will never fully understand terrorism without it.

Protecting Critical Infrastructures and Key Assets

From Rules to Analysis Algorithms with Time and Space Guarantees

PI:Y. Annie Liu
Computer Science

Many computation problems, including program analysis and model checking problems, for security applications in particular, are most clearly and easily specified using relational rules. Yet developing and implementing efficient algorithms for these problems is a nontrivial, recurring task. This project develops a unified method for transforming rule-based specifications into efficient algorithms and characterizes the specifications and the transformations to provide both time and space guarantees for the derived algorithms. The project focuses in particular on rule-based specifications for program analysis and model checking problems and develop fully automatic methods for the transformations and the time and space analysis in this domain. (NSF)



Mesh Networks for Wireless Devices

PI: Samir Das
Computer Science

This project develops routing and automatic host configuration support for multihop wireless networks of handheld wireless devices. The goal is to be able seamlessly to communicate to wired networks via a "remote" gateway access point. Such networks can be used as an extension of an access point-based network, or to optimize the performance of such a network. (Computer Associates)

Protocols for Wireless Ad Hoc/Sensor Networks

PI: Samir Das
Computer Science

This project is developing routing and data aggregation protocols for ad hoc networks of wireless sensors. One goal is exploiting redundancy in the sensor networks to conserve battery power so that the network can be operational for longer periods of time. (NYSTAR, Sensor CAT)

Root Causes of Terrorism

PI: Ian Roxborough
Sociology

Estimates of the terrorist threat and the development of strategies to mitigate the threat require a sophisticated sociological understanding of the root causes of terrorism The development of appropriate strategies for homeland security requires an understanding of how the public responds to perceived threats and disasters. Military efforts to suppress terrorism and to deal with the wide range of problems involved in promoting democracy abroad require a sociological understanding of the social bases of terrorism and insurgency and an understanding of the organizational dynamics of military systems. This research involves a study of the organizational dynamics of strategy formulation in the U.S. military. It examines the which the military often encounters in attempting to conceptualize and identify enemies. These often stem from particular ways in which military forces are organized and how military and soldiers are trained. The research identifies areas where preparations for homeland security and military doctrine can benefit from better sociological understanding.

Examples involving response to mass casualty attacks include widespread panic as the "worried well" overwhelm medical facilities, and the timely mobilization of federal assets. Examples involving military operations abroad include an analysis of ways to deal with social movements and mass-based insurgency, appropriate training for troops involved in support and stability operations, and managing the political consequences of operations in urban areas. (Army War College, Carnegie Corporation, Princeton Institute of Advanced Studies)

Transactions Everywhere

PI: Michael A. Bender
Computer Science
(with B. Kuszmaul and C. Leiserson, MIT)

Among the most basic problems inherent in the coordination of concurrent tasks is the enforcing of atomicity so that the partial results of one task do not inadvertently corrupt another task. Atomicity is typically enforced through locking protocols, but these protocols can introduce other complications, such as deadlock, unless restrictive methodologies in their use are adopted. This research proposes a novel approach, called transactions everywhere, which offers a way out of the rat's nest of concurrency protocols, allowing ordinary programmers to exploit parallelism freely.

In 1993, Herlihy and Moss proposed transactional memory as an alternative mechanism for enforcing atomicity, since it allows the user to avoid many of the complications of locking. With transactional memory, a program can read and modify multiple, disparate memory locations as a single atomic operation, much as occurs within a database transaction. But, despite the innovative nature of Herlihy and Moss's proposal, hardware transactional memory (HTM) has never been implemented in a real system. Instead, the trend has been toward software transactional memory (STM), the overhead of which discourages the use of transactions.

This vertically integrated research project refocuses on Herlihy and Moss's original proposal of HTM, but adopting the point of view that transactions, rather than occuring infrequently in code, should be the rule, not the exception. The researchers contend that the transactions-everywhere approach can simplify parallel programming dramatically and that hardware support can make overheads negligible.

Transactions everywhere will make it far easier for all programmers, not just those who are specialists in today's arcane practices of parallel computing, to write correct high-performance multithreaded programs, thereby allowing concurrency to be employed in routine applications for ordinary users. This research project aims to confront and overcome the problems in developing transactions everywhere so that transactional memory may eventually become, like cache, an expected subsystem of any computer architecture. (NSF)

Exploiting Spatial and Channel Diversity in Mobile Ad Hoc Networks

PI: Samir Das
Computer Science

Mobile ad hoc networks are multi-hop wireless networks, with dynamically changing network topology. Such networks are useful in forming a self-organizing communication network among the first-responders in an emergency rescue scenario or among soldiers and battlefield units in a military operation. Exploiting available network capacity is an important problem in such networks because of the shared nature of the radio medium. One way to exploit capacity is to exploit spatial diversity by using multiple routing paths. This project is developing dynamic multipath routing protocols that can achieve a good load balance. The protocols are on-demand and can form link-or node-disjoint, as needed, in a loop-free fashion . The effectiveness of such multipath routes is reduced when paths are formed in the radio vicinity. Multiple channels are being used in the underlying medium access control layer so that independent channels can be assigned to neighboring routes. Channel selection m ethods for such an approach are important components of the research. In summary, the goal in this project is to exploit spatial and channel diversity in a mobile ad network with a synergistic use of multipath routing and multichannel medium access protocols. (NSF)

A Layered Approach to Securing Network File Systems

PI: Erez Zadok
Computer Science

This project explores a layered approach to file system security. By transparently stacking (or layering) file systems in strategic locations along a data path, we can explore security guarantees at different levels, including end-to-end guarantees. Stacking file systems at the client allows us to capture user-information early and encrypt data on the wire. Stacking at the server allows us to capture file system events close to the storage source, something that system—call—based security systems cannot do at the server since in-kernel file server code is invoked from the networking subsystem. Moreover, we can stack a file system in one place, then export it to another, creating a transparent secure file server proxy in between clients and servers. We are developing fan-out file system support for security. Such file systems can transparently provide many features useful to security: load-balancing to cope with DoS attacks, private branching for sandboxing, replication for disaster recovery, and more. Stackable file systems were chosen for this work because they offer a novel, new, and uniform API for developing secure file systems on clients, servers, and proxies. The stackable API is the ideal location for such work: neither too low (i.e., network packets) nor too high (system calls). (NSF)

Data Structures and Algorithms for Maintaining Data Locality

PI: Michael A. Bender
Computer Science

As modern memory architectures grow in complexity, it is becoming increasingly important to design algorithms with high data locality. Standard approaches parameterize algorithms by aspects of the memory hierarchy, such as the size and block size of each memory level. Unfortunately, this parameterization often leads to complex algorithms that are tuned to particular architectures. A promising new line of research is to develop memory-hierarchy-sensitive algorithms that avoid any memory-specific parameterization. Such platform-independent algorithms are said to be "cache-oblivious." If a cache-oblivious algorithm works optimally on a two-level hierarchy, then it works optimally on all levels of a multilevel memory hierarchy: cache-oblivious algorithms automatically tune to arbitrary memory architectures. This research involves maintaining data locality in irregular and dynamic settings, where the data flow is continually changing and unpredictable. The investigator will design cache-oblivious solutions for a variety of common problems in data manipulation. (NSF)

Model Checking for Detecting Computer System Vulnerabilities

PIs: C.R. Ramakrishnan, I.V. Ramakrishnan, R. Sekar, Scott Smolka and Scott Stoller
Computer Science

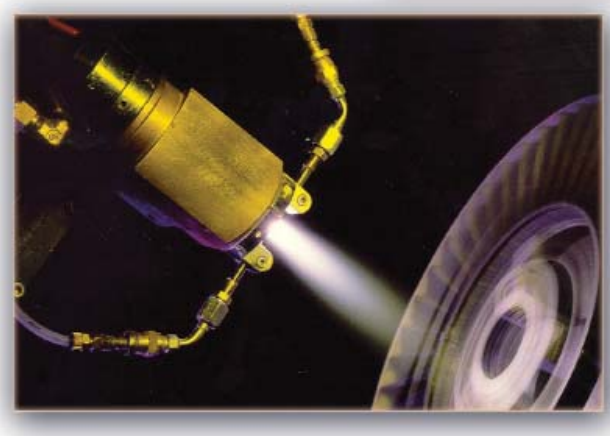
Securing our nation's computing and networking infrastructure against damage due to malicious attacks or spontaneous faults is a problem of paramount importance. This project aims to contribute to this mission by developing novel techniques and tools based on model checking and program analysis for vulnerability analysis: the problem of identifying and monitoring weaknesses in computer systems that can be exploited to compromise system security. A major expected outcome of the project is a set of tools for determining the consistency and safety of computer system configurations, such as those specified by rules and domain type rules. (NSF)

CAREER: An In-Kernel Runtime Model-Carrying Code: A New Approach for Mobile Code Security

PIs: R. Sekar, C.R. Ramakrishnan, I.V. Ramakrishnan, Scott Smolka
Computer Science

Mobile code has become a part of our day-to-day experience on the Internet. It appears in many forms: implicitly downloaded code (e.g. Java applets, web pages containing Java Script or Active X), explicitly downloaded code freeware, shareware, demoware, upgrades and patches), and content that invokes pluging/helper applications (e.g. mail attachments and multimedia content). Existing approaches for mobile code security achieve security at the cost of functionality: in particular, existing approaches will cause most nontrivial mobile applications to abort due to security violations . As a result, users often disregard such approaches and simply execute mobile code without any protection.

The goal of the Model-Carrying Code project is to develop a solution to the mobile code security problem that enables users to benefit from this rich functionality provided by mobile code without taking undue risk. MCC provides a framework in which code producers and consumers can cooperate in order to realize the benefits of mobile code. Code producers simply state the security needs of their code using a high level model. New techniques have been developed in this project to automate the generation of such models. These models allow a code consumer formally to reason about the security-relevant actions of mobile code and make informed decision regarding the risk that he/she will be taking to realize the benefits provided by this code. (Office of Naval Research, DOD University Research Initiative in Critical Infrastructure Protection)



Checking Critical Software for Concurrent, Distributed, Open, Secure Systems

PI: Scott D. Stoller
Computer Science

The overall goal of the proposed research is the development of analysis methods and tools that will increase the quality of concurrent and distributed software by helping programmers to debug, systematically test, and verify such software. Specifically, the primary contributions will be: (1) New techniques that significantly reduce the time and memory needed for state-space exploration of concurrent systems, by increasing the granularity of transitions (execution steps), while preserving properties of interest. (2) Automated support for generation of programs that simulate the environment of an open system. This is particularly useful for generating hostile environments for testing of secure distributed systems. (3) Incorporation of the above techniques, and other techniques developed for state-space exploration of distributed programs and programs that use cryptography, in a toolset for testing and verification of Java programs. (Office of Naval Research, PYI)

Generating Efficient Trust Management Software from Policies

PIs: Scott D. Stoller and Y. Annie Liu
Computer Science

In today's widely distributed large-scale computer systems, there is a growing need to establish and enforce enterprise-wide security policies. Trust management systems offer flexible solutions for secure decentralized management of authorization (access to resources) in such systems. Rule-based languages are an attractive foundation for trust management languages. In fact, several proposed trust management languages are based on Datalog, a classic rule-based language. A significant obstacle to deployment of trust management systems is lack of suitable implementations of such languages.

This project is developing a method for automatic generation of lightweight and components for analysis and enforcement of security policies expressed in rule-based trust management languages. The method also produces formulas bounding the worst-case time and space complexity of the components, so resource usage is more predictable. The method is based on a systematic approach to incremental computation and data structure design. The generated algorithms incrementally maintain policy-specific indices and use sophisticated combinations of indexed and linked data structures.

The project contributes to the development of a flexible and efficient distributed infrastructure for expressing, managing, and enforcing enterprise-wide security policies. (Office of Naval Research)

Robust Multivariate Evaluation & Failure Prediction of Inhomogeneous Solids Based on Inverse Analysis

PI: Toshio Nakamura
Mechanical Engineering

The latest advances in material fabrication technologies have enabled manufacturing of highly versatile component systems. It is now possible to design and produce materials suitable for specific functions, such as heterogeneous layers to enhance failure resistance of armors and embedded electronic sensors to detect internal stress evolutions. However, at the same time, efforts required to identify their multivariate properties, such as constituent compositions, modulus and fracture toughness, have increased drastically. In many cases, complex experimental processes are necessary to determine and define their properties. Those techniques must be tailored to measure multiple parameters, and those parameters can be spatially variable due to inhomogeneous microstructures. Consequently, material and structural evaluations of inhomogeneous solids may require several experimental steps and processing of massive data. In order to simplify such procedures, novel approaches to process measured information are required. Furthermore, with new types of measurement devices available today, traditional post-data analyses may not be capable of maximizing information obtainable through these devices. To conduct more meaningful evaluations to bridge effects of nano/micro-scale components to structural level responses, these advanced schemes are essential. This project is developing novel approaches to quantify parameters of material systems containing inhomogeneous microstructures and multiple components and to predict their failure responses under various loading states using physically based fracture models. Essentially, the inverse analysis techniques allow estimation of unknown parameters that are not apparent from observed records. These data-interpretation schemes lead to accurate assessment of properties at multi-scales and optimized designing of configurations without resorting to experimental operations. The primary goal is to use new mechanics based approaches to design and develop next generation material systems rather than evaluate them a posteriori. In the identification and failure analyses, several types of material systems are considered. They include elastic-plastic graded layer heterogeneous solids and multi-layered fiber-reinforced composites. The outcome of this project lays a framework for robust data processing and modeling approaches suitable for new generations of high-performance material systems. (Army Research Office)

An In-Kernel Runtime Execution Environment for User-Level Programs

PI: Erez Zadok
Computer Science

IIt is vital to ensure that kernel and OS code is bug free because, today, malicious hackers are specifically looking for bugs and other OS vulnerabilities to exploit in order to gain unauthorized access to computer systems. Techniques are explored to add bounds-checking and other memory pointer checking for kernel code. Using a modified gcc, we build kernel modules with additional checking in them. When run, these kernel modules also check for array bounds, illegal pointer arithmetic, and other invalid pointer uses that normally will not cause the kernel to panic (but may still corrupt kernel memory). (NSF CAREER)

Urban Dispersion Modeling and Visualization

PI: Arie E. Kaufman
Computer Science

A numerical method has been developed from computational fluid dynamics, the Lattice Boltzmann Model (LBM), to model the airborne dispersion of contaminants in urban environments. Unlike other approaches, LBM discretizes the micro-physics of local interactions and can handle very complex boundary conditions, such as deep urban canyons, curved walls, indoors, and moving objects. Furthermore, its computational pattern which is similar to Cellular Automata lends itself to multi-resolution hierarchy and is easily parallelizable. Hence it can be accelerated on commodity graphics processing units (GPUs), achieving real-time or even accelerated real-time on ordinary PCs and laptops, providing a predictive tool for anticipating subsequent propagation. Another key innovation of LBM is its extension to support input from pervasive sensors. This allows us to influence the simulation so as to maintain its faithfulness to real-time sensor readings. We have implemented a 3D city navigation system (web-based or stand alone), featuring a 3D polygonal model GIS with faÁade texturing, flow visualization streamlines, volume rendering plumes, and information visualization of real-time sensor data. We have tested it with a 110 building GIS around the building in the West Village of NYC, overlaid with results of dispersion simulation and real-time readings from 3 sensors installed on that building. We are currently experimenting with other areas of NYC (e.g. Times Square, Madison Square Garden) and with its use also in open environments to predict the airborne transmission of the Foot and Mouth Disease Virus. (Department of Homeland Security)

Gene Design for Vaccines and Therapeutic Phages

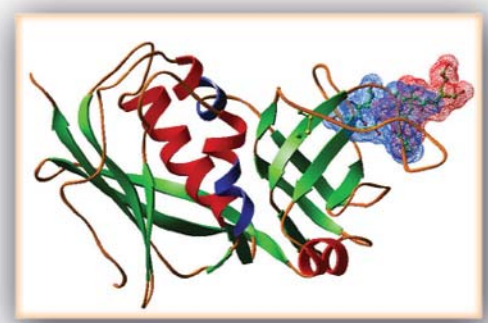
PI: Steven Skiena
Computer Science

Vaccines and antibiotics have proven to be tremendously important agents against viral and bacterial infections, respectively. However, current vaccines are ineffective against certain viruses (e.g. rhinovirus) and potentially dangerous against others (e.g. smallpox). Further, the evolution of antibiotic-resistant strains of bacteria has become a critical problem in treating diseases such as tuberculosis. We propose to exploit the redundancy inherent in the genetic code to create both safer and more effective vaccines and an improved class of anti-bacteriological agents. We apply design and synthesis techniques to replace viral genes so they code for identical proteins as in the wildtype virus, but in different ways. For the first application, we seek to weaken viral strains by introducing mutations that alter translational efficiency and RNA secondary structure without affecting protein coding so as to create better vaccine candidates. For the second application, we seek to strengthen bacteriophages (viruses which attack bacteria) by eliminating important restriction sites so as to improve their ability to combat pathogenic infections. The homeland security implication of this research is that it suggests a new approach for rapidly designing new vaccines in response to novel bioterror agents. (NSF)

Multichannel, Multihop Wireless LAN for Rapid Deployment

PI: Samir Das
Computer Science

This project involves an experimental study to design and develop a prototype multihop wireless local area network architecture. The architecture consists of (i) access points that are connected via a backbone wireless network, and (ii) client devices that connect to the access points. The project will explore routing protocols for such an architecture, and use of multiple radios in the access points tuned to different bands/channels to provide bandwidth aggregation. The access points can be battery powered. The project will study scheduling algorithms so that access points can be powered off if not needed to maintain network coverage. This will improve network lifetime. This project will have an impact on lowering the deployment costs of telecommunication infrastructure and services in "developing" countries such as India and will contribute to reducing the "digital divide" between those who can and cannot use new information and communication tools effectively. This study will also benefit development of wireless local area network architecture that can be deployed rapidly and thus will be for many for many emergency or tactical operations. (NSF -U. S. India Cooperative Research)

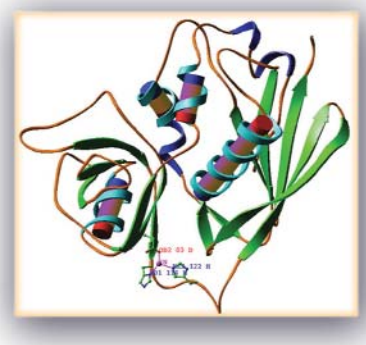


A System for Discovering Bioengineered Threats by Knowledge Base Driven Mining of Toxin Data

U.S. Army Medical Research Institute of Infectious Disease

PIs: Michael Kifer, I.V. Ramakrishnan, Computer Science
Subramanyam Swaminathan (BNL)

Advances in recombinant DNA technology have opened up possibilities for production of bioengineered pathogens or their products on scales that could make them formidable weapons of bioterrorism. Chimeric molecules form another kind of threat wherein the virulent domain of a toxin is hidden in what is otherwise a non-pathogenic protein. In this project all relevant information are collected pertaining to toxins at the molecular level and store them in the Toxin Knowledge Base. Advanced machine learning and data mining techniques are used to look for motifs and to try to predict structure and function of molecules for which these data are not available. Knowledge learned from this and similar analysis will be encoded as rules in the Toxin Knowledge Base and used for analyzing genomic data to identify specific regions that encode factors that contribute to virulence. (BNL)



Terrorism and the International Order: Global Perspectives on 9/11

PI: Saïd Amir Arjomand
Sociology

As a comparative sociologist specializing on the Middle East and Central Asia, and as the founder and first President of the Association for the Study of Persianate Societies (1996-2002) and the Editor-in-Chief of the Studies on Persianate Societies, Arjomand has extensive research interests in a region of the world that is critically important to global security. He has been following the post-revolutionary transformation of Iran, and the political reconstruction and constitutional developments in Afghanistan and Iraq, and has written several articles and chapters on them. He is also interested in the resurgence of Islam generally, and in the growth Islamic fundamentalism and political Islam, including the impact of globalization on terrorism-subjects on which he has written extensively. He organized a conference on constitution-making in the Middle East in April 2005 and worked on his book on Islam and constitutionalism as the inaugural Crane Fellow and Visiting Professor of Public Affairs at the Woodrow Wilson School of Princeton University. He is also contributing two chapters to the new 7-volume Cambridge History of Islam, one on political regimes and the second on the contemporary resurgence of Islam.

Mass Surveillance and Privacy

PI: James Rule
Sociology

Development of a critical overview of what is termed mass surveillance is crucial. These are processes by which government and private organizations monitor the movements, activities and characteristics of literally millions of ordinary citizens. The purposes of mass surveillance range from the benign to the unfriendly from administration of medical care to the tracking of terrorists. Though often bracketed as manifestations of "technology," particularly computing, they are in fact a distinctive genre of social processes that go back well before the advent of computing. The earliest manifestations of mass surveillance by governments had to do with efforts by states to administer taxation, pensions and passport control. By the 1960ís public opinion throughout the developed world was growing alarmed over the privacy invading repercussions of mass surveillance. As a result, every major democracy now has a body of law or policy aimed at disciplining these systems, moderating their demands or otherwise making them more publicly acceptable.

Does the record of recent history give grounds for hope that measures like these actually work to protect citizens' privacy interests? Do overriding public obsessions like the War on Terror or the desire for cheap, quick credit simply overwhelm any limits that might be set on the unfolding extension of mass surveillance? Research currently under way shows clearly that other countries have succeeded in establishing more meaningful protections than this country. But it is by no means so clear that existing guarantees in other countries can withstand the political and economic forces that continue to erode privacy in the United States. (NSF and the MacArthur Foundation)

Defending Against Catastrophic Threats

Modeling and Forecasting Support for the Urban Dispersion Program

PI: Brian A. Colle
Marine Sciences Research Center

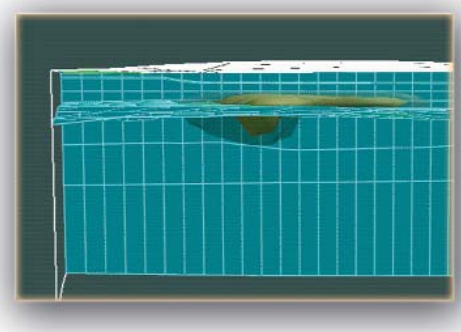
This research involves participation in the New York City Urban Dispersion Program (NYC UDP), which is a four-year (2004-2007) research project whose major objectives are to improve the permanent network of wind stations in and around New York City (NYC), to conduct field studies to advance knowledge about the movement of contaminants in NYC and within building interiors, to improve and validate computer models that simulate the atmospheric movement of contaminants, and to transfer the improved capabilities to NYC emergency agencies.

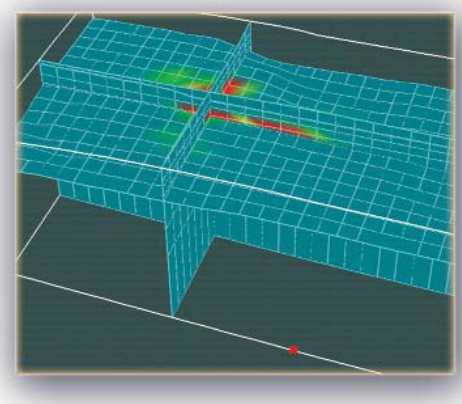
Accomplishing these objectives requires both high resolution observations and atmospheric models. Since the Fall of 1999, numerical forecasts have been made using a research atmospheric model (MM5) down to 4-km grid spacing around the NYC region. In collaboration with other agencies, the MM5 results will also be used to drive more sophisticated urban models, which can explicitly resolve the flows within the deep street-canyons of NYC. The output from urban dispersion models will eventually be used by emergency management, law enforcement, and intelligence personnel to plan for, train for and respond to terrorist attacks and accidental releases of harmful contaminants. Numerous portable wind-sampling instruments have been placed around NYC to measure wind patterns. This researcher participated in a multi-agency field study in central Manhattan during March 2005, in which safe, inert tracers were released from five locations near Madison Square Garden. Daily forecast support was provided for the experiment as well as real-time running of the MM5 modeling system for this area.

Asthma in Children Living Near Ground Zero Before & After 9/11

PI: Anthony Szema
Medicine

We retrospectively evaluated clinical parameters of asthmatic children living near the World Trade Center before and after September 11, 2001. Our results indicate that children with preexisting asthma diagnosed prior to 9/11/01 had worsening of asthma based on: 1) increased physician visits for asthma 2) increased asthma medication use 3) decreased peak expiratory flow rates. Asthma visits increased and numbers of newly diagnosed asthma patients surged by 66% compared to a control asthma population in Queens 11.9 miles away. The control asthma population in Queens actually had a decline in asthma visits and diagnosed patients during the same time period.





Electronic Noses for Homeland Security Applications

PI: Pelagia-Irene Gouma
Materials Sceince and Engineering

Certain volatile organic compounds in exhaled human breath may be used to study the mechanisms of human metabolism fast and efficiently, thus enabling the early identification of diseases (such as asthma, SARS, or lung cancer) which cause oxidative stress. Currently, there are no direct measures for these diseases in clinical practice, only invasive procedures (e.g. fiber optic bronchial biopsies). Non-invasive monitoring may assist in differential diagnosis of pulmonary diseases, assessment of disease severity and response to treatment. We have been developing arrays of selective gas sensors. Measurements of exhaled ammonia may differentiate between viral and bacterial infections in lung diseases to justify the use of antibiotics. (Sensor CAT)

Molecular Dynamics Simulations of Biotoxins on Ultrascalable Supercomputers

PI:Yuefan Deng
Applied Mathematics and Statistics

The toxin produced by the bacterium Clostidium botulinum is one of the deadliest known to humans today, thus has become one of the most dangerous agents for biological weapon. Understanding its structures and functions, and devising efficient defense strategies, is of vital importance to our national security.

Recently, a great deal of information about its mode of action has been investigated through structural and other biophysical studies. The toxin itself (BoNT) is a protein with approximately 1270 residues. It is made up of two chains, a light chain of approximately 50 kDa and a heavy chain of approximately 100 kDa. The two are linked by a disulfide bond as shown below. The light chain contains a Zn2+ ion which acts within the cell to cleave a protein necessary for neurotransmission leading to paralysis and death. This process is believed to involve several steps: binding of the toxin to the endosomal membrane, translocation through the lipid bilayer, and proteolysis of specific neurotransmitters within the cell. The structural studies show that the heavy chain contains two domains responsible for binding and translocation while the light chain contains the catalytic domain. Both the structure of the toxin outside the cell (but not at endosomal pH) and the mechanism of action of the zinc protease are reasonably well understood. What is not known are the structures at low pH (5.1-5.4) and the mechanism of translocation.

We have begun study of these two aspects in details using highly parallel molecular dynamics and energy minimization codes. MDoC (Molecular Dynamics on Chip) a package designed by our group for ultra-scalable architectures, such as IBM's BG/L and Columbia's QCDOC. (BNL LDRD)

Computation Analysis of Genomic Sequence Tags

PI: Steven Skiena
Computer Science

There is currently no effective technology to assay the relative abundance of complex microbial communities. Probe-based methods such as microarrays can only hope to detect species which have already been at least partially sequenced; these represent a vanishingly small fraction of the millions of microbial species. The genomic sequence tag (GST) approach, pioneered by our collaborators at Brookhaven, promises to make such analysis possible for the first time. The success of the GST method largely depends upon the degree to which computational analysis can identify microbial species from very limited experimental data. GST technology has important applications in many areas of the life sciences, but particularly ecological and medical research. Homeland security applications revolve around detection of novel pathogens, particularly previously unsequenced or genetically altered bacterial strains. (USB-BNL Seed Grant)

Sensor Consortium— a Consortium for Security and Medical Sensor Systems

PI: Serge Luryi
Electrical and Computer Engineering

The consortium seeks to promote and increase awareness of entrepreneurship and technology transfer activities on Long Island with a focus on national security and medical sensor systems that can provide a fast medical diagnosis in case of a crisis. There are three components of the project: the Education, Research and Technology Transfer and Outreach and Dissemination components. The goal of the Education component is to introduce entrepreneurial skills to the engineering and technology curriculum across Long Island. To achieve this goal, an Inter-University Entrepreneurship Taskforce has been established. For the first time, four of Long Island's campuses join forces to educate our students in technology entrepreneurship. The Inter-University Entrepreneurship Taskforce includes Deans and Division Heads of Stony Brook University, Hofstra University, Farmingdale State University, and Suffolk Community College. This is an interesting partnership as it consists of a mix of public and private universities; four-year and two-year colleges; and research oriented and predominantly undergraduate institutions. The taskforce will oversee all educational activities including the Technology Entrepreneurial-Team (E-Team) Competition Program in which four E-Teams compete in developing a prototype sponsored by an industrial partner of the Sensor Consortium. To emphasize the interdisciplinary nature of the program, each team will have ONE student from EACH of the education partners. Each undergraduate team will be led by a Stony Brook graduate student and supervised by Stony Brook faculty.

The goal of the Outreach and Dissemination component is to promote the Sensor Consortium's achievements through the Outreach Partners. The vision is that these three components are interlinked to provide an infrastructure and a community to support each other. It is the goal that at the end of the two-year project period, through the many activities, faculty and students of the four Education Partners will be well aware of how a successful entrepreneur thinks about a problem and makes its technology solution the basis for a new business. It is the vision that the consequence of such awareness will translate into more patentable inventions, more startup technology companies, and more research and development projects in national security and medical sensor systems on Long Island.

The goal of the Research and Technology Transfer component is to provide a permanent infrastructure to promote research and technology transfer in security and medical sensor systems. This is built upon the success of the Sensor CAT (Center for Advanced Technology) and Stony Brook's Office of Technology Licensing and Industry Relations (OTLIR). Research partners include Brookhaven National Laboratory (BNL) and the industry partners of the Sensor CAT. (NSF)

Enhancing Regional Preparedness for WMD Events Through Fostering Public-Private Collaboration

PIs: Les Paldy and Paula Scalingi
Technology and Society

This Consortium will facilitate the development of regional public-private collaborations/partnerships in order to identify WMD preparedness shortfalls, including associated infrastructure interdependencies that could exacerbate response and recovery, and to develop and implement cost-effective plans, procedures, methodologies, tools and technologies to mitigate the shortfalls. A particular focus of these regional collaborative mitigation activities will be creating pilot projects with stakeholder organizations. Such pilot projects will include the development of modeling and simulation capabilities (tools and systems) to access WMD impacts on public health and safety, economic and national security; mitigation options, and decision-making processes. Projects will build upon existing and DHS/S&T and other modeling and simulation capabilities/systems and complement ongoing DHS work in this area.

Emergency Preparedness and Response

Strengthening Hospital Resources in the Event of an NRBC Attack

Strengthening Hospital Resources in the Event of an NRBC Attack Stony Brook University Hospital and Medical Center has been designated a Regional Resource Center (RRC) for Suffolk County by the New York State Department of Health. The activities of the RRC are intended to provide leadership and coordination of planning for and clinical responses to an NRBC event in Suffolk or on Long Island. In the latter case there are substantial interactions with the North Shore LIJ Health System (the designated RRC for Nassau) and with the Nassau-Suffolk Hospital Council as well as with the Department of Health. The hospital has undertaken a number of efforts to strengthen its resources in the event of such an attack. (NYS DOH, HRSA)

Emergency Error Detection System (EEDS)

PI: Rob Kelly
Computer Science

In some instances, the first recognition of an abnormal external event is the Emergency Room, where symptoms can be recognized, as well as treatment provided. The Emergency Error Detection System (EEDS) under development is a system that will automatically capture demographic and clinical data while patients are still in the ER. Data are captured from a variety of sources, including medical chart, vital signs, lab data, and data available from medical monitors. The data are used in the processing of clinical rules, each of which recognize values outside the normal ranges for specific patient demographic data. The rules also allow for the presentation of guideline information and capture of disposition data.

The clinical rule objects are created from external textual representations that are both portable and easily adaptable. The rules include information in clinical practice guidelines among many other sources, and are general enough to serve multiple Emergency Departments through local modification of the rule set. The system architecture allows for centralized update of textual rule data in response to developing events along with distribution to participating Emergency Departments. (EMF)

Water-Air Quality Sensing Project (WASP)

PI: Rob Kelly
Computer Science

The Water-Air Quality Sensing Project (WASP) is a prototype effort to employ water-based platforms to deploy sensors that provide real-time monitoring of water and air quality. The system was developed with the Marine Sciences Research Center (MSRC) and deployed on a local ferry. The ferry houses all the sensors and the computers used to collect and transport the data to a project ground station. Collected data includes near-surface atmospheric wind, pressure, temperature, relative humidity, solar and infrared radiation and rainfall, as well as near-surface water temperature and salinity and surface-to-bottom current profiles. The sensor information is collected and transmitted back to the MSRC in real-time via wireless communication where one-minute average values are archived and made available through a Web interface. The interface allows for the generation and display of images relating to the sensor data and map positional data. The sensor data plots are available for current data as well as historical data.

The WASP prototype can be expanded to include other environmental sensors relevant to homeland security (e.g., other sources of radiation, atmospheric aerosols, marine toxins, etc.) with enhanced forms of data redundancy, access, and analysis features. (NYSG)

Multichannel, Multihop Wireless LAN for Rapid Deployment

PI: Samir Das
Computer Science

This project involves an experimental study to design and develop a prototype multihop wireless local area network architecture. The architecture consists of (i) access points that are connected via a backbone wireless network, and (ii) client devices that connect to the access points. We will explore routing protocols for such an architecture, and use of multiple radios in the access points tuned to different bands/channels to provide bandwidth aggregation. The access points can be battery powered. We will study scheduling algorithms so. that access points can be powered off if not needed to maintain network coverage. This will improve network lifetime. This project will have an impact on lowering the deployment costs of telecommunication infrastructure and services in "developing" countries such as India and will contribute to reducing the "digital divide" between those who can and cannot use new information and communication tools effectively. This study will also benefit development of wireless local area network architecture that can be deployed rapidly, and thus will be useful for many emergency or tactical operations. (NSF - U.S.-India Cooperative Research)

Streamlining Communication and Collaboration Using Direct Eye Contact

PI: G. Zelinsky
Psychology

Efficient response in a crisis situation often requires rapid communication and collaboration between two or more people. Whether the task is for two police officers to locate a sniper in a building window, or a team of security agents trying to track a person of interest in a crowd, the goal is the same; to coordinate behavior so as to quickly find a target. Here, seconds really can make a difference. Complicating these tasks is the fact that the crucial information being communicated is spatial in nature and is often difficult to express verbally. Our research seeks to remove this communication bottleneck by enabling people to communicate with their eyegaze. Using networked eyetrackers, we have developed a system in which Partner A can see Partner B's gaze position superimposed over her display, and vice versa. If A wants to communicate a target's location to B, she therefore needs only to look at the target. By enabling team members to see where each other is looking, it will be possible for them to efficiently perform time-critical tasks as a coordinated group. We envision this technology evolving into lightweight wearable appliances for use in security and first responder situations.

Development of Training Courses in WMD Preparedness and Response

PIs: Les Paldy and Paula Scalingi
Technology and Society

The Consortium will develop a series of low-cost, model training seminars and courses on biological, chemical and nuclear/radiological preparedness that local emergency managers and other interested organizations can easily customize to educate personnel of utilities, local government agencies, businesses and other private sector organizations, as well as the general public and media. The work will utilize existing federal and state WMD training capabilities. The model training seminars and courses will be conducted in different regions of the nation to test their utility. Training manuals and other supporting instructional materials will also be developed. Once finalized, the training seminars and courses will be incorporated into a distance learning program to ensure wide national distribution.

Development of Multi-Disciplinary WMD Expertise

PIs: Les Paldy and Paula Scalingi
Technology and Society

The Consortium will create instructional models (curricula and related materials) and implement multi-disciplinary pilot projects to augment the pool of experts necessary to address WMD challenges in the post 9/11 environment. A particular focus will be on biosecurity. The work will include a full trial of the materials and an evaluation of their use; supporting materials for general distribution; a project website to enable rapid dissemination of project information and materials; and creation of two-day short courses that can be offered at research universities focusing on how to establish similar programs at their institutions. A major goal of the work will be to create a heightened awareness, particularly in the bioscience, as well as other WMD-related research communities, of the need to involve researchers and graduate students in WMD research and policy study and how to go to meet this need.

The Next Step

For general information please contact Dr. Ann-Marie Scheidt, 631-632-7006.
Or call the individual departments listed to find out projects details, and how Stony Brook is meeting the future head-on.

Applied Mathematics and Statistics
631-632-8370

Biochemistry, Pathology and Oral Biology
631-632-8550

Biomedical Engineering
631-444-2303

Computer Science
631-632-8470

Electrical and Computer Engineering
631-632-8420

Biomedical Engineering
631-444-2303

Marine Sciences
631-632-8700

Mechanical Engineering
631-632-8340

Medicine
631-444-2958

Physics and Astronomy
631-632-8100

Political Science
631-632-7650

Psychology
631-632-7810

Sociology
631-632-7700

Technology and Society
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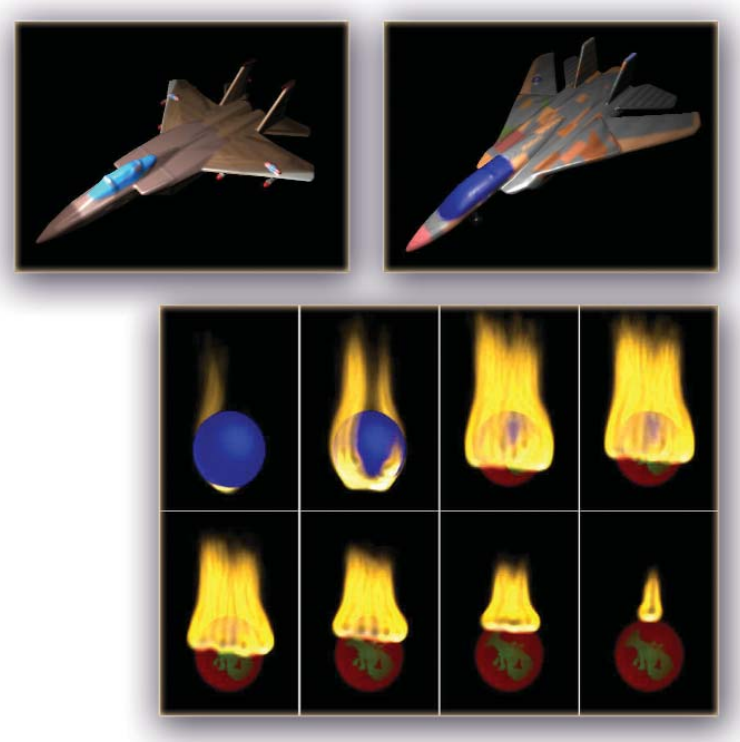

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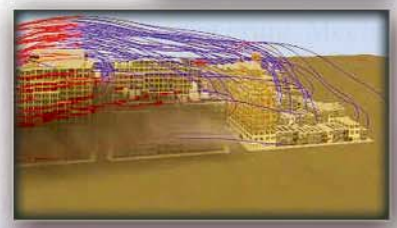

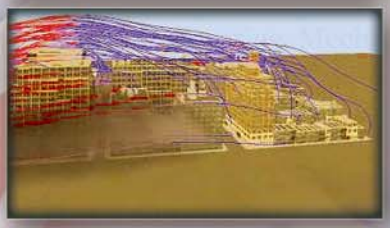

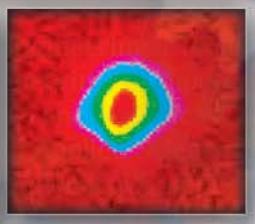

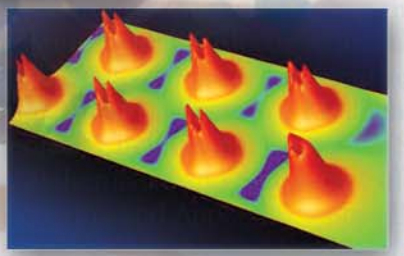

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