The Undergraduate Experience at Oak Ridge National Laboratory

A description of your facility's experience hosting undergraduate students for internships, for example, number of interns hosted each summer, approximately how many years have you hosted interns.

Oak Ridge National Laboratory (ORNL) has a 60-year history of hosting research participants in substantial and productive research experiences. Each summer, ORNL hosts over 250 undergraduate and graduate students. These individuals represent dozens of different colleges and universities and are sponsored by a wide range of federal agencies. The Laboratory's multi-purpose nature gives students the freedom to participate in projects in various areas of science and engineering, including neutron science, biological systems, energy, advanced materials, national security, and supercomputing. DHS-sponsored and focused research occurs in various research divisions, and in many cases spans multiple divisions because of the interdisciplinary nature of the research.

ORNL has many exciting facilities that accommodate students. With the world's highest flux reactor-based neutron source (the High Flux Isotope Reactor) and the world's most intense pulsed accelerator-based neutron source (the Spallation Neutron Source), ORNL provides neutron scattering capabilities unavailable anywhere else in the world. The new BioEnergy Science Center is designed to make advances in sustainable production and economic conversion of biomass to enable the production of biofuels. The new Center for Nanophase Materials Sciences provides unique opportunities to understand nanoscale materials and phenomena. The National Center for Computational Sciences (NCSS) was designated by the Secretary of Energy as the Leadership Computing Facility for the nation, to provide for unclassified research a resource 100 times more powerful than current capabilities. Today, the computing resources of the NCCS are among the fastest in the world, able to perform more than 119 trillion calculations per second. Investigations by researchers nationwide range from materials science to astrophysics; combustion to fusion simulations, and beyond. The National Security Directorate has a wide array of technologies and capabilities in the areas of advanced materials, chemical and biological detection, mass spectroscopy, modeling and simulations, personal protection, sensors, and software development.

All students at ORNL are assigned stimulating projects under the direction of qualified mentors. They become part of interdisciplinary research teams that allow them to contribute to major scientific problems while learning from world-renowned scientists and engineers. In addition, they become part of a larger group of students that interact through scheduled enhancement activities.

ORNL has a long tradition of quality mentoring. ORNL scientists and engineers are experienced in working with students, teaching them about cutting-edge science involved in their projects, helping them explore and discover rather than providing answers, giving them career advice, providing them with networking opportunities, and guiding them to the successful conclusion of

their projects. ORNL mentors accept students as valuable contributors to their research projects and look forward to the mentoring opportunities that internship programs provide.

A description of additional benefits your facility can provide interns, for example, subsidized housing arrangements, local transportation allowance, professional lectures and seminars, social activities, etc.

ORNL provides a rich experience for students each summer. The summer begins with an orientation session to convey information about ORNL, the various programs for students, and safety information. There is a seminar series showcasing the research being conducted at ORNL, which includes at least one lecture on national and homeland security. There are brown bag lunches exploring various topics such as professionalism and ethics in science, choosing a graduate school, and finding local recreational activities. Students are also incorporated into other Laboratory activities including research group activities, ORNL's Multicultural Friendship Club, and Safety Fair. There are student specific events, such as a summer picnic, hiking in the Smokey Mountains, young professional group lunches, as well as activities designed specifically for DHS students. Students are taught how to write a research abstract and are invited to participate in a poster session near the end of the summer. In addition, a graduate school fair is held to link students with opportunities to pursue a graduate education at top universities.

Students have two options for housing. Housing can be arranged for and prepaid by ORNL. In this option, students are housed with a large portion of the student population in apartments that are off-site but in a secure community. For students choosing to identify their own housing, stipends are supplemented by a set housing allowance to help defray costs.

The name and contact information for the person that would be the primary point of contact for DHS S&T in administering internships at your facility.

As ORNL's partner in education-related initiatives, ORISE facilitates the entry of all DHS students into the Laboratory.

For information on research projects at ORNL:
Johnnie Cannon, cannonjb@ornl.gov or (865) 574-1145

For information on the ORNL student experience:
Marie Westfall at marie.westfall@orau.org or (865) 576-3425

Request for DHS Interns
Oak Ridge National Laboratory
October 16, 2007

Researcher Contact Information	Title and Description of Research Project	# of Interns Requested
B. L. Bhaduri Geographic Information Science and Technology Group 865-241-9272 bhaduribl@ornl.gov	**High Resolution Population Dynamics Modeling to Access Human Dependence of Critical Infrastructures** - Understanding the behaviors of the seventeen critical infrastructures and their interdependencies is essential for ensuring capacity, resistance, and resiliency during normal and disaster operations scenarios. Modeling and simulations of the engineering components of critical infrastructures have long been the focus of critical infrastructure protection to emergency preparedness and response. It is well realized that the scientific and engineering principles of infrastructure functions are strongly coupled with an element of underlying human factors. However, the interactions and interdependencies of critical infrastructures on human dynamics, which requires an explicit assessment of possible infrastructure vulnerabilities rising from plausible human response to disasters, are often not addressed explicitly. Utilizing a high resolution population distribution and dynamics model, we are focusing on the issue of understanding the human dependence of infrastructures. At 90m spatial resolution, LandScan USA is the highest resolution population data available for the US. LandScan USA also includes a daytime activity based population distribution scenario. In addition, the spatio-temporal variability of population distribution with respect to critical infrastructures include recognizable socio-economic and behavioral patterns resulting from the demographic influence on human activities such as students at schools and colleges; doctors and public health professionals at hospitals and other medical facilities; seniors at daytime residential locations. Preparedness, response, and recovery of critical infrastructure for natural and technological disasters are driven by local responders including the infrastructure support personnel.	**1**
Steven Fernandez Geographic Information Science and Technology Group 865-576-3565 fernandezsj@ornl.gov	**Modeling and Simulation for DHS Missions, Daily Functioning in the Face of Threats to Critical Infrastructure, ORNL -- A Part of a National Capability -** Oak Ridge National Laboratory collaborates with six other national laboratories to provide senior level DHS staff key asset information during times of national scale disruption of the electrical infrastructure. Our role employs the tools and capabilities ORNL developed over the last two decades and focused over the last five years into recovery and resilience decision support systems. These systems are used by the Department of Homeland Security to predict, exercise and assist utility emergency and disaster planning. **Electric Power and Social Dynamics** As part of the Program sponsored by the Department of Homeland Security, ORNL has representations and models of electric grid of the Eastern United States, and reasonable representations of the electric grid of many OCONUS regions employing interdependent infrastructure contingency screening modules, these models calculate the impact of from the loss of infrastructure element, model repair and recovery, and population reaction and response. **Elements of the Modeling Toolkit** • Databases and sources management including CONUS real-time updating • Numeric Weather Prediction models for damage prediction as a result of extreme weather events • Wind and flood damage models on infrastructure • Infrastructure vulnerability and criticality models for electric grid, transportation, and economic impact • Agent-based modeling of repair crews and security response including impacts of uncleared debris • Models to generate restoration maps for emergency planning and exercise scenarios • Visualization through the VERDE tool for continuous situation awareness	**1**
R. E. Flanery, Jr. Geographic Information Science	**Advanced Data Analysis and Visualization, EVEREST Powerwall Project, Creating pipelines for powerwall visualizations -** The GIST group at ORNL currently is working with many datasets related to Energy Production,	**1**

and Technology Group 865-574-0630 flaneryrejr@ornl.gov	Energy Infrastructure and Security. Not only is there a tremendous amount of data, the relationships within the datasets are complex and visualizations must be created to fully understand and present these relationships. We currently have methods developed specifically to process this data and produce visualizations, static as well as time-dependent, for display on ORNL's EVEREST powerwall. We are looking for students to help bring these methods together into a software 'pipeline' that will enable us to take new datasets as they arrive and have them automatically processed into visualizations for EVEREST. We are searching for a student with a strong background in programming. In particular a good working knowledge of either perl or python scripting languages (preferably python) as well as solid experience in C/C++ programming. Any work with imaging software (especially scripting of actions for Imagemagick or similar software) would be a huge plus. Previous work in parallel computing environments would be nice, but is not required.	
A. R. Ganguly Geographic Information Science and Technology Group 865-241-1305 gangulyar@ornl.gov	**Natural Disasters and Related Geophysical Studies** - Rainfall extremes have the potential to cause significant damage to human lives and property through floods and flash floods. The great Mississippi floods of 1993 resulted in fifty deaths and $15B economic loss. A 2004 United Nations study pointed out that the people exposed to catastrophic floods worldwide will increase from a billion to twice that amount by 2050 and the yearly costs will be in the $50B to $60B range, mostly in developing countries. There are debates in the scientific community on how global climate change may affect the frequency, intensity or duration of rainfall extremes at regional scales. Thus, the ability to understand the trends in the properties of rainfall extremes in space and time is critical. However, rainfall extremes, while a major cause of flood related hazards, are not necessarily hazardous by themselves. In addition, under certain conditions, for example when the soil moisture in near saturation level or when the surface soil conductivity is low, even relatively less intense rainfall events can cause large stream flows or runoff. Large stream flows may cause severe floods when hydraulic infrastructures like levees, dams and embankments cannot withstand the flows. These large floods become catastrophic when the exposed population or critical assets are high and vulnerable to the floods. The project explores our ability to provide anticipatory information to policy-makers on the possibility of catastrophic flood-related disasters at regional scales. The ability to allocate resources optimally in space and time based on risk maps, as well as optimal policy guidance based on root cause analyses, are key requirements. The focus of the internship will be to understand the state of the art in these areas within the United States and the world, and to explore ways in which existing gaps can be plugged.	**1**
A. R. Ganguly Geographic Information Science and Technology Group 865-241-1305 gangulyar@ornl.gov	**Risk and Decision Sciences and Emergency Preparedness and Response -** The need to develop precise predictive models for low-probability and high-consequence events is a recurring theme across homeland security and intelligence analysis applications. On the one hand, the available data can be overwhelming to the analyst or end user, or even to an automated system which attempts to define patterns of normal or baseline behavior and extract the abnormalities of interest. On the other hand, the data of interest, for example past occurrences of similar events, may be rare or even non-existent. The project will explore how available data from multiple sources may be exploited to extract relevant information for rare events, how the information can in turn be adapted to the context of a domain, and how the contextual information can then be processed and provided to human analysts or end-users for faster and more accurate decision-making. The primary focus of the internship project will be to explore how insights extracted from data can be presented to decision-makers to prepare for and respond to anticipated emergency situations.	**1**
M. S. Neergaard Cyber Sciences and Information Intelligence Research Group 865-241-5988 neergaard@ornl.gov and	**Research Subject: Insider Threat Monitoring (ITM) -** Risk management of the insider threat problem involves a complex combination of behavioral, technical, and organizational issues. Organizations can concentrate on physical and technical security measures such as authentication mechanisms, firewalls, and intrusion detection systems to defend against external cyber threats. However, insiders may be authorized to bypass all of those measures in order to perform their daily duties. Former employees are familiar with internal policies and procedures, which can also be exploited to facilitate attacks. External attackers can choose collusion with insiders as an attack mechanism. Although insider threats as defined above utilize technology to carry out their attack, a combination of technical, behavioral, and organizational issues must be considered in order to detect and prevent insider threats.	**1**

F. T. Sheldon Cyber Sciences and Information Intelligence Research Group 865-576-1339 sheldonft@ornl.gov	Because insiders are legitimate users of their organization sophisticated technical capability is not necessarily required to carry out an insider attack. On the other hand, technically capable insiders are able, and have, carried out more sophisticated attacks, that can have more immediate, widespread impact. These technical insiders also sometimes have the capability to "cover their tracks" so that the identification of the perpetrator is more difficult. Insiders can be motivated by a variety of factors. Financial gain is a common motive in certain industries, while revenge can span industries. Theft of intellectual property is prevalent in some sectors, for various reasons former employer, or to enhance an employee's reputation with a new employer. Organizational issues that factor into the insider threat problem range from the degree and impact of managerial trust in employees, to the organizational culture itself. The study of insider threats is focusing on identification of behavioral and technical indicators of potential insider threats, suggesting best practices and other recommendations for prevention, detection, and identification, and possibly formulating recommendations for organizational culture in which the risk of insider threats is minimized. It is imperative that the insider threat research expand and continue, because the impacts from crimes perpetrated by insiders are enormous, ranging from significant financial losses to severe impacts on reputation. A methodology is needed that can capture and analyze the complex interactions between behavioral, technical, and cultural issues, integrated risk management approach can be developed for the problem. In our approach we will develop a baseline profile/description for computer/electronic behavior of broad classes of employees. Ideally, we would want to categorize individuals into a manageable set of occupational types (maybe 5-7?) that ideally could be generalized to other labs and government agencies. Then identify a set of key variables on which we would base the base-line profiles on. Creating this base-line profile would be the first step to any investigation of what is typical vs. atypical and would also provide useful information on what computer technology skills, resources, monitoring, electronic protection, updating, etc. are needed for the different occupational categories.	
M. S. Neergaard Cyber Sciences and Information Intelligence Research Group 865-241-5988 neergaard@ornl.gov and **F. T. Sheldon** Cyber Sciences and Information Intelligence Research Group 865-576-1339 sheldonft@ornl.gov	**Research Subject: Scalable Network Monitoring -** We propose a passive network intrusion detection system (IDS) that detects network attacks by locally monitoring network packet arrival rates. This contrasts with current practice, which either looks for signatures of known attack implementations in files on a node or centrally monitors network management logs. Current approaches have high false positive rates and consume excessive resources. A comparison [NSR02] reports false positive rates high enough to cause systems running the IDS to crash frequently. In one case, the system crashed in over 30% of the days it was used. We expect our approach to work on-line, require minimal resources, detect new attack implementations, and have low false alarm rates. Our approach is challenging, since the statistics dominating Internet traffic flow (burstiness, long-tailed distributions, and infinite variance) are not consistent with the queuing models traditionally used to analyze networks [WP98]. In particular, empirical studies repeatedly show the self-similar, fractal nature of Internet traffic [Wil97]. Conventional intrusion detection approaches cannot capture, and thus disregard, these patterns that dominate Internet data. However, recent advances in nonlinear stochastic system analysis have produced tools that successfully monitor physical systems with statistical properties like Internet traffic. To date no study has used these tools to analyze and explain the behavior of Internet traffic. We believe that using a model capable of predicting the statistics of Internet traffic will allow us to effectively detect deviations from normal behavior. In turn, our IDS should have a low false positive rate. Our prototype IDS will combine features from the derived nonlinear model with other empirically derived features to avoid the high false-positive rate present in current IDS's. The delivered system will incorporate associated network-sampling strategies designed to help contain infestations. The IDS will be tested on the operational network of a major university, possibly the most challenging environment for any IDS. We expect the following positive outcomes: **(1)** an effective approach for accurate and reliable intrusion detection in complex networks, (2) a major advance in the understanding of computer network dynamics, (3) a computationally fast approach suited for real-time monitoring, (4) customized representations, models,	**1**

	and features that match underlying traffic dynamics, (5) guidelines for sampling network traffic to detect intrusions quickly and stop their propagation, (6) traffic features for classes of attacks capable of detecting botnets and new attacks, (7) nonlinear dynamic systems methods for analyzing Internet traffic sets, (8) a mapping of network topology to expected network traffic measures, and (9) integration of network traffic data sampling and data analysis into intrusion detection.	
R. M. Patton Applied Software Engineering Research Group 865-576-3832 pattonrm@ornl.gov	**Advanced Data Analysis -** Evolutionary Algorithms to Swarm Intelligence to General-Purpose GPU (GPGPU) computing are the research topics the Applied Software Engineering Research (ASER) group explores. ASER seeks highly-qualified computer science students to participate in DHS-related research. Specifically, the student's project will focus on the novel approaches to temporal analysis of textual data to identify how patterns of words change over time. Identifying temporal changes to word patterns is a significant challenge to DHS, DOD, and the Intelligence Community. The student's project will begin with research of related works, then proceed to development and programming of new algorithms, and finish with a publishable paper. The student will work in an environment that will provide the opportunity to learn from researchers and gain a new perspective on various new technologies and their application to challenges facing DHS.	**1**
D. R. Resseguie Data System Sciences and Engineering Group 865-2415385 resseguiedr@ornl.gov	**SensorPedia** - SensorPedia is a DHS sponsored program at Oak Ridge National Laboratory that seeks to utilize emerging Web 2.0 "social networking" standards for organizing and providing access to online sensor network data and related data sets. SensorPedia is based on the same underlying technologies as popular websites such as Wikipedia, YouTube, Google Maps, and MySpace to provide a "write-able" website for near-real time collaboration amongst a community with a requirement to share sensor information while preserving the integrity, security, authenticity and provenance of sensor information. The SensorPedia program seeks interns to assist in one of three research areas: (1) Population of SensorPedia Database. The SensorPedia program seeks interns from a variety of disciplines that can assist in identifying and integrating available online data sources. These data sources may belong to a large number of research domains, customizable to the student's personal research interest areas. Students participating in this project would be responsible for researching available data sources and creating SensorPedia entries for identified data sets in the form of a Web 2.0 mashup. No prior programming experience is required for this task. The value of SensorPedia entries depends greatly on high quality, accurate and detailed sensor system descriptions. Therefore, students would be required to perform research into each identified sensor system to identify data accuracy, system limitations, and access capabilities. For example, an intern who is interested in environmental monitoring could participate in this project by researching existing environmental sensor networks and creating SensorPedia entries for each system, including descriptions of the system's geospatial coverage, included sensor modalities, data reporting rate, and tasking capabilities. The entry for such a system would likely include a Google Maps mashup showing sensor locations and near-real time sensor data. In addition to expanding the SensorPedia database, this research provides an opportunity for students to investigate existing data sets and sensor systems that might benefit their personal research goals. (2) Development of SensorPedia Interface Components. The SensorPedia program seeks interns with programming experience to extend and enhance the SensorPedia user interface. Prior experience with web programming technologies (AJAX, JavaScript, Google Web Toolkit, etc) is a plus, but not required. Students participating in this project would be responsible for developing cutting edge Web 2.0 style components for entering, displaying, and combining sensor data. Individual development tasks will be customized to the intern's personal experience and programming interest area(s).	**1-2 in each of three research areas**

	(3) SensorPedia Usability Studies. The SensorPedia interface consists of a number of components that are used by end users for the registration and publication of sensor data. SensorPedia components must support the generation of sensor system descriptions and data mashups by the typical end user with little or no programming experience. Students participating in this research task will evaluate the SensorPedia interface based on fundamental usability and human-computer interaction principles. This evaluation will require students to design and execute usability experiments. Interns will also be responsible for identifying typical use cases for utilizing SensorPedia by a number of different user groups (law enforcement, emergency first responders, research scientists, etc) and suggesting recommended improvements or additions to the SensorPedia user interface.	
R. L. Sanders Modeling and Simulation Group 865-576-7608 sandersrl@ornl.gov	**Use of Second Life Virtual Reality Platform for Management of SensorNet Data -** As part of the Sensor Net project for Homeland Security, a research project has been initiated that uses a Mirrored Environment to study several issues related to the detection and effects of Weapons of Mass Destruction. The research areas include Emergency Preparedness and Response; Advanced Data Analysis and Visualization; Chemical, Biological, and Nuclear Threats and Countermeasures; and several other key aspects of Population Modeling and Behavior Simulation. This research is similar to a project currently sponsored by the National Oceanic & Atmospheric Administration (NOAA), which uses the "Second Life" virtual reality platform. This platform is a 3-D online world with a rapidly growing population from 100 countries around the globe. The residents themselves create and build the virtual world by including components such as homes, vehicles, stores, landscapes, and weather. The intern that accepts this position will work with a team to model various realistic virtual environments. The work will include the development of physics engines for modeling the effects associated with various incidents and the development of applications and procedures for running simulations.	**1**
F. T. Sheldon Cyberspace Sciences and Information Intelligence Research Group 865-576-1339 sheldonft@ornl.gov	**Research Subject: Cyber Security Econometrics -** From our standpoint, the enterprise system is viewed as network of interconnected processing nodes and data nodes. Security requirements may mandate various partitions of the system, for the sake of protection, risk mitigation, and access control. Stakeholders to these systems are users or user communities, who can be characterized by the set of nodes or the subsystem to which they have access or have a stake in, the services that they expect from (their part of) the system, the stakes they have in the delivery of these services. The same node or subsystem may serve more than one stakeholder; it may deliver different services to different stakeholders; and it may carry different stakes for different stakeholders. Hence we do not evaluate the system in a centralized fashion, but rather from individual stakeholder standpoints; each stakeholder defines a specific Enterprise Mission, and attaches specific stakes to accomplishing this mission.	**1**

Thomas Thundat Nanoscale Sciences. & Devices 865-574-6201 thundattg@ornl.gov	**Microcantilever explosive vapor sensor development -** We have developed a receptor-free explosive vapor sensor based on MEMS platform. Most of the currently used MEMS techniques use receptors, such as polymers, SAMs, and biomolecules, for achieving specificity in detection. Our technique that exploits the extreme low thermal mass of the cantilever utilizes thermodynamic properties of explosives for speciation. Programmed heating of the MEMS devices with adsorbed explosives produce responses that are very characteristic to classes of explosives. We have achieved speciation of pico gram level explosives molecules adsorbed on MEMS structures. Development of a hand-held device for explosive vapor detection is in progress.	**1**
Thomas Thundat Nanoscale Sciences. & Devices 865-574-6201 thundattg@ornl.gov	**Microcantilever-based chem./biowarfare agent detector** – Adsorption of chemical and biomolecules on microfabricated cantilevers result in variation in resonance frequency and bending. We have demonstrated detection of chemicals and biomolecules with extreme high sensitivity. Selectivity in detection is achieved by using chemically selective self-assembled monolayers (SAM). We are in the process of evaluating different coatings (self-assembled monolayers and polymers) for achieving multi-target detection. Recently we demonstrated detection of ricin using cantilevers with immobilized aptamers. Microcantilever platform can be used for the detection of many BW/CW simulants at unprecedented sensitivity.	**1**
Thomas Thundat Nanoscale Sciences. & Devices 865-574-6201 thundattg@ornl.gov	**Standoff Detection of Explosives -** At present we are developing standoff method for obtaining molecular signatures of explosive residues on surfaces. This technique combines infrared spectroscopy with photoacoustic technique to obtain molecular signatures at standoff distances. At present we have demonstrated the technique for RDX, TNT, and PETN residues of surfaces. Experiments are presently underway to increase detection range and sensitivity.	**1**
Jun Xu Surface Chemistry & Catalysis Group 865-574-8955 xuj2@ornl.gov	**Development of sensors for monitoring trace explosives** - This project is supported by the DoD Strategic Environmental Research and Development Program (SERDP). The objective is to develop sensors for monitoring trace explosives, chlorinated hydrocarbons, and other threat agents in groundwater. New analytical methods developed in this project will be potentially useful for detecting trace explosive and chemical warfare agents in homeland security applications. Dr. Jun Xu and other staff members will assist students in meeting the internship requirements and provide technical guidance and advice to students during the internship duration. Dr. Jun Xu has been awarded as an outstanding mentor by DOE.	**1**
Warren C. Edwards National Security Directorate 865-574-8277 edwardswc@ornl.gov	**Community and Regional Resilience Initiative (CARRI) -** Oak Ridge National Laboratory's Community and Regional Resilience Initiative is a program of the Congressionally-funded Southeast Region Research Initiative. CARRI is a regional program with national implications for how communities and regions prepare for, respond to and recover from catastrophic events. CARRI will develop the processes and tools with which communities and regions can better prepare to withstand the effects of natural and man-made disasters. In its first year, CARRI will collaboratively develop a definition of community resilience that is accurate, defensible, welcomed, and applicable to communities across the region and the nation. CARRI is presently working with three partner communities in the southeast: Gulfport, Mississippi; Charleston, South Carolina; and Memphis, Tennessee. These partner communities will help CARRI define community resilience and test it at community level. Using input from the partner communities, lessons learned from around the nation, and the guidance of ORNL-convened researchers who are experts in the diverse disciplines that comprise resilience, CARRI will develop a community resilience framework that delineates a process that communities can work through to become more resilient, and be so recognized. Its objective metrics will help communities differentiate themselves from less-resilient communities and regions resulting in positive economic benefits. As part of developing the community resilience framework, CARRI will collect and make available practical tools to help communities assess their resiliency status and systematically take steps towards enhancement.	**2**
Ralf Deiterding Computational Mathematics Group 865-241-0782 deiterdingr@ornl.gov	**Coupled fluid-structure interaction simulation of three-dimensional blast waves impinging on building structures** - In order to strengthen ORNL's modeling capabilities within the ongoing project "Bombing Prevention Capabilities and Analysis", funded by the Office for Bombing Prevention of Department of Homeland Security, preliminary numerical studies will be conducted to investigate the response of building structures in urban environments to strong shocks in air created by the explosion of high energetic materials. The calculations will utilize	**1**

	the Cartesian adaptive shock hydrocode AMROC, developed by Dr. Deiterding, coupled on-the-fly to the structural mechanics code DYNA-3D and will be run on parallel ORNL computers. The software has been validated for laboratory-scale fluid-structure experiments involving shocks in water or air and detonations in gaseous media. Emphasis of the student project will be to validate the software further against available data for blast wave interaction with concrete walls and possibly extrapolate the experimental results. Additionally, three-dimensional shock phenomena arising from the propagation of blast waves through complex urban settings will be investigated and compared with results from scale-model tests. This project would be ideal for graduate students of engineering or applied mathematics with great interest in computational fluid and/or solid dynamics.	
Vincent J. Jodoin Reactor Analysis Group 865-574-0420 JodoinVJ@ORNL.gov	**Post-Detonation Determination of the Integrated Radiological Dispersal Device (RDD) Source Strength -** Technical nuclear forensics that supports the attribution of an RDD event is concerned with four fundamental questions: 1.) What material was dispersed? 2.) How much material was dispersed? 3.) What is the extent of the dispersion?, and 4.) What information about the origin of the material can be determined? This project addresses the second and third requirements directly and the fourth indirectly. Determining the integrated source strength in a post-detonation environment is unique to RDDs. The amount of curies dispersed in a fission weapon is directly related to the nuclear yield which can be estimated by various prompt effects. In an RDD, the amount of material dispersed must be estimated by the radiological footprint left behind after the event. Limited field readings, laboratory analyses of field samples and aerial measurements of the entire field can all be used to estimate how much material was dispersed. This data can also be used to estimate the extent of the dispersion. The integrated source strength will provide clues to the origin of the material by bounding the range of known sources that match what was used. The research will provide a method to rapidly estimate the source strength once the input data becomes available. It will also provide a revisable estimate as new data is collected and refined. Two approaches will be taken: 1.) Smart smoothing and integrating of sparse readings and field samples, and 2.) Forward prediction matching to field readings and sampling data.	**1**
Jeffrey O. Johnson Radiation Transport & Criticality Group 865-574-5262 johnsonjo@ornl.gov	**Maritime and Port Security** - Detection and interdiction of Special Nuclear Materials (SNM) continues to be a high priority focus area of the NNSA NA-22 Proliferation Detection Program. A major component of the program is the development of enabling radiation sensing technologies for use across a wide variety of operational scenarios. Maritime scenarios are of particular interest including, “high seas” ship-to-ship, and on board ship detection of threat quantities described in relevant SNM Detection requirements documents. The primary emphasis to date has been focused on detecting SNM due to operations supporting the large container ship capable of transporting thousands of containers at a time. The threat basis evaluated here focuses on fishing trawlers, small cargo transport ships (e.g. tramp steamers), and luxury yachts at sea. This project involves a scoping study to evaluate leading proposed active interrogation techniques for detecting SNM in the restricted threat basis (small ships) for the maritime operational scenarios of interest. This work will include: • performing a gap analysis of existing work to determine what calculations have yet to be done or need to be enhanced to yield a comprehensive assessment relative to the GOR document, • collecting descriptive data for representative vessels in the expanded threat basis, • benchmarking calculational methods against existing experiments • performing computational evaluations as to the applicability of active interrogation methods such as linac interrogation, and • assessing experiments that can be performed to experimentally evaluate this capability and benchmark the computational methods.	**1**

	The evaluation will include how many containers can be between the container with the fissile object and the interrogation source. Variables in this assessment will be source type, energy, intensity, and location; detector type, size, and location; contents of the containers and shielding for smaller vessels; measurement times; accuracy; and dose to the vessel.	
Rekha S. Pillai Decision Engineering Group 865-946-1307 pillairs@ornl.gov	**Knowledge Management Research** - Oak Ridge National Laboratory's Engineering Science and Technology Division (ESTD) is seeking to identify summer interns majoring in one or more of the following fields: operations research/industrial engineering/management science, computer science, economics, and/or statistics. Interns will work in the area of Knowledge Management. The activities will encompass safeguards and security challenges associated with the nations' critical transportation infrastructure and associated interdependent infrastructures (e.g., energy, banking). We develop national level knowledge management systems through innovative use of information technology (computing, communication, and visualization), operations research (applied mathematics), and statistics to improve the security and efficiency of transportation systems to ensure safe and free movement of people and goods in the United States. Specific expertise required includes data acquisition, structuring, and analysis, simulation, optimization, GIS, software engineering, and decision analysis. **Interns Academic Background:** Operations research/industrial engineering/management science/applied mathematics, statistics, computer science, and economics. **Duties, Responsibilities, and Deliverables:** MAJOR DUTIES AND RESPONSIBILITIES: Selected intern(s) will work with ESTD research staff member(s) and provide support in the conduct of research and development in the areas of knowledge mapping, visualization, large scale optimization analysis, transportation system security assessment (for different threat), statistical and simulation analysis. Intern(s) will also help in literature review, data gathering and analysis, design and development of algorithms, software implementation, simulation model development and analysis, statistical analysis, and application interfaces development. Intern(s) participating in the project will be considered a core project team member for the duration of their internship. **Major deliverables include:** 1. Maintaining a daily log of activities, work performed, people met and impressions. 2. Weekly update (a briefing) of activities, task assignment, and progress. 3. Final report that briefly describes the internship program and project, progress to date, issues/challenges, results, lessons learned, conclusion, and next steps. The report format will be provided to the interns before the completion of this internship. 4. A Poster/Oral presentation as required by the DHS program.	**2-3**
Tom Karnowski Image Science and Machine Vision Group 865-574-5732 karnowskitp@ornl.gov	**Target Acquisition and Tracking for Gamma Ray Imaging** - We are performing research and development on the fusion of a gamma ray coded aperture imager, which images radiation sources at very large distances, with video imaging to produce accurate radiation profiles of moving vehicles. Moving vehicles are acquired with video cameras and are identified and labeled between frames. Their location is superimposed on gamma ray pixels and this information is used to provide longer integration times for each vehicle, producing high signal-to-noise ratio and high specificity. Summer interns who are interested in this work should have some knowledge or interest in image processing and pattern recognition, as well as software development environments such as visual basic, Matlab, and C++ / C#.	**1**