Neutron Scatter Camera

Special nuclear material (SNM) emits penetrating, high-energy radiation during active and passive interrogation. This radiation can be imaged and thus allows visualization of shielded and/or smuggled SNM. Although g-rays are one option for imaging, neutrons have the advantage of better penetration through high-z shielding, and are thus preferred in many cases. We are developing a neutron scatter camera to image fission neutrons from SNM. This will be the first instrument of its kind and a powerful tool to aid in the detection of smuggled SNM.

Mentor Contact:

Nick Mascarenhas, 925-294-6216, nmascar@sandia.gov

Secondary Reachback Project

Project 1

The Secondary Reachback project requires the intern to investigate applying Web technologies to visualize temporal trends in large DHS data sets. Some possibilities include exploring different clustering, binning, and partitioning techniques; exploring 2D or 3D visualization tools; and exploring use of 2D animation. Experience with Web applications, computer programming and the ability to creatively solve problems would be beneficial.

Edward Walsh

Project 2

The Secondary Reachback project is seeking a computer science, engineering, physical science, or math student to assist with the development of data analysis tools. The tools are designed to query a data store (SQL database or CERN ROOT file or XML file), retrieve result sets, parse the results, analyze the data, and store the data in a file (text file, binary file, Excel file, CERN ROOT file, or XML file). This data is then available for use in more sophisticated analysis software.

The candidate will be expected to contribute to developing the base software as well as designing and performing higher-level analysis. Specific analysis details will depend on the intern's skills and the immediate needs of the project.

Dov Cohen

Microengineered Tools Enabling Single Cell Studies of Immunity

At Sandia/CA we are developing innovative microsystems-based tools for the study of individual cells, particularly those comprising the innate immune system – the body's first line of natural defense against pathogens. This multidisciplinary (biology, engineering, and imaging) effort should provide new insight into the molecular mechanisms underlying innate immunity, thereby facilitating identification of disease biomarkers and therapeutic targets.

There are three main projects associated with this research area:

Project 1: Microfluidic Analysis of Single Cells For Systems Biology

As part of the engineering team, the student will design and optimize microfluidics based flow assays to elucidate intracellular signaling cascades that is triggered when macropahges are infected different Gram-negative bacteria (Escherichia coli, Francisella tularensis, Yersinia pestis).Microfluidic assays will be optimized to monitor early infection events in host-pathogen interactions with fine temporal as well as spatial resolution.

Mentor Contact:

Nimisha Srivastava, 925-294-2507, nsrivas@sandia.gov

Project 2: Optical Manipulation of Single Cells

As a member of the engineering team, the student will use photonic forces to levitate and move cells using laser light in a microfluidic chip. We are developing many applications from the manipulation of cells by optical forces including a fluorescence-activated cell sorter and an array of single, living macrophage cells.

Mentor Contact:

Thomas Perroud, 925-294-3133, tperrou@sandia.gov

Project 3: Discovery of Molecular Mechanisms Enabling Host Cell Recognition of Bacterial Pathogens

As a member of a multidisciplinary team, the student will use biochemical and biophysical approaches to help elucidate the means by which key sentry cells (macrophages) perceive pathogenic challenges, mount appropriate responses, and coordinate those responses via cell-cell communication.

Mentor Contact:

Steve Branda

DHS Systems Analysis

In Systems Analysis, students will conduct analyses for DHS programs to support development and evaluation of requirements for detection technologies and countermeasures to defend against chemical and biological attacks; decisions and responsive actions that are critical to mitigate the medical, infrastructure, and operational effects of chemical and biological attacks; and design and deployment of detection architectures for the protection of cities and high-value civilian targets. Results from these studies support DHS policy, planning, deployments and system requirements.

Mentor Contact:

Lynn Yang, 925-294-4667, liyang@sandia.gov

Nathaniel Gleason, 925-294-1461, njgleas@sandia.gov

Exploratory Computer and Software Engineering

In this department, students will work to implement or test software for DHS programs in support of large enterprise models that allow evaluation of response options and countermeasures to defend against chemical and biological attacks; role-based software training aimed at the formation of incident management teams and the decisions of key principals in the national incident; and management system used to respond to catastrophic evens and natural disasters domain-specific submodels such as biological threat, health care capacity, and prophylaxis distribution. This software will support DHS training, planning, deployment, and system requirements.

Mentor Contact:

Paul Nielan, 925-294-2510, pen@sandia.gov

Advanced Platforms for Spore and Virus Enrichment and Detection

This project will focus on the development of cheap, rapid, robust, and efficient polymer-based microsystems that will enable the targeted enrichment of viable spores and intact viruses that pose a threat to human health. This platform would be autonomous and suited for integration with any currently available aerosol and/or liquid collection system.

Mentor Contact:

Blake Simmons, 925-294-2288, basimmo@sandia.gov

Discovery of Molecular Mechanisms Enabling Host Cell Recognition of Bacterial Pathogens and Toxins using the soil nematode C. elegans

Invertebrates are exposed to the same toxins and bacterial pathogens that afflict all multicellular organisms, and they rely on a robust innate immune system for survival. Studies of invertebrates,

such as the genetically well-characterized soil nematode *C. elegans,* have revealed molecular mechanisms of innate immunity that are highly conserved across species. We are using *C. elegans*, and combining behavioral, genetic, and microfluidic assays, to dissect the molecular mechanisms of the innate immune response to specific bacterial pathogens and toxins.

Mentor Contact:

Catherine Branda, Postdoctoral Researcher, Biosystems Research (8321); cbranda@sandia.gov; 925-294-6833

Nanofluidic Biomarker Detection and Analysis

A first step in the mitigation of any biosecurity threat is the identification of the organism or biotoxin. At Sandia/CA we are developing innovative micro- and nanoscale tools for the detection and analysis of biomarkers. In this project, we utilize the electrokinetic concentration and separation capabilities of nanoscale fluidic channels to enable rapid, label-free detection of biomarkers.

As a member of the engineering team, the student will investigate the pre-concentration and separation capabilities of nanofluidic devices featuring embedded nano-electrodes. Depending on the student's experience and interests, additional tasks might include the design and fabrication of new nanofluidic devices or the development and optimization of proof-of-concept biomarker assays.

Mentor Contact:

David Huber, Postdoctoral Researcher, Microfluidics Department (8324); dhuber@sandia.gov; 925-294-1474

Analysis of Protein - Carbohydrate Interactions Involved in Host Cell Recognition of Bacterial and Viral Pathogens

Host pathogen recognition is often mediated by interactions among carbohydrates on the pathogen cell surface with carbohydrate recognizing proteins (lectins) on the host cell surface or vis versa. This project is aimed at understanding the molecular mechanisms underlying these recognition events and developing computational approaches to predicting carbohydrate - protein interactions. The ability to predict these interactions will provide innovative tools applicable to such areas as the design of lectin arrays for characterization of pathogen cell surface carbohydrates and thus pathogen detection (biomarker discovery) and the rational design of anti-adhesion therapies aimed at preventing pathogen attachment to its host and thus preventing infection.

Mentor Contact:

Ken Sale, Member of Technical Staff, Biosystems Rsearch (8321); klsale@sandia.gov; 925-294-2143

Please stay tuned! This Sandia National Laboratories/CA list will have more projects added soon!

DHS students are eligible for housing subsidization not to exceed 50% of federal accommodations per diem ($1410 per month in CA and $1050 per month in NM). This reimbursement is contingent upon completion of appropriate vouchers accompanied by valid receipts.