Draper Biosecurity Research Interests

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Introduction

Draper has established a major presence in the biosecurity domain, working with a range of key government stakeholders on critical applications ranging from biosurveillance and clinical diagnostics to therapeutic screening of medical countermeasures for high priority pathogens.

About Draper Laboratory (www.draper.com)

Draper is an independent, not-for-profit corporation, chartered to work on problems in the national interest. Draper is seeking collaborative research partners from universities to further the state of the art in key technologies of mutual interest. Research Whitepapers describing Draper's technology interests and Technical Points of Contact can be found on the Draper Scholars webpage (Draper Scholar Program | Draper). The Draper Scholars Program funds thesis-bearing MS and PhD students at partner universities as one of the effective ways to progress the technology. Other means of collaborative research (e.g. joint proposals, sabbaticals, etc.) are also encouraged. Please contact education@draper.com if you have further questions.

Research Interests

1. ***Biosurveillance***

   Infectious diseases are one of the largest threats to global public health. Factors such as climate change, increased population growth, expansion into animal habitats, and prevalence of antimicrobial resistance have led to emergence of novel pathogens as well as rise of previously controlled infections. The ability to rapidly monitor the spread of disease is crucial for prevention, interference and control. With the emergence of SARS-CoV-2, wastewater surveillance has shown to be a useful rapid approach for monitoring disease spread and levels in the community. Additional pathogens have been shown to be detectable in wastewater, allowing for the monitoring of multiple circulating pathogens. The principles of wastewater biosurveillance can extend beyond the general public to the government agencies to help monitor safety and threats against key assets and locations in addition to other complex environmental samples. Development of rapid pathogen agnostic detection is necessary to protect communities against and prevent spread of novel infectious threats.

2. ***Modeling emerging and high priority pathogen infections for medical countermeasure development***

   Draper has been developing organ-on-chip technologies toward a range of applications for over two decades, with a central focus on engineered tissues for disease modeling and screening of medical countermeasures against high priority pathogens. While the fundamental engineered platform for these model systems is well-established, several key technical advances could augment and expand capabilities toward key biosecurity applications. These include: 1) the development of new organ models beyond Draper's current portfolio, with particular interest in neural and cardiac models; 2) the integration of immune components into organ models; 3) the development of new disease models such as for thrombosis and coagulopathy applications; 4) Automation of downstream

assays via innovations in microfluidics and related domains are also key to driving down the costs and increasing the throughput of these model systems. Advancements in organ-on-chip technologies will enable rapid response to emerging threats and improve medical countermeasure development.

3. ***Development of High-Fidelity Multi-Omics Capabilities***

   Modeling emerging threats and developing mitigation strategies requires an ever-advancing set of capabilities for analyzing data obtained from clinical samples, preclinical animal studies, and *model* systems such as organs on chips. Conventional analytical tools provide a limited window into the dynamics of pathogenesis, including entry, replication, and immune downregulation, which has resulted in a dearth of countermeasures despite years of research. Novel capabilities in single-cell analysis and in capturing and probing multi-omics datasets including proteomics/genomics, epigenomics and the microbiome, will be critical in designing increasingly complex and powerful model systems for the investigation of disease mechanisms and evaluation of therapeutic approaches. Integration of these multi-omic readouts at both the tissue and single-cell levels will ultimately contribute to accelerated response to emerging threats, and reduced costs and wider availability of vaccines and therapeutics during health emergencies.

We are interested in exploring Draper Scholar opportunities for both MS and PhD students pursuing graduate research programs in the Life Sciences / Microbiology, Bioengineering, and other related disciplines and academic departments.