

WORKSHOP ANNOUNCEMENT & PROGRAM

Solutions through Highly Integrated Engineering and Life Sciences for Defense (SHIELD)

NSF-Engineering Research Center Proposal Development

December 18-19, 2018

University of California at Davis, Putah Creek Lodge

The University of California at Davis, Colorado State University (CSU), and Tuskegee University (TU), along with other partner investigators are leading an effort to create a multi-university convergent engineering research center, bringing engineering and synthetic biological sciences at academic institutions together with industry and national and regional stakeholders to develop next-generation integrated systems for biomanufacturing novel products using existing and emerging platforms to address an innovative biodefense strategy.

To help focus the scope of our mission, we are organizing a one and a half-day workshop with leaders in the field to define priority areas and unmet research, workforce development, and innovation needs related to the topic. We also hope to use this opportunity for team-building, to refine the research scope of SHIELD, and for identifying overlaps and synergies with other on-going efforts, stakeholders we need to consult, and critical gaps in center expertise.

The Solutions through **H**ighly **I**ntegrated **E**ngineering and **L**ife Sciences for **D**efense (SHIELD) ERC will address one of our society's biggest challenges, namely protecting lives, human health, animal health, our food supply, and our social structure in the face of naturally occurring emerging and re-emerging infectious diseases, and intentional acts of bioterrorism. The 2018 National Biodefense Strategy states: "Biological threats - whether naturally occurring, accidental or deliberate - are among the most serious threats facing the United States and the international community". Over the past decade, the integration of engineering and life sciences has advanced the speed of detection, identification and sequencing of toxins/infectious agents/pathogens, and global mapping of "hot spots" for early detection of pathogens. The One Health approach recognizes the integral human-animal-ecosystem connections that dictate pathogen transmission. However, **what is still lacking**, as exemplified in the 2009 H1N1 pandemic, the 2014-2015 highly pathogenic avian influenza outbreak, and the 2013-2016 and 2018 Ebola virus crises, **is our ability to respond rapidly** in terms of providing culturally congruent countermeasures (diagnostics, therapeutics and vaccines) to save lives, prevent spread of disease, and protect livelihoods. More ominous is the possibility that new "designer" infectious agents could be deployed by bioterrorists against people, livestock, or our food supply. Gene editing using new technologies such as CRISPR/Cas-9 holds enormous promise but is a double-edge sword that might offer a facile path to weaponized pathogens.

Thus, the **vision** of the SHIELD ERC is to establish **innovative bioengineering platforms** for the **rapid, on-demand manufacturing of medical, veterinary and plant security countermeasures**, for unknown, or unanticipated, biological threats. The realization of this vision will require convergent communication and integrated research among engineers (biochemical, chemical, biomedical, and biological), computer scientists, medical and veterinary scientists, biologists (molecular, cellular, genetic, virologists, plant and animal scientists, entomologists), as well as social scientists and bioethicists; disciplines not typically aligned, who speak very different languages and approach solutions to challenges in different ways. The **goals** of the SHIELD ERC are to **create, design, develop and evaluate platform technologies and define their implementation**. The main **research thrusts** include: 1) detection, design and/or identification of target countermeasures once the pathogen or toxin is identified, 2) rapid production of different types of countermeasures (diagnostics, vaccines, protein and peptide-based therapeutics, etc.), 3) rapid assessment of the countermeasure in terms of safety and efficacy, 4) formulation and delivery of countermeasures, and 5) decontamination technologies. Furthermore, the SHIELD ERC will conduct techno-economic modelling to evaluate countermeasure production costs, and assess the safety and bioethics associated with the countermeasure production and/or its deployment. These research thrusts directly address Goal 3 of the 2018 National Biodefense Strategy, namely to "Ensure biodefense enterprise preparedness to reduce the impact of bioincidents".

A major goal of the SHIELD ERC is the development of **countermeasure biomanufacturing platforms that are fast, scalable, cost-effective, and safe**. A variety of broadly applicable methods for the rapid bioproduction of protein therapeutics have been demonstrated by our team and others, including recombinant and virus-based gene expression in plants, mammalian cells, insect cells or insects, and cell-free systems. Our team has also developed novel methods at the laboratory scale for rapid vaccine prototyping and production, including chemical and/or genetic conjugation of antigens to viral nanoparticles, as well as the use of riboflavin and UV photochemistry for inactivation of viral pathogen RNA or DNA while keeping viral particles and antigens intact. These and similar approaches show great promise; however, their scale-up, downstream processing, product quality, cost, biosafety, and their societal acceptance remain to be addressed. An ERC is essential to tackle these challenges because the complexity and multidisciplinary nature of the problem is not amenable to a single investigator, or even small group research projects, and requires input and guidance from multiple disciplines, industries, governmental and regulatory agencies and other stakeholders. The SHIELD ERC will address these challenges by establishing an open, intellectually vibrant, diverse and inclusive culture that will enhance biodefense workforce development, engage the community and K-12 education sectors, and stimulate innovation.

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DAY 1 **Tuesday, Dec 18, 2018 (Putah Creek Lodge at UC Davis - <https://cru.ucdavis.edu/putahcreeklodge>)**

12:00 - 1:15 pm **Lunch, Informal Welcome Reception and Introduction (all)**

1:15 - 1:30 pm Welcome and Introductory Remarks by Jennifer Curtis, Dean, College of Engineering, UC Davis

1:30 - 1:45 pm Welcome and Introductory Remarks by Prasant Mohapatra, Vice Chancellor for Research, UC Davis

1:45 - 2:15 pm Overview of the Workshop Goals and the NSF Gen-4 ERC Program – Karen McDonald

2:15 - 2:20 pm Workshop Logistics - Somen Nandi

Introduction to the Problem (Moderator: Somen Nandi)

2:20 - 2:40 pm Global Biodefense in the Age of Synthetic Biology – Michael Ladisch, Distinguished Professor, Purdue University

2:40 - 3:00 pm Need for Global Biodefense – Alan Rudolph, Vice President of Research, Colorado State University (Via Zoom)

3:00 - 3:15 pm **Short Break**

Overview of Core Partner Universities

3:15 - 3:40 pm University of California, Davis (UCD) – Karen McDonald

3:45 - 4:10 pm Colorado State University (CSU) – Raymond Goodrich

4:15 - 4:40 pm Tuskegee University (TU) – Deloris Alexander

Research Overviews by Potential Affiliate Faculty

4:45 - 5:00 pm University of California, Berkeley – Adam Arkin

5:00 - 5:15 pm University of California, Davis – Roland Faller

5:15 - 5:30 pm Touro University -- Alison McCormick

5:30 - 5:45 pm University of Louisville -- Jill Steinbach-Rankins (via Zoom)

5:45 - 6:30 pm **Networking and Happy Hour on the Patio of Putah Creek Lodge (weather permitting, otherwise inside the room)**

6:30 - 8:00 pm **Dinner at Putah Creek Lodge**

DAY 2 **Wednesday, Dec 19, 2018 (Putah Creek Lodge at UC Davis)**

7:30 - 7:50 am **Continental Breakfast**

7:50 - 8:00 am Opening Remarks – Recap of Day 1 and Agenda for Day 2 – Somen Nandi

Introduction to One Health (Moderator: Somen Nandi)

8:00 - 8:25 am One Health and Global Biodefense – Bennie Osburn, Dean Emeritus, School of Veterinary Medicine, UCD

Research Overviews by Potential Affiliate Faculty and Companies (Moderator: Karen McDonald)

- 8:30 - 8:45 am Christopher Snow, CSU
8:45 - 9:00 am Rebekah Kaeding, CSU
9:00 - 9:15 am Bryan Wilson, CSU
9:15 - 9:30 am Gregory Bernard, TU (Via Zoom)
9:30 - 9:45 am Ambarish Kulkarni, UCD
9:45 - 10:00 am Coleman Kronawitter, UCD
10:00 - 10:15 am Michael Pauly, Mapp Biopharmaceutical
10:15 - 10:30 am Short Break
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Research Overviews by Potential Affiliate Faculty (Moderator: Denneal Jamison-McClung)

- 10:30 - 10:45 am Monique Van Hoek, George Mason University (Via Zoom)
10:45 - 11:00 am John Mizia, CSU
11:00 - 11:15 am Mark Steinglein, CSU
11:15 - 11:30 am John Wyckoff, CSU
11:30 - 11:45 am Jiandi Wan, UCD
11:45 - 12:00 pm Natalia Corporale, UCD
12:00 - 12:15 pm Hannah Love, CSU
12:15 - 1:30 pm Group Formation, Working Lunch, and Photos at Putah Creek Lodge

VISIONING & INNOVATION SESSIONS: All Participants

- 1:30 - 2:15 pm Research Thrusts: Existing centers, what's missing, challenges and plausible solutions, and identification of SHIELD research thrusts – Moderator: Somen Nandi (interactive discussion input from all)

Pillars of SHIELD ERC (Concurrent Working Groups) (Moderator: Denneal Jamison-McClung)

- 2:15 - 3:15 pm Engineering Workforce Development (Group members)
2:15 - 3:15 pm Diversity and Culture of Inclusion; Community Engagement (Group members)
2:15 - 3:15 pm Creating and Nurturing an Innovation Ecosystem (Group members)
3:15 - 3:30 pm Short Break
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- 3:30 - 4:15 pm Research Thrusts and Working Group Updates: Discussion and Take-home Messages (all participants)
Moderator: Somen Nandi
4:15 - 4:45 pm Discussion of the SHIELD Three-Plane Strategic Planning Chart – Karen McDonald
4:45 - 5:00 pm Workshop Adjournment and Concluding Remarks – Karen McDonald and Somen Nandi
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A Few Logistics

Directions to Hyatt Place Hotel, UC Davis: <http://ucdavis.place.hyatt.com/en/hotel/home.html>

Directions to Putah Creek Lodge, UC Davis: <https://cru.ucdavis.edu/content/330-location-and-contact.htm>

For out of town guests and invitees, local organizers will organize the travel between the hotels in advance. So, please feel free to contact any of the following if you have any questions or special requests.

PERC Local Organizing Committee, University of California at Davis

Karen A. McDonald, kamcdonald@ucdavis.edu

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Directions to Putah Creek Lodge Parking Lot:

From the Bay Area and Sacramento:

- Take Interstate 80 to Highway 113 north. Exit (1st exit) on Hutchison Drive and turn right on to Hutchison Drive. Continue on Hutchison Drive and make a right turn on La Rue Rd (At second light). Follow to Garrod Rd, and make a right on Garrod. Drive to first left turn ONLY entrance into the Putah Creek Lodge Parking Lot.

NOTE: THIS IS A LARGE (L shape) PARKING LOT AND IT IS RECOMMENDED TO DRIVE TO THE VERY END OF THE PARKING LOT IF YOU ARE ATTENDING AN EVENT AT PUTAH CREEK LODGE.

USE GOOGLE MAPS APP FOR THIS LINK FROM YOUR PHONE:

<https://www.google.com/maps/dir/38.5318406,-121.7594211/@38.5267821,-121.7664973,15z/data=!4m2!4m1!3e0>

Here is a map showing the lodge and the parking area opposite on the other side of the creek. You have to drive on La Rue Road, turn down Garrod Drive, and then drive to the very end of the parking lot. There is a bridge into Putah Creek Lodge. You cannot drive on Putah Creek Lodge Drive.

Daily parking permit: Veronica Stanton (vstanton@ucdavis.edu) will in Putah Creek Lodge helping to set up on 18th morning since 10:30 am, if you need a complementary parking permit - please call her cell phone and she will meet you in the parking lot opposite the lodge and give you a daily parking pass to leave on your dashboard.



Acknowledgment

The ERC-SHIELD Local Organizing Committee would like to thank the National Science Foundation (EEC-1840476), College of Engineering (CoE Proposal Planning Award) and Department of Chemical Engineering (particularly Veronica Stanton), for sponsoring this workshop, as well as Colorado State University and Tuskegee University for supporting participation by their faculty.

List of Participants

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Note: Highlighted colleagues will participate over ZOOM