The National Academies of
SCIENCES • ENGINEERING • MEDICINE

"Surprise Resulting From Convergence"

Intelligence Community Studies Board
Division on Engineering & Physical Sciences

December 4th and 5th, 2018
The Keck Center of the National Academies
500 Fifth Street, NW, Room K208, Washington, DC 20001

Day One - Tuesday, December 4, 2018 – Room K208

8:00 **Working Breakfast and Committee Introductions**
Setting expectations, getting to know each other and gaining alignment

8:25 **Welcome**
Alan Shaw, NASEM Staff Director of the Intelligence Community Study Board
Dan Flynn, Office of the Director of National Intelligence (ODNI), Director of IC Net Assessments
Mel Eulau, Office of the Director of National Intelligence (ODNI), S&T Adviser

9:00-12:00 Session #1 - AI, Autonomy, Robotics, Ethics: Strategic surprise on the Battlefield (Facilitator: Tomás Díaz de la Rubia, Workshop Planning Committee Member)

Artificial Intelligence methods continue to evolve and converge with robotics and autonomous systems to create new avatars and systems with heretofore unforeseen functionality and capability. Will a future adversary choose to deploy AI-based autonomous robotic systems into the battlefield that will be fully capable of making decisions without a human in the loop? While such a scenario may not be ethically acceptable to the United States, an adversary may decide that it is in their national interest to deploy such a system in order to win a war. Will this be a surprise, or will we be ready to respond and counter such an adversary? How do we mitigate this possibility?

9:00 – 9:05 **Introductory Remarks**

9:05 – 9:35 **Supercomputing as an Exemplar for Strategic Surprise and Mitigation**
Dona Crawford, former Associate Director Computation at Lawrence Livermore National Laboratory and President of Livermore Lab Foundation

9:45 – 10:15 **Thinking Differently About Conflict in the 21st Century: Advanced Technologies, Artificial Intelligence, Information Warfare, and Military Decision Making**
Gen (Ret) Robert Latiff (USAF), Author of Future War: Preparing for the New Global Battlefield, member of ICSB and Research Professor, George Mason University, School of Engineering, Intelligence Community (IC) Programs Directorate

10:15 – 11:15 **Artificial Intelligence: A Look Under the Hood and Implications for Our Future**
Patrick Wolfe, Dean of the College of Science at Purdue

11:15 – 11:30 **Break**

11:30 – 12:00 **Q&A Moderated by Tomás Díaz de la Rubia**

12:00 – 1:00 **Working Lunch**

1:00-4:00 - Open Session #2 - Neuroscience, Medical Devices, Human-Machine Interface (Facilitator: Dr. Ellis Meng, Workshop Planning Committee Member)

Medical devices and biomedical technologies are invented with the intent of treating or managing medical conditions and enabling discovery, respectively, for improving human health. However, the access and insight they provide on the human body pose risks from the perspective of the use of the underlying technology and science for malicious purposes. This is of particular concern for invasive implants that have access to critical body areas such as the heart and brain. This session will discuss the implications of the compromise of such technologies and possible strategies to mitigate such surprise.

1:00 – 1:05 **Introductory Remarks**

1:05 – 1:50 **Medical Devices and Healthcare Technology: Can Systems Created to Help Be Turned Into Systems That Can Harm?**
Ken Hoyme, Director, Product and Engineering Systems Security, Boston Scientific

1:50 – 2:35 **Non-invasive Neuromodulation Devices and Technologies**
Sarah H. Lisanby, Director, Division of Translational Research, National Institute of Mental Health (NIMH), National Institutes of Health (NIH)

2:35 – 2:45 **Break**

2:45 – 3:35 **Invasive Neuromodulation Devices and Technologies**
Nader Pouratian, Assistant Professor of Neurosurgery, UCLA

3:35 – 4:00 **Q & A**

4:00 **Adjourn**

Day Two – Wednesday, December 5, 2018 – Room K208

8:00 **Working Breakfast and Committee Introductions**

8:30 **Sponsor Reflections**
Dan Flynn

9:00 – 12:00 - *Open Session #3 – Genomes, Genomics, and Delivery Systems (Facilitator: Dr. David Relman, Workshop Planning Committee Member)*

Manipulation or degradation of host genomes of a population, including the microbiomes of individuals, via genome editing technologies, delivery technologies (e.g. developed for drugs and vaccines), and cyber techniques. Possible consequences include chronic, insidious modification of the genomes of a targeted population for delayed or triggered effects. Detection and mitigation will be challenging. A key issue for the threat posed by genome editing technologies is the ability to deliver the genome editing mechanism to a large number of target hosts. Thus, the development of much more efficient, cheap and miniaturized delivery technologies will greatly enhance this threat. Additional enabling components might include the targeting of the host microbiome via engineering and modification of indigenous organisms, and the use of cyber techniques for 'harvesting' host genomes/microbiomes, identifying genomic vulnerabilities, and corrupting the databases on which we might rely for addressing the threat.

9:00 – 9:05 **Introductory Remarks**

9:05 – 9:40 **Molecular Recording Devices From Within Living Systems**
Seth Shipman, Gladstone Institutes of Data Science and Biotechnology; Assistant Professor of Bioengineering & Therapeutic Sciences, UC San Francisco

9:40 – 9:55 **Q&A for this presentation**

9:55 – 10:30 **Engineering Viral Vectors and Other Delivery Technologies for Biological Agents**
Viviana Gradinaru, Professor of Neuroscience and Biological Engineering, Caltech (Video Teleconferencing)

10:30 – 10:45 **Q&A for this presentation**

10:45 – 11:00 **Break**

11:00 – 11:35 **Applications of Machine Learning in Genomics and Computational Health**
James Zou, Assistant Professor of Biomedical Data Science and of Computer Science and of Electrical Engineering, Stanford University

11:35 – 12:00 **Q&A for This Presentation and General Discussion**

12:00 – 1:00 **Working Lunch**

1:00 – 4:00 Open Session #4 – Quantum and Fusion Technologies (Facilitator: Dr. Jeremy Munday, Workshop Planning Committee Member)

Fusion is likely a few decades away; however, what if a new technology/advancement made it possible today? Which technologies might aid that (machine learning, AI, new physics, quantum computing)? What would the global socio-economic implications be if it could be done economically? What happens when Quantum Supremacy is achieved? What if a foreign entity suddenly has a useful quantum computer? What are other quantum technologies that might suddenly appear? This session will explore the convergence of quantum & computing, as well as deeper links. Advances in computing associated with quantum is super computers that imply capability will further advance that capability because of the complexity of achieving viable fusion. Exoscale may be the next iteration of super computers to help advance this form of energy.

1:00 – 01:05 **Introductory Remarks**

1:05 – 1:50 **Quantum Technologies**
Robert Wisnieff, CTO Quantum Computing, IBM

1:50 – 2:35 **Fusion**
Robert Goldston, Professor of astrophysics at Princeton University and a former director of the Princeton Plasma Physics Laboratory

2:35 – 2:45 **Break**

2:45 – 3:05 **Quantum Computing**
Michele Mosca, University Research Chair, University of Waterloo
(Video Teleconferencing)

3:05 – 4:00 **Closing Discussion**

4:00 **Adjourn**

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