2019 MIT Japan Conference

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	Agenda
8:40	Registration
9:20	**Opening Remarks** **Gregory K. Ornatowski**, *Senior Director, Corporate Relations* **Karl Koster**, *Executive Director, MIT Corporate Relations Industrial Liaison Program*
9:30	**The Promise, Limits and Future of Intelligent Autonomy in the Air and on the Ground** **Nicholas Roy,** *Bisplinghoff Professor of Aeronautics & Astronautics* Artificial intelligence and machine learning are disrupting industries across the globe, from self-driving cars to smart home assistants to automated call centers. There are many potential benefits including improved safety and productivity and reduced environmental footprint, however, there are technological limits, and not every sector of the economy is reaping the same level of benefits. State of the art AI and robotics will be discussed, along with how these technologies are impacting a range of business sectors, such as transportation, telecommunications, construction, and media. Emerging technologies in both academic and industrial research and development labs will be highlighted, alongside a summary of current hard problems and how these technologies are likely to evolve over time.
10:10	**From Data to Information to Action: Reasoning, Uncertainty and Resource Limitations** **John Fisher,** *Principal Research Scientist MIT Computer Science and Artificial Intelligence Laboratory* How many conscious decisions does an adult make in a single day? Estimates vary widely, ranging from the low hundreds to an astounding 35,000. While not all decisions bear equal importance -- "Should I study engineering or physics?" versus "Should I wear a blue shirt or a green shirt?" -- there is a cost to the decision-making process itself. Uncertainty in the outcome may be difficult to quantify. Information sources may be numerous and complex. Time is often a critical limitation. As such, individuals expend resources -- reasoning, information gathering, physical energy -- in order to make decisions. Analogously, in many distributed sensing problems, resource limitations (e.g. time, energy, computation, etc.) constrain the process of data integration and decision-making. In this talk, I will highlight some of the appealing properties of structured probabilistic models as a representation beyond their primary (and well known) use as a framework for inference. For example, Value of information (VoI) analysis, informed by the structure of the model, facilitates analysis of the trade-off between exploiting the informational utility of a distributed set of information sources and the resources necessary to acquire them, fuse them into a model of uncertainty, and ultimately reason over the representation for decision making. A critical aspect of this process is understanding the relations between information, uncertainty and risk. In the course of this talk, I will present a variety of real-world applications of these methods highlighting both their advantages as well as pointing to new challenges.
10:50	Break
11:05	**Towards Accelerated Medical Innovation** **Jeffrey M. Karp,** *Professor of Medicine, Brigham and Women's Hospital, Harvard Medical School; Affiliate faculty, Broad Institute and at the Harvard-MIT Division of Health Sciences and Technology* For companies and academics aiming to innovate in the medical space, we often don't spend

enough time thinking about the problem we are trying to solve. This goes far beyond reading the academic literature. We need to think critically and constantly pressure test our assumptions to really understand problems and turn them into opportunities for solutions. This often involves connecting biology and materials science to practical considerations for technology implementation by the clinician, as well as all the other factors, such as market pull, regulatory, reimbursement, manufacturing, and patents for example. It's about committing to a journey that can lead to critical insights that direct us towards the most tractable solutions. And for that, we need a different set of tools to help challenge our thinking and constantly bring in fresh ideas and perspectives

One approach we have implemented to constantly bring in new ideas, is to turn to nature for inspiration. Millions and millions of years of research and development at our fingertips, and all we need to do is look outside to the amazing creatures that inhabit our planet. We like to harness lessons from nature for inspiration, from creatures such as geckos, spiders, jellyfish, porcupine quills, snails, and spiny-headed worms.

Another approach is radical simplicity — reducing a problem to its essence. This tool has been harnessed to develop a new skin care approach that is advancing towards global market adoption, therapeutic strategies to combat inflammatory bowel disease and arthritis that are advancing towards clinical studies, and a drug combination to functionally restore hearing in patients with chronic hearing loss that is currently being tested in a Phase I/II trial. Some of the technologies are rapidly advancing to the clinic and some are already on the market helping patients. We must constantly pave new paths to continual innovation that is essential in our fast-changing world.

MIT Startup Exchange Introductions
Marcus Dahllöf, *Program Director, MIT Startup Exchange*

11:45

- Privo – nano cancer treatment
- Affectiva - emotion AI
- Figur8 – medical device, movement intelligence
- Liquid Piston – new combustion engine
- ClimaCell – microweather data AI/ML
- Interpretable AI – predictive AI for life sciences/other
- Cambridge Crops – advanced materials for perishables/food
- Catalog – new DNA storage tech
- Silverthread – software code health, quality assessment

12:30	Lunch with Startup Exchange Exhibits

Electronic, Optical, and Magnetic Tools to Study the Nervous System

Polina Anikeeva, *Class of 1942 Associate Professor in Materials Science and Engineering*

2:00

To understand the mechanisms underlying the function and dynamics of the nervous system, it is essential to develop tools capable of recording and modulating a diversity of signals employed by neurons and glia. In addition to addressing the signaling complexity of the nervous system, these tools must match the mechanical and chemical properties of the neural tissue to avoid foreign body response and functional perturbation to local circuits. Our group relies on materials design to address these challenges. By leveraging fiber-drawing methods inspired by telecommunications and textile industries, we create flexible and stretchable multi-functional probes suitable for recording and stimulation of neural activity as well as delivery of drugs and genetic information into the brain and spinal cord. We use these tools to probe brain circuits involved in control of motor functions, anxiety, and fear and to promote recovery following spinal cord and peripheral nerve injury. In addition to polymer-based fibers, we develop a broad range of magnetic nanotransducers that can deliver thermal, chemical, and mechanical stimuli to neurons when exposed to externally applied magnetic fields. Magnetic nanoparticles can undergo hysteresis and dissipate heat in alternating magnetic fields. This local temperature increase can be used to directly stimulate activity of heat-sensitive neurons or to trigger release of pharmacological compounds and designer drugs from thermally responsive carriers. Similarly, magnetic nanomaterials with large magnetic moments can be employed to deliver torques when exposed to slow-varying magnetic fields. Since biological tissues exhibit negligible magnetic permeability and low conductivity, magnetic fields can penetrate deep into the body with no attenuation allowing us to apply the nanomagnetic transducers to remotely control deep brain circuits associated with reward and motivation as well as adrenal circuits involved in regulation of corticosterone and (nor)epinephrine release.

Drivers of technological change in energy systems

Jessika Trancik, *Atlantic Richfield Career Development Assistant Professor in Energy Studies*

2:40

Renewable energy installations have grown rapidly in recent decades as their costs have fallen. Will these trends continue and extend to other low-carbon energy industries, allowing these technologies to contribute measurably to climate change mitigation? Answering this question requires understanding the determinants of technological change. This research uncovers key drivers, from technology features to the formulation of policy. Several practical lessons emerge that can inform efforts by engineers and policy-makers in new areas such as energy storage, clean vehicles, and artificial intelligence.

3:20	Break

Inverse materials design through artificial intelligence and physics-based simulations

Rafael Gomez-Bombarelli, *Toyota Assistant Professor in Materials Processing*

3:45

Machine learning tools, combined with theoretical simulations can effectively accelerate design of novel materials. Data-driven approaches can access the information embedded in years of experiments, perform rapid optimization of high-dimensional experimental conditions and design parameters, increase the accuracy and speed of physics-based simulations, or design new molecules and crystals automatically. By combining cutting-edge machine learning models on experimental data with automated theoretical simulations (molecular dynamics, electronic structure) the Gomez-Bombarelli addresses the design and optimization of novel materials in multiple areas such as small molecules (organic electrolytes for flow batteries), soft materials (lithium-conducting polymers, organic light-emitting diodes) and crystalline frameworks (zeolite catalysts). Here, we will describe recent results and ongoing work in using machine learning as the connector between multiple scales of simulation and experiment and automation of computer simulations.

4:25	**The Next IT: Innovation Transformation & the Technologies of Virtuous Cycles?** **Michael Schrage,** *Research Fellow, MIT Center for Digital Business* Data-driven digital innovation continues to redefine how organizations create and manage value inside the enterprise and out. ‘Network effects’ are now as important as networks for business success. Training algorithms has become as important as training people. The global economics of innovation have profoundly changed, so innovators and fast-followers alike increasingly look to platform architectures, business models, and investments to take advantage of this growing wealth of digital opportunities. This talk explores, explains, and argues that the key to digital transformation is investing the human capital, creativity, competences, and capital of one’s customers and clients. This insight is poorly understood yet key to the global success of companies ranging from Alibaba to Amazon to Tencent to Google to Netflix. Drawing from MIT Sloan School Initiative on the Digital Economy research, this talk presents an actionable framework for translating this concept into action.
5:05	**Closing Remarks** **Gregory K. Ornatowski**
5:10	Reception and Networking

* All schedule and speakers are subject to change without notice. (12.21.18)