附件 2

第六届中美工程前沿研讨会（CAFOE）各子议题内容摘要

Session 1: Smart Cities

Session Abstract

The world's urban population is expected to grow by 2.5 billion people through 2050 (United Nations, 2018), with much of the growth concentrated in urban areas. This context creates heightened urgency to develop, restore, and enhance urban infrastructure systems such as buildings, energy, transportation, and water. Due to the high cost of infrastructure investments, new technology-focused smart cities approaches are being explored to improve the efficiency, sustainability, and resilience of urban infrastructure systems needed to support this expanding and urbanizing population.

The integration of sensing, communication, and computing capabilities at all scales in the infrastructure allows for improved understanding and eventually the possibility of real-time and continuous improvement of urban infrastructure systems. However, deploying new smart cities approaches are challenging for a number of reasons including:

- Urban systems are large, costly, complex, and interdependent;
- The potential for new cyber-vulnerabilities created by the internet of infrastructure;
- Human infrastructure interaction is only beginning to be understood;
- The comparatively long design life of physical infrastructure systems is currently incompatible with cyber timescales.

This session will explore these and other issues in the context of China and the US, highlighting commonalities and differences between each country's respective approaches. The US population today is already primarily urbanized, with 82% of the population living in urban areas, and is dependent on infrastructure often in serious need of restoration. In contrast, China represents one of the most acute urban growth regions on the planet, giving rise to larger and more megacities that will need to support 255 million new urban dwellers by 2050. The approaches taken by both countries towards the development of smart cities technologies are often distinct, with top down approaches needed in China to achieve scale quickly, while organic approaches are more common in the US. In this session, we are looking forward to have both academic and industry speakers who will focus on different aspects and give more inspiring ideas to motivate the discussion.

Session 2: New Materials

Session Abstract

Materials are the building blocks for societal advances, from computing miniaturization to smart, energy-efficient homes. Underlying these technological advancements is the development of new materials, inspired by natural systems, motivated by synthetic and manufacturing innovations, and driven by sustainability concerns. One example is the illumination strategy of the beetle, which has inspired the design of light scattering pigments from sustainable materials. Another avenue of new materials development is the development of inorganic-organic hybrids and multifunctional systems that enable sensing, signaling, and processing in interconnected environments.

Session 3: Neuroengineering

Session Abstract

Neuroengineering is an inter-disciplinary, high-impact research area that spans multiscale neuroscience (from neurons to behaviors) and engineering (from electrodes to integrated artificial systems) in order to address scientific questions relating to the complexity and function of the nervous system, as well as clinical challenges in diagnosis, treatment, and rehabilitation for individuals with neurological or psychiatric disorders or other sensory or motor deficits.

Current frontiers in neuroengineering have transformed neural interfacing technology for recording and stimulating neurons, enhancing computational capacity in neural decoding and encoding, and translating neurotechnology to clinical applications. For example, advances in new materials and electronics enable the fabrication of a ultra-large channel-count microelectrode arrays to record large-volume, high-fidelity neural signals simultaneously. Excitation of neurons in the brain can be achieved beyond electrical stimulation nowadays; other afferent modalities for neural modulation, such as optogenetic stimulation and ultrasound stimulation, have become feasible. Neuroscientists and engineers harness big data, machine learning, and cloud computing into neural signal analysis and decoding to gain deeper understanding of neural networks and their functions. The clinical translational efforts are built upon the improvement of reliability and safety of novel neural technologies that can potentially benefit millions of individuals with brain disorders or functional deficits.

Given the breadth of the field, this session focuses on system-level research in neuroengineering that aims to restore human motor or sensory function. The goal of the session is (1) to present the state-of-the-art research in brain-machine interfaces for mobility restoration, communication and neurostimulation for sensory rehabilitation or augmentation, (2) to discuss the knowledge gaps and challenges in neuroscience, engineering, and clinical translation, and (3) to foster new collaborative ideas among the audience.

Session 4: 5G Wireless Communications Technology

Session Abstract

In both the United States and China, 2019 marks the year for the commercial rollouts of 5G wireless communication systems based on the global 3GPP 5G New Radio (5G-NR) standard. To support the expanded connectivity needs for the next decade and beyond, 5G will take on a more expansive role than previous cellular generations. 5G networks are being designed to not only deliver enhanced mobile broadband (eMBB) experiences with wider bandwidths and higher data rates, but also expand to support new ultra-reliable low latency communications (URLLC) services as well as consumer and industrial IOT applications.

In addition to the breadth of applications being addressed, another key differences of 5G compared to 3G and 4G networks is the range of frequency bands being targeted from *low bands* (sub-1GHz), to *mid bands* (1-7 GHz), to millimeter wave (mmW) *high bands* (> 24Ghz), across licensed, shared, and unlicensed approaches. Furthermore, 5G networks are being designed to leverage a broad span of topologies and technologies such as cloud radio access networks (C-RAN), virtualized radio-access networks (VRAN), massive MIMO antenna arrays, mmW integrated access and backhaul, and lower latency mobile-edge computing (MEC) and communications.

This expansive range of 5G wireless communications technology and applications has resulted in very active research and development across the academic and industrial research communities. In this session we are pleased to have a mixture of academic and industry speakers who will not only each highlight the state of the art in key 5G technology area, but also give a broader perspective on future research challenges and how they are being addressed.