Talk info _ Mobile & Wireless in EE

Nov 2nd (Thur)

13:00 ~ 13:50

Prof. Andreas F. Molisch
USC

Sub-Terahertz propagation channels: measurement, modeling, and impact on system design

14:00 ~ 14:50

Prof. Rui Zhang
NUS

Intelligent Reflecting Surface (IRS) Empowered Wireless Networks: Recent Advance and Future Trend

15:00 ~ 15:50

Prof. Yonina Eldar
Welzmann Institute of Science

Model-Based Deep Learning: Applications to Imaging and Communications

Title

Sub-Terahertz propagation channels: measurement, modeling, and impact on system design

Abstract

The need for ever-higher data rates of wireless communication system motivates the exploration of new frequency ranges in which large contiguous, and currently fallow, bands are available. For this reason, the sub-THz regime, in particular 100-500 GHz, is anticipated to be an important part of Beyond 5G (B5G) / 6G systems. The high carrier frequency changes the physical propagation processes that dominantly impact the channel, and thus require new channel measurements and models. This talk will discuss a series of extensive channel measurement campaigns we have performed in both outdoor environments, as well as channel models derived from them. We will see that - contrary to widespread opinion - the number of multipath components can be very significant. We will then analyze the impact of this finding on system design, and show that while systems that combine (i) operation in line-of-sight channels and (ii) low modulation order (e.g., BPSK) can operate without complex equalizers, such simplified system architectures may not be feasible for other operational situations. We will also analyze different types of beamforming and the impact on interference levels in multi-user scenarios. An outlook of future needs for measurement and system analysis will wrap up this talk.

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Intelligent Reflecting Surface (IRS) Empowered Wireless Networks: Recent Advance and Future Trend

Abstract

Intelligent Reflecting Surface (IRS) is a digitally controlled metasurface that can be densely deployed in wireless networks to reconfigure the propagation channels among wireless nodes by dynamically tuning the signal reflection. IRS is able to not only significantly improve the network spectral and energy efficiency for communications, but also greatly enhance the performance for other emerging applications such as wireless power transfer, sensing and localization, etc. The existing research on IRS has mainly considered wireless systems with single-IRS-reflections at the link level, which does not reveal the full potential of IRS for future wireless networks. In this talk, we will focus on the main design challenges in efficiently integrating IRS to future wireless networks/6G, including IRS reflection optimization, channel acquisition and optimal deployment, with an emphasis on double-/multi-IRS-reflections. Furthermore, we will present emerging new architectures of IRS and their advantages for future applications. We will conclude the talk by discussing research directions worthy of further investigation in the future.

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Abstract

Deep neural networks provide unprecedented performance gains in many real-world problems in signal and image processing. Despite these gains, the future development and practical deployment of deep networks are hindered by their black-box nature, i.e., a lack of interpretability and the need for very large training sets. On the other hand, signal processing and communications have traditionally relied on classical statistical modeling techniques that utilize mathematical formulations representing the underlying physics, prior information and additional domain knowledge. Simple classical models are useful but sensitive to inaccuracies and may lead to poor performance when real systems display complex or dynamic behaviour. Here we introduce various approaches to model-based learning which merge parametric models with optimization tools and classical algorithms leading to efficient, interpretable networks from reasonably sized training sets. We will consider examples of such model-based deep networks to image deblurring, image separation, super resolution in ultrasound and microscopy, efficient communication systems, and finally we will see how model-based methods can also be used for efficient diagnosis of COVID19 using X-ray and ultrasound.

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Talk info _ Mobile & Wireless in EE

Nov 3rd (Fri)

09:00 ~ 09:50

Prof. Fadel Adib
MIT

Decoding Hidden Worlds: Unprecedented Sensing and Connectivity for Climate, Robotics, & Smart Environments

10:00 ~ 10:50

Prof. Shyam Gollakota
University of Washington

Enabling superhuman hearing: Creating the future of hearables and smart speakers

11:00 ~ 11:50

Prof. Falko Dressler
TU Berlin

Virtualized Edge Computing as a Basis for Edge AI

Title

Decoding Hidden Worlds: Unprecedented Sensing and Connectivity for Climate, Robotics, & Smart Environments

Abstract

This talk will cover a new generation of technologies that can sense, connect, and perceive the physical world in unprecedented ways. These technologies can uncover hidden worlds around us, promising transformative impact on areas spanning climate change monitoring, ocean mapping, healthcare, food security, supply chain, and even extraterrestrial exploration.

The talk will cover four core technologies invented by Prof. Adib and his team. The first is an ocean internet-of- things (IoT) that uses battery-free sensors for climate change monitoring, marine life discovery, and seafood production (aquaculture). The second is a new perception technology that enables robots to sense and manipulate hidden objects. The third is a new augmented reality headset with ``X-ray vision", which extends human perception beyond line-of-sight. The fourth is a wireless sensing technology that can "see through walls" and monitor people's vital signs (including their breathing, heart rate, and emotions), enabling smart environments that sense humans requiring any contact with the human body.

The talk will touch on the journey of these technologies from their inception at MIT to international collaborations and startups that are translating them to real-world impact in areas spanning healthcare, climate change, and supply chain.

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Virtualized Edge Computing as a Basis for Edge AI

Title

Creating the future of mobile systems: From melding bits and biology to democratizing healthcare

Abstract

This is an exciting time to be a wireless and mobile systems researcher where we are not only blurring the boundaries between reality and science fiction but also creating technology that can positively impact society. In this talk, I will first show how we can create futuristic technology where bits and biology meld by designing the Internet of biological and bio-inspired things. Specifically, inspired by dandelion seeds and origami structures, I will present battery-free wireless sensors and shape-changing microfliers that can be dispersed in the wind to create a large-scale sensor network. I will also show how to integrate embedded systems with living organisms (e.g., bees) and have real-world impact by helping find the nests of invasive "murder" hornets. I will then shift gears and make a case for how our community has an incredible opportunity to thoughtfully impact society by creating intelligent mobile systems that democratize healthcare. I will provide examples where we can use smartphones and smart speakers to detect sleep apnea, opioid overdoses, irregular heart rhythms and cardiac arrests by running software on devices that already exist in millions of homes. Finally, I will demonstrate how mobile technology has the potential to bring healthcare to millions of people in middle and low-income countries by creating screening tools for ear infections, new-born hearing loss as well as performing blood clot testing at a fraction of the cost.

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Virtualized Edge Computing as a Basis for Edge AI

Title

Virtualized Edge Computing as a Basis for Edge AI

Abstract

We will discuss the challenges and opportunities of distributed data management solutions ranging from the mobile edge to the data centers. Modern 5G networks promise to provide all means for communication in this domain, particularly when integrating Mobile Edge Computing (MEC). However, it turns out that despite the many advantages, it is unlikely that such services will be provided with sufficient coverage. As a novel concept, virtualized edge computing (V-Edge) have been proposed that bridges this gap. We present a learning-based approach to make such an V-Edge resilient to dynamics, failures, and even malicious attacks. In particular, we contrast centralized and federated learning approaches and reinforcement based approaches.

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Talk info _ Mobile & Wireless in EE

Nov 6th (Mon)

10:00 ~ 10:50

Prof. Chenyang Lu
University Washington at St Louis

Internet of Medical Things: Precision Medicine with AI and Wearables

11:00 ~ 11:50

Prof. Mo Li
HKUST

Towards AIoT

Title

Internet of Medical Things: Precision Medicine with AI and Wearables

Abstract

Artificial intelligence (AI) has emerged as a powerful tool for solving complex medical problems using advanced data-driven techniques. AI for medicine is fueled by both the advancement in AI methods and the availability of clinical data provided by electronic health records (EHR) and wearables. In this talk, we will explore the Internet of Medical Things (IoMT) and its potential to revolutionize precision medicine by leveraging AI in conjunction with wearable devices. Wearable devices enable unobtrusive monitoring of patients in their daily lives, presenting a unique opportunity for personalized medicine. However, to harness the full potential of wearables, it is crucial to develop machine learning (ML) models that can extract reliable clinical information from noisy and incomplete sensor data. Moreover, these ML approaches need to scale effectively across a wide range of sample sizes, providing robust predictions even with limited data, while enhancing predictive power with large datasets. We will highlight three clinical studies that use Fitbit wristbands as wearable instruments. Firstly, we have established a robust feature engineering and ML pipeline specifically tailored for wearable studies with limited sample sizes. This pipeline demonstrated its effectiveness in predicting post-operative complications in a prospective clinical trial of patients undergoing pancreatic surgery. Secondly, we have developed WearNet, an end-to-end deep learning model designed to detect mental disorders using wearable data. WearNet has been trained and validated on a large public dataset comprising 8,996 participants, including 1,247 diagnosed with mental disorders. Lastly, we have explored multi-task ML approaches to predict individualized treatment responses to depression therapy based on wearable data collected from a randomized controlled trial (RCT). By the end of the talk, we will discuss the promising opportunities and directions in the interdisciplinary field of AI and IoT for medicine, showcasing the transformative impact they can have on healthcare outcomes.

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Towards AIoT

Abstract

Internet of Things (IoT) supports massive sensing that deeply penetrates our physical world at scale, which builds great data basis for downstream AI adoption. The integration of AI and IoT (AIoT) shows high potential to transcending state-of-the-art technologies in both AI and IoT. On one hand the unprecedented data scale and prevalence from IoT magnifies the AI power; on the other hand the machine intelligence from AI helps excel every aspect of sensing, computing, and communication in nowadays IoT. This talk will introduce our recent research efforts into devising viable AIoT solutions that seek to address fundamental challenges due to (i) massiveness of devices, where hundreds of billions of networked sensors in the physical world may exhaust limited computing and communication resources, (ii) sensing intrusion to people and their things, where improper IoT instrumentation may impairs the harmonious co-existence of people and the machine intelligence, and (iii) plethora of data, where unprecedented scale and prevalence of the IoT data not only contributes to training powerful AI but also sets obstacles for distilling, verifying, adapting, and transferring the machine learning processes across people and different cyber or physically engineered systems.

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