**Session 1: Living on the Edge: Mobile Systems at the Network's Edge**

Title: Surface MIMO: Using Conductive Surfaces for MIMO Between Small Devices

Author: Justin Chan, Anran Wang, Vikram Iyer, Shyamnath Gollakota.

Chan, J., Wang, A., Iyer, V., & Gollakota, S. (2018). Surface MIMO. *Proceedings of the 24th Annual International Conference on Mobile Computing and Networking,* 3-18.

In the article “Surface MIMO: Using Conductive Surfaces for MIMO Between Small Devices”, the author introduces the new technique which uses to enhance the multi-input and multi-output communication between the small devices. The author claims that placing the conductive surfaces under two small devices as a second portal for MIMO communication, since most of small devices have limited antennas. The author demonstrates the feasibility of using conductive surface for MIMO communication by testing the performance of propagation over the surfaces produced by various materials. Consequently, conductive surface can enhance MIMO capabilities on small devices since its breakthroughs the traditional MIMO technology with antennas.

Title: FoggyCache: Cross-Device Approximate Computation Reuse

Author: Peizhen Guo, Bo Hu, Rui Li, Wenjun Hu.

Guo, P., Hu, B., Li, R., & Hu, W. (2018). FoggyCache. Proceedings of the 24th Annual International Conference on Mobile Computing and Networking, 19-34.

In the article “FoggyCache: Cross-Device Approximate Computation Reuse”, the author discusses the problem of computational expense and energy-hungry for implementing speech recognition on local device or backend server. Unlike the traditional solution for this issue, author claim a solution with reduce redundant computation during processing. Since the applications have the high chance used in multiple devices even in similar context, it is feasible to reduce computational time through capture and reuse the result from previous processing; thus, achieving low latency and accurate result by avoiding unnecessary computation either locally or remotely.

Title: SkyCore: Moving Core to the Edge for Untethered and Reliable UAV-based LTE Networks

Author: Mehrdad Moradi, Karthikeyan Sundaresan, Eugene Chai, Sampath Rangarajan, Z. Morley Mao.

Moradi, M., Sundaresan, K., Chai, E., Rangarajan, S., & Mao, Z. (2018). SkyCore. *Proceedings of the 24th Annual International Conference on Mobile Computing and Networking,* 35-49.

In the article “SkyCore: Moving Core to the Edge for Untethered and Reliable UAV-based LTE Networks”, the author discusses the performance of the current popular UAV-based LTE network and emphasize the advantages of SkyCore by expressing how this new design breakthrough the limitation of traditional UAV-based network. Compare to the UAV designed by AT&T and Verizon, SkyCore can support a multi-UAV LTE network deployment, and this is impossible recently.

Title: SWAN: Stitched Wi-Fi Antennas

Author: Yaxiong Xie, Yanbo Zhang, Jansen Christian Liando, Mo Li.

Xie, Y., Zhang, Y., Liando, J., & Li, M. (2018). SWAN. Proceedings of the 24th Annual International Conference on Mobile Computing and Networking, 51-66.

In the article “SWAN: Stitched Wi-Fi Antennas”, the author introduces his new design named SWAN, which is a stitched wi-fi antennas. For the most commodity wi-fi network interface card (NIC), increasing the number of antennas will result high cost because the design complexity influenced by the number of antennas. Consequently, the high-speed baseband processor comes with high hardware cost for many antenna NIC. The recent efforts have been made to minimize the hardware cost is building multi path communication such as large-scale MIMO. Unlike the traditional solution, SWAN was designed as a antenna extension to commodity wi-fi with lower cost, and it can easily scaled to support massive number of antennas to one access point.

**Session 2: Blinded by the Light: AR, VR, and Vision**

Title: Battery – Free Eye Tracker on Glasses

Author: Tianxing Li, Xia Zhou

Li, T., & Zhou, X. (2018). Battery-Free Eye Tracker on Glasses. Proceedings of the 10th on Wireless of the Students, by the Students, and for the Students Workshop, 27-29.

In the article “Battery – Free Eye Tracker on Glasses”, the author discusses the usage of continuous eye tracking in multiple fields and the mainly challenge about the performance and cost. In order to support the application such as cognitive process, identifying health issues, and assessing the effectiveness of clinical treatments, the eye tracking must have high tracking rate at the sub-millimeter level. In the addition, it should support long-term usage with the high accuracy. Because of this, high performance always bundles with high energy consumption. Consequently, high-end eye tracker entails an extremely high price because of the tracking camera and require external battery pack to sustain long-term usage. For providing a clue of conflict between cost and performance, the author introduces a low-cost design that satisfying the requirement of tracking rate. This design can operate at the rate above 100 Hz with sub-millimeter accuracy while the energy consumption at the microwatt level. However, the current version only feasible and reach the requirement in the environment where ambient NIR light is relatively weak, and unable to detect micro-saccades.

Title: Conductive Inkjet Printed Passive 2D Trackpad for VR Interaction

Author: Chuhan Gao, Xinyu Zhang, Suman Banerjee.

Gao, C., Zhang, X., & Banerjee, S. (2018). Conductive Inkjet Printed Passive 2D TrackPad for VR Interaction. Proceedings of the 24th Annual International Conference on Mobile Computing and Networking, 83-98.

In the article “Conductive Inkjet Printed Passive 2D Trackpad for VR interaction”, the author introduces the technique of mobile virtual reality. The idea of this technique is that making smartphones a self-contained virtual reality device by slotting it into a variety of headset; thus, offering mobile VR experience to users anywhere and anytime. However, this design faces a problem with poor interaction capability – there is no touch interface since the smartphone screen is chambered in the headset, which limits user interacts with the virtual world. Considering using the external controller, it is not feasible because it is costly – there is no cheap way to satisfy multi-fingers interaction. Because of that, author designs Inkput pad, which is a lightweight and passive paper-based interface served multi-finger touch sensing. This design supports the precision with millimeter-level, and it is easy to construct – it can be produced by the home printer with photo paper and carbon ink.

Title: Flare: Practical Viewport-Adaptive 360-Degree Video Streaming for Mobile Devices

Author: Feng Qian, Bo Han, Qingyang Xiao, Vijay Gopalakrishnan

Qian, F., Han, B., Xiao, Q., & Gopalakrishnan, V. (2018). Flare. Proceedings of the 24th Annual International Conference on Mobile Computing and Networking, 99-114.

In the article “Practical Viewport-Adaptive 360-Degree Video Streaming for Mobile Devices”, the author discusses the challenge with 360-degree video. Compared to the conventional videos, it is much larger under the same perceived quality; as a result, bandwidth of wireless networks can be scarce. In the addition, higher CPU, GPU, and energy consumption is needed for streaming 360-degree video. In order to provide a solution to these problems, author designed a new practical system for streaming named Flare, which significantly reduces the bandwidth usage, or boost the video quality with the same bandwidth compared to the conventional design. Instead of downloading the entire panoramic scene, Flare predicts the user’s future viewports and fetches only the portion that cover what the viewer is about to consume.

Article: DeepCache: Principled Cache for Mobile Deep Vision

Author: Mengwei Xu, Mengze Zhu, Yunxin Liu

Xu, M., Zhu, M., Liu, Y., Lin, F., & Liu, X. (2018). DeepCache. Proceedings of the 24th Annual International Conference on Mobile Computing and Networking, 129-144.

In the article “DeepCache: Principled Cache for Mobile Deep Vision”, the author discusses the Convolutional Neural Network (CNN) which is a state-of-the-art algorithm used in the field of continuous mobile vision. This model will capture each frame of video streaming as inputs, produce intermediate result of each input through deep learning engine and store them as feature maps, and eventually outputs inference results. Such CNN execution stresses the mobile device with limited resource because of its high time and space complexity. To avoid this problem, caching and result reusing are considered as a potential solution since there is a rich information redundancy among consecutive video frames. However, there are two major challenges need to figure before implementing – one is classic way of caching doesn’t apply to CNN cache and the other one is it is expensive to inspect feature maps and access their similarity because of the volume and dimension complexity. Consequently, most optimized deep leaning engines suffer from low coachability and high overhead. Unlike these engines, DeepCache successfully conquer the challenges by storing recent input frames as cache keys and storing recent feature maps for individual layers as cache values. Under this structure, it only needs to execute region matcher once for each video frame at the input, then load cached feature maps at all layers inside CNN. According to this, DeepCache reduces the inference time by 18% on average and up to 47%.

**Session 3: Slice, Schedule, Repeat: 5G Cellular Networks**

Title: Resolving Policy Conflicts in Multi-Carriers Cellular Access

Author: Zengwen Yuan, Qianru Li, Yuanjie Li, Songwu Lu, Chunyi Peng, George Varghese

Yuan, Z., Li, Q., Li, Y., Lu, S., Peng, C., & Varghese, G. (2018). Resolving Policy Conflicts in Multi-Carrier Cellular Access. Proceedings of the 24th Annual International Conference on Mobile Computing and Networking, 147-162.

In the article “Resolving Policy Conflicts in Multi-Carriers Cellular Access”, the author introduces the technique of multi-carrier cellular and its performance. This technique is used to improve the cellular service quality of a mobile device, by selecting carrier with best performance from multiple carriers networks according to the location. For the scheme of inter-carriers switching, the design of policy-based switching has been widely used because it doesn’t need for runtime access to fine-grained cell-level information and reuse of legacy standards for cell-level handoffs. However, the policy-based switching can rise the policy conflicts between inter-carrier selection and internal cell-level handoffs within each carrier. To solving this problem, the challenge is that it is hard to coordinate between inter-carrier and intra-carrier policies because of their autonomy and privacy. In ordering to breakthrough the challenge, the author categorized the inter-carrier policies to three, and derive analogous conditions to allow policy flexibility without conflicts when the conflicts arise between carriers.

Title: ECHO: A Reliable Distributed Cellular Core Network for Hyper-scale Public Clouds

Author: Binh Nguyen, Tian Zhang, Bozidar Radunovic, Ryan Sthtsman, Thomas Karagiannis, Jakub Kocur, Jacobus Van der Merwe

Nguyen, B., Zhang, T., Radunovic, B., Stutsman, R., Karagiannis, T., Kocur, J., & Van der Merwe, J. (2018). ECHO. Proceedings of the 24th Annual International Conference on Mobile Computing and Networking, 163-178.

In the article “ECHO: A reliable Distributed Cellular Core Network for hyper-scale Public Clouds”, the author discusses the challenge of the public clouds. Currently, more and more companies move their services to public cloud to avoid extremely high cost on upgrading and maintaining their private services. However, in order to achieve the same performance as on the private service, the reliability faces the challenge – the typical public cloud availability is 99.99% or less, but the cellular core network today often requires up to 99.999%. In the addition, the typical fault detection in a public cloud is of order of 10 second, and it is too slow for the cellular core which needs to be 1 second. Consequently, the fail-over techniques from private service are not feasible to the public one. To solve these challenges, the author proposes ECHO, a distributed EPC architecture for the public cloud that achieves availability superior to conventional EPC, by continuing safe operation even in the presence of software, host, network, or data center failures.

Title: Experience: Implications of Roaming in Europe

Author: Anna Maria Mandalari, Andra Lutu, Ana Custura, Ali Safari Khatouni. Etc.

In the article “Experience: Implications of Roaming in Europe”, the author introduces the single digital market across the European Union, which is named Roam like Home. It allows users use voice and data services while roaming in EU if they accept additional charges. The author did a experience that placing six device in different countries in EU, and eventually found that this cross aboard service result with latency penalties of 60ms or more depend on geographical distance.

Title: GPF: A GPU-based Design to Achieve ~100us Scheduling for 5G NR

Authors: Yan Huang, Shaoran Li, Y. Thomas Hou, Wenjing Lou

In the article “GPF: A GPU-based Design to Achieve ~100us Scheduling for 5G NR”, the author introduces the 5G New Radio, which is designed to operate under a board range of frequency bands and support new applications with ultra-low latency. In order to support its diverse operating conditions, it is required to perform scheduling with a time resolution of ~100us. However, current LTE schedulers can’t fulfill this requirement. To solving this problem, author proposes the new design named GPF, which is a GPU-based scheduler that can meet the requirement. The architecture of this design is scheduling the problem into a large number of small and independent sub-problems those spaces can fit into a GPU.

**Session 4: What's the Frequency, Kenneth? Millimeter-Wave Networks**

Article: Multi-Stream Beam-Training for mmWave MIMO Networks

Author: Yasaman Ghasempour, Muhammad K. Haider, Carlos Cordeiro

In the article “Multi-Stream Beam-Training for mmWave MIMO Networks”, the author discusses the technique of multi-stream communication. It has the potential to achieve data rate up to 100 Gbps via multiple data stream, but this results in extremely high overhead procedure. To solve this problem, the author presents a novel system named MUTE, which has zero overhead for path discovery.

Article: Adaptive Codebook Optimization for Beam Training on Off-the-shelf IEEE 802.11ad Device

Author: Joan Palacios, Daniel Steinmetzer, Adrian Loch, Matthias Hollick, Joerg Widmer

In the article, the author discusses the challenge of designing wireless communication system that operate at very high frequencies (mmWave). The current design on Off-the-shelf IEEE 802.11ad device is straightforward and need lots of optimization. First, none of the available beam patterns in the codebook may steer exactly towards the receiver. Second, strong reflectors in the environment may remain unused even though they could contribute to the received signal strength. Third, existing reflections may result in destructive interference at the receiver, causing significant harm to the communication. To solve this problem, the author proposes a mechanism to extract full channel state information (CSI) regarding phase and magnitude from coarse signal strength readings on the device.

Article: Towards Scalable and Ubiquitous Millimeter-Wave Wireless Networks

Author: Sanjib Sur, Loannis Pefkianakis, Xinyu Zhang, Kyu-Han Kim

In the article, the author discusses the performance of mmWave technology on the mobile device. Currently, the mmWave technologies is unsuitable for ubiquitous coverage. Thus, the author designs and implements UbiG – a mmWave wireless access network – that can deliver ubiquitous gigabits per second wireless access consistently to commercial device.

Article: LiSteer: mmWave Beam Acquisition and Steering by tracking Indicator LEDs on Wireless Aps

In the article, the author discusses the problem of the high training overhead while we implement mmWave on the devices. To solve this problem, author presents LiSteer which is a novel system that steers mmWave beams at mobile devices by repurposing indicator LEDs on wireless Access Points to passively accuire direction estimates using off-the-shelf light sensor. This system maintains beam alignment at the narrowest beamwidth level even in case of device mobility, without incurring any training overhead at mobile devices.

**Session 5: Take Me Back to School: Learning and Sensing**

Article: Towards Environment Independent Device Free Human Activity Recognition

In the article, the author discusses the challenge of free human activity recognition techniques. To utilize the information collected by various wireless infrastructures to infer human activities, the information obtained always consist of human action and environment feature. This fact causes that we can not use only one recognition model in multiple environments since they have different features. To solve this problem, the author presents a machine learning model which able to extract the feature of human activity from the data. Thus, it is feasible to train the model can read the human action in different environments.

Article: CrossSense: Towards Cross-site and Large-Scale WiFi Sensing

In the article, the author introduces how the Wi-Fi sensing were used in multiple fields and the challenges we are facing. It requires a labor-intensive and time-consuming process of collecting training measurements. In addition, many Wi-Fi sensing solutions currently only can handle small sets of subjects. To solving this problem, the author presents CrossSense, a novel system for scaling up WiFi sensing to new environments and larger problems.