UAV5GB
UAV Communications for 5G and Beyond

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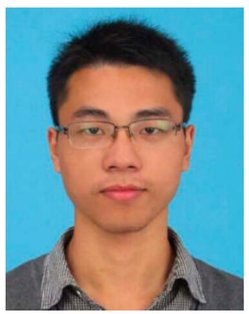
Chairs

Dr. Xuesong Cai

Assistant Prof. Dr. José Rodríguez-Piñeiro

Short CVs of Chairs



Xuesong Cai received the B.S. degree and the Ph.D. degree (Hons.) from Tongji University, Shanghai, China, in 2013 and 2018, respectively. Since May 2018, he has been a postdoctoral fellow with the Department of Electronic Systems, Aalborg University. His research interests include radio propagation channel measurement, high-resolution parameter estimation, channel characterization, channel modeling, over-the-air testing and UAV communications for 5G. He has authored/co-authored more than 40 journal and conference papers.

José Rodríguez-Piñeiro received the B.Sc. Degree (Hons.) and the M.Sc. degree (Hons.) from the University of Vigo (Pontevedra, Spain), in 2009 and 2011, respectively, and the Ph.D. degree (Hons.) in 2016 from the University of A Coruña (Spain). Between 2008 and 2011, he was a researcher at the Department of Signal and Communications, University of Vigo (Pontevedra, Spain) and between 2011 and 2017 he was with the Group of Electronics Technology and Communications (University of A Coruña). Since 2017 he is with the College of Electronics and Information Engineering, Tongji University (P.R. China), becoming an Assistant Professor in 2020. His research interests include experimental evaluation of digital mobile communications, especially for high mobility environments, including terrestrial and aerial vehicular scenarios. He is the author of more than 60 papers and patents, and participated in more than 35 research projects.

Unmanned Aerial Vehicles (UAVs) – A new paradigm for future communications

- Becoming more and more popular due to reduced size and cost
- Promising in various civil applications, such as delivery, sensing, etc.
- Serve as aerial base stations (BSs) to establish fast wireless coverage
- A new type of user equipments (UEs) in commercial cellular networks.
- Perform as relays for energy-efficient sensing/IoT, etc.
- High throughput communications and low latency reliable communication are required

Presentations in this session

- Radio channel characterization
  - Characterizing the Small-Scale Fading for Low Altitude UAV Channels
  - Bounded Path-Loss Model for UAV-to-UAV Communications
- Performance evaluation
  - Communications for Massive UAV Scenarios
  - Affordable Quality of Service Assessment for Cellular-Connected UAV Communications
- Application of localization
  - A High-Accuracy DoA-Based Localization Method: UAV Virtual Multiantenna Array

Radio channel characterization

- **Characterizing the Small-Scale Fading for Low Altitude UAV Channels**

  Low altitude air-to-ground channel was investigated in this work based on emprical measurements, with specific focus on the fast-fading behaviour. It is found that Rician distribution can best fit the distributions of small-scale fading.

- **Bounded Path-Loss Model for UAV-to-UAV Communications**

  This work focus on the system-level modeling and analysis of ultra-dense UAV-to-UAV communications. A bounded path-loss model is introduced to avoid the singularity issue created by conventional power decaying unbounded path-loss model. A mathematically tractable framework of coverage probability and capacity is proposed. The analytical results are verified and in a good agreement with Monte-Carlo simulations.

Performance evaluation

- Communications for Massive UAV Scenarios

  This work considers a realistic communication scenario where thousands of UAVs are autonomously flying in the scope of typical medium-sized cities. Based on simplified yet still realistic data, the author proposes a de-centralized control system for scenarios with massive UAVs. The range for the de-centralized communications, as well as the number of simultaneous users to be considered for each UAV for the communication, is considered and it is suggested that even the current technology could afford such a scenario.

- Affordable Quality of Service Assessment for Cellular-Connected UAV Communications

  In this work, the performance of A2G communications for UAVs is analyzed based on a realistic channel model obtained from measurements. The feasibility of meeting the requirements established by the 3GPP in terms of reliability, latency and throughput of the communications is studied. Finally, the authors prove that the SINR can be used as a condensed metric to account for the feasibility of meeting the 3GPP requirements, severely decreasing the cost of communications performance evaluations.

Application of localization

- A High-Accuracy DoA-Based Localization Method: UAV Virtual Multiantenna Array

  Leveraging the high probability of line-of-sight (LoS) channel between a UAV and a ground transmitter, a UAV equipped with a single antenna is utilized to form a virtual array to estimated the direction of the transmitter on the ground. In this way, the location of the ground transmitter can be estimated. The provided simulation results show the feasibility of the proposals of the authors. Technical challenges such as accurately estimating the relative positions of the UAV and compensating the offset between the local oscillators of the transmitter and receiver must be tackled.

Future challenges

- Measurement-based or simulation-based angular channel models
- Efficient and effective performance evaluation
- Massive UAV communications
- Coexistence of UAVs and Ground UEs – Interference mitigation, resource allocation, power control, trajectory optimization, etc.
- Energy efficient sensing and communications