Friedrich-Alexander-Universität
Department of
Electrical Engineering

EEI-Colloquium

Distributed Phased Arrays: Challenges and Recent Progress

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Live: Lecture Hall H15 (Cauerstr. 7, Ground floor, 91058 Erlangen)

Abstract: There has been significant research devoted to the development of distributed microwave wireless systems in recent years. The progression from large, single-platform wireless systems to collections of smaller, coordinated systems on separate platforms enables significant benefits for radar, remote sensing, communications, and other applications. The ultimate level of coordination between platforms is at the wavelength level, where separate platforms operate as a coherent distributed system. Wireless coherent distributed systems operate in essence as distributed phased arrays, and the signal gains that can be achieved scale proportionally to the number of transmitters squared multiplied by the number of receivers, providing potentially dramatic increases in wireless system capabilities. Distributed array coordination requires accurate control of the relative electrical states of the nodes. Generally, such control entails wireless frequency synchronization, phase calibration, and time alignment, but for remote sensing operations, phase control also requires high-accuracy knowledge of the relative positions of the nodes in the array to support beamforming.
This lecture presents an overview of the challenges involved in distributed phased array coordination, and describes recent progress on microwave technologies that address these challenges. Requirements for achieving distributed phase coherence at microwave frequencies are discussed, including the impact of component non-idealities such as oscillator drift on beamforming performance. Architectures for enabling distributed beamforming are reviewed, along with the relative challenges between transmit and receive beamforming. Microwave and millimeter-wave technologies enabling wireless phase-coherent synchronization are discussed, focusing on technologies for high-accuracy internode ranging, wireless frequency transfer, and high-accuracy time alignment. The lecture concludes with a discussion of open challenges in distributed phased arrays, and where microwave technologies may play a role.

Lecture series by the Department of Electrical Engineering, Electronics and Information Technology