Friedrich-Alexander-Universität
Department of
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EEI-Colloquium

Reconfigurable Surfaces for Wireless Communications: Transmission Schemes with Minimal CSI Requirement

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Abstract: Reconfigurable Intelligent Surfaces (RIS) is envisioned to offer spectral efficiency gains by utilizing a large number of passive reflecting elements that induce phase shifts on the impinging electromagnetic waves to smartly reconfigure the signal propagation environment. This can be particularly relevant bearing in mind the shift towards using higher frequencies including the mmWave and THz bands. Many works in the literature have shown promising gains assuming the availability of perfect channel state information (CSI) at the base station (BS) to optimize its transmission and the RIS reflection. This assumption is highly impractical, and a shift towards less demanding schemes in terms of CSI is needed to improve the feasibility of RIS deployment. In light of this, we study transmission schemes for RIS-assisted systems which have minimal CSI requirement, and demonstrate that gains can be achieved even in this case. In particular, we consider transmission schemes that rely on channel statistics only and use random rotations and opportunistic beamforming to enhance performance while lowering the CSI acquisition requirement. In addition to this, many works in the literature focus on studying RIS-assisted systems in the narrowband. However, an RIS can have a wideband response, and such a response can be beneficial in some scenarios. We show that an RIS with a well-designed wideband response can be effective in scenarios where only user location is known by leveraging an optimization of the phase-frequency response of the RIS. We propose methods for the design of the RIS during its fabrication phase as well as methods for its optimization during the operation phase. As an outlook into future uses of reconfigurable surfaces, we discuss stacked intelligent metasurfaces and their potential use in future wireless networks.

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