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Channel Estimation Using Deep Learning for Reconfigurable Intelligent Surfaces-Assisted Millimeter Wave Systems

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Abstract : Reconfigurable intelligent surfaces (RISs) are expected to be an important part of next-generation wireless communication networks due to their potential to reduce the hardware cost and energy consumption of millimeter Wave (mmWave) massive multiple-input multiple-output (MIMO) technology. However, owing to the lack of signal processing abilities of the RIS, the perfect channel state information (CSI) in RIS-assisted communication systems is difficult to acquire. In this paper, the uplink channel estimation for mmWave systems with a hybrid active/passive RIS architecture is studied. Specifically, a deep learning-based estimation scheme is proposed to estimate the channel between the RIS and the user. In particular, the sparse structure of the mmWave channel is exploited to formulate the channel estimation as a sparse reconstruction problem. To this end, the proposed approach is derived to obtain the distribution of non-zero entries in a sparse channel. After that, the channel is reconstructed by utilizing the least-squares (LS) algorithm and compressed sensing (CS) theory. The simulation results demonstrate that the proposed channel estimation scheme is superior to existing solutions even in low signal-to-noise ratio (SNR) environments.

Keywords : channel estimation, reconfigurable intelligent surface, wireless communication, deep learning
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