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Impact of Hardware Impairments on Large-scale MIMO Systems over Composite RG Fading Channels

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Abstract

In this paper, we analyze the impact of receiver hardware impairments on the achievable sum rate of multiple-input multiple-output (MIMO) systems, where the channel follows composite Rician-Gamma (RG) distribution and may be correlated at the transmitters. More specifically, we derive the analytical expressions on the lower bound for the achievable sum rate of regular and large-scale MIMO systems with zero-forcing (ZF) receivers. In order to obtain deeper insights, the asymptotic analysis for the achievable sum rate of regular MIMO systems at high signal-to-noise ratio (SNR) regime is explored. It explicitly reveals that there is a finite rate ceiling on the achievable sum rate for regular MIMO systems at high SNRs, which is irrespective of the transmit power. Additionally, for large antenna configuration, three representative cases are considered insightfully by deriving in closed-form expressions for the asymptotic achievable sum rate. It demonstrates that the finite rate ceiling vanishes for large-scale MIMO limits, which means that large-scale MIMO systems are robust to hardware impairments.

Keywords: Hardware impairments, large-scale MIMO, Rician-Gamma fading, zero-forcing receivers.