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Beamforming on the MISO interference channel with multi-user decoding capability

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This paper considers the multiple-input-single-output interference channel (MISO-IC) with interference decoding capability (IDC), so that the interference signal can be decoded and subtracted from the received signal. On the MISO-IC with single user decoding, transmit beamforming vectors are classically designed to reach a compromise between mitigating the generated interference (zero forcing of the interference) or maximizing the energy at the desired user. The particularly intriguing problem arising in the multi-antenna IC with IDC is that transmitters may now have the incentive to amplify the interference generated at the non-intended receivers, in the hope that Rxs have a better chance of decoding the interference and removing it. This notion completely changes the previous paradigm of balancing between maximizing the desired energy and reducing the generated interference, thus opening up a new dimension for the beamforming design strategy.
Our contributions proceed by proving that the optimal rank of the transmit precoders, optimal in the sense of Pareto optimality and therefore sum rate optimality, is rank one. Then, we investigate suitable transmit beamforming strategies for different decoding structures and characterize the Pareto boundary. As an application of this characterization, we obtain a candidate set of the maximum sum rate point} which at least contains the set of sum rate optimal beamforming vectors. We derive the Maximum-Ratio-Transmission (MRT) optimality conditions. Inspired by the MRT optimality conditions, we propose a simple algorithm that achieves maximum sum rate in certain scenarios and suboptimal, in other scenarios comparing to the maximum sum rate.

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