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Codewords With Memory Improve Achievable Rate Regions of the Memoryless Gaussian Interference Channel

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Abstract

The two-user Gaussian interference channel (GIC) has been extensively studied in the literature during the last four decades. The full characterization of the capacity region of the GIC is a long-standing open problem, except the case of strong or very strong interference. For general GIC's, many inner bounds have been provided over the years, among of them, the Han-Kobayashi (HK) region, is the most celebrated one. Unfortunately, the calculation of the HK region is prohibitively complex, due to the appearance of some auxiliary random variables, whose optimal choice is an open problem. As in other multi-user communication systems, these achievable regions are based on ensembles of i.i.d. (memoryless) codewords, in the sense that the symbols within each codeword are drawn independently. In this paper, we show that for the GIC, it is worthwhile to employ random coding ensembles of codewords with memory. Specifically, we take known achievable regions for the GIC, and generalize/improve them by allowing dependency between the code symbols. For example, we improve the state-of-the-art HK region by drawing the codewords (of each codeword and for each user) from a first-order autoregressive moving average (ARMA) Gaussian process. In this way, we suggest several new achievable rate regions, which are easily calculable, and which are strictly better than state-of-the-art known achievable regions.

Index Terms

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