TUM

Seminar

Channel Shortening

This topic is offered as part of the Seminar on Digital Communications course.

Satellite channels and long-haul fiber-optic channels are two examples where transmitted signals exhibit excessive inter-symbol interference (ISI).

The mutual information between channel input X and channel output Y describes a reliable communication rate. This rate is achievable when the decoder uses the probabilistic channel description as a decoding metric. However, for excessive ISI the complexity of optimal decoders quickly becomes prohibitive and one must often resort to mismatched decoding by considering a truncated channel impulse response. Clearly, omitting a large number of channel taps impacts system performance.

Linear channel shortening was first considered in the early 70s for maximum-likelihood (ML) sequence detection. A channel shortener "compresses" the channel memory prior to ML detection and the detector can then run with a reduced number of effective channel taps. This significantly reduces computational cost.

Previously, channel shortening filters were derived using the mean squared error (MSE) as a surrogate function. In [1,2] a lower bound on the mutual information was used to optimize channel shorteners for channels with AWGN and Gaussian inputs X.

[1] F. Rusek and A. Prlja, "Optimal Channel Shortening for MIMO and ISI Channels," in IEEE Transactions on Wireless Communications, vol. 11, no. 2, pp. 810-818, February 2012, doi: 10.1109/TWC.2011.121911.110809.

[2] G. Colavolpe, A. Modenini and F. Rusek, "Channel Shortening for Nonlinear Satellite Channels," in IEEE Communications Letters, vol. 16, no. 12, pp. 1929-1932, December 2012, doi: 10.1109/LCOMM.2012.102612.121929.

Prerequisites

- Linear Algebra
- Information Theory

Advisors

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