Associative Professorship of Line Transmission Technology
TUM Department of Electrical and Computer Engineering
Technical University of Munich

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

Daniel Plabst