SPCOMIT Seminar Invitation

Title: Fundamental performance limits for channels with periodic characteristics

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Abstract

Channels with periodic characteristics arise in many communications scenarios. A common scenario in which periodicity is exhibited is interference-limited communications. Since man-made signals typically have periodic characteristics, interference inherently has periodically time-varying statistics, and can be modeled as a cyclostationary process. The periodicity of interference-limited communications is exhibited in wireless communications, e.g. WiFi and 4G cellular networks, in wireline communications, e.g., DSL networks, and in cognitive radio communications. Periodic channels are also common in power line communications, especially in the narrowband frequency range of up to 500 kHz. These channels, which play an important role in the realization of smart power grids and has therefore been drawing considerable interest in recent years, are commonly modeled as linear periodically time-varying (LPTV) systems with additive cyclostationary Gaussian noise (ACGN). While channels with periodic characteristics are common in communications scenarios, fundamental performance limits for this model have not been characterized before. In our work we address two fundamental characterizations: Capacity for secure and non-secure communications. For the non-secure setup, we provide two derivations of the capacity, one in the time-domain and one in the frequency domain. Furthermore, we characterize the capacity achieving transmission scheme, which leads to a practical code construction that approaches capacity. The capacity derived in this work is numerically evaluated and the results show that the optimal scheme achieves a substantial rate gain over a previously proposed ad-hoc OFDM based scheme.

For the secure setup, i.e., in the presence of an eavesdropper, we characterize the secrecy capacity of Gaussian multiple-input multiple-output (MIMO) channels with finite memory, a fundamental model in modern communications, for which the secrecy capacity has not yet been characterized. We show that this result also characterizes the secrecy capacity of LPTV channels with ACGN as a special case. Our result is expressed as a maximization over the input covariance matrices in the frequency domain. For the Gaussian scalar case, we show that the secrecy capacity can be obtained by waterfilling and present a closed-form expression. We conclude that the finite memory of the channel introduces an additional degree of freedom for concealing the information from the eavesdropper.

The seminar will take place on **Wednesday, 4-1-2017, 12:10, in room 102 building 33**.