Institute for Digital Communications

Prof. Dr.-Ing. Robert Schober
University of Erlangen-Nürnberg

Master Thesis

Design of New Channel Codes for Optimal Half-Duplex Relaying

Future generations of communication networks are expected to include some form of cooperative, relay-based communication. Relaying networks offer several benefits over traditional non-cooperative networks such as better connectivity because of their increased coverage area, and an improved quality-of-service because of their higher throughput and/or reliability. Moreover, given the limitations of current radio implementations, concurrent transmission and reception at the nodes is not possible due to self-interference. As a result, for practical cooperative networks, nodes are not allowed to transmit and receive at the same time and in the same frequency band simultaneously, i.e., half-duplex communication is preferred.

In this project, we focus on a simple two-hop relay channel as illustrated in Fig. 1. For this channel, most of the available coding schemes assume that the relay node receives a codeword in one time slot, decodes the received codeword, and re-encodes and re-transmits the decoded information in the following time slot. However, such fixed switching between reception and transmission at the relay has recently been shown to be suboptimal. In fact, the optimal transmission scheme achieving the capacity requires the relay to switch between reception and transmission in a symbol-by-symbol manner[1].

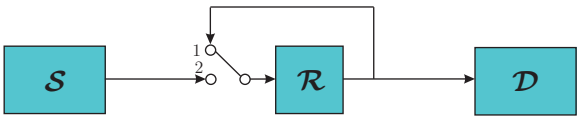

Figure 1: Relay channel consisting of a source, a half-duplex relay, and a destination. If the relay node is transmitting, the switch is in position 1, otherwise, in position 2.

In this thesis, our goal is to design practical codes which, unlike the conventional codes for half-duplex relaying, indeed employ random switching between transmission and reception at the relay nodes. This requires a systematic design of such codes as well as implementation of the proposed codes in order to verify their promised theoretical superiority. If successful, this work may lead to a journal and/or conference paper.

Prerequisites	
Scientific skills	Channel Coding and Information Theory (obtained e.g. in lectures "Channel Coding" and "Information Theory and its Application to Communications Engineering")
Programming skills	Experience in MATLAB and/or C programming
Contact	Nikola Zlatanov, Vahid Jamali (room E 1.14), `{zlatanov,jamali}@LNT.de` Dr.-Ing. Clemens Stierstorfer (room N 5.32a), `clemens@LNT.de`

[1] N. Zlatanov, V. Jamali, and R. Schober, "Capacity of the Two-Hop Half-Duplex Relay Channel," *IEEE Trans. Inf. Theory*, under review.