Institute for Digital Communications

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Master Thesis

Equalization Techniques for Diffusive Molecular Communications

Molecular communication (MC) is a biocompatible approach for enabling communication among so-called nano-machines by exchanging information via molecules. Integrating communication capabilities enhances the potential functionalities of individual nano-machines such that communities of them, so-called nano-networks, can execute collaborative and challenging tasks in a distributed manner. Sophisticated nano-networks are expected to have various biomedical, environmental, and industrial applications.

Establishing reliable diffusion-based MC is challenging due to the impairments in the MC channel. For instance, diffusion is a random process which causes signal-dependent noise. Therefore, by releasing more molecules, the variance of the diffusion noise increases as well. In addition, since the MC channel is dispersive, the MC channel impulse response (CIR) may span several symbol intervals before it fully decays to zero. This induces inter-symbol interference (ISI) which impairs communication. In this project, the main goal is to investigate linear/non-linear equalization techniques to mitigate the ISI in diffusive MC systems while taking the signal-dependence of the diffusion noise into account.

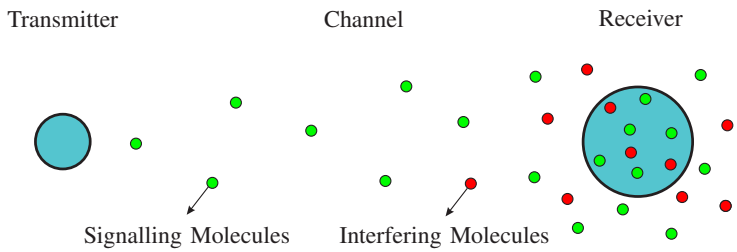

Figure 1: Example of a typical diffusive MC system consisting of a transmitter, a fluid MC channel, and a receiver. The molecules released by the transmitter in a given symbol interval are shown in green color whereas the noise and interference molecules are shown in red color.

Guidelines for the project:

- Review of equalization and detection schemes.
- Design and implementation of linear/non-linear equalization schemes that take into account the impairments of the MC channel.
- Verification of the performance of the designed equalization schemes via simulation.

If successful, this work may lead to a journal and/or conference paper.

Prerequisites	
Scientific skills	Interest in communications and signal processing, basic knowledge of digital communication systems (e.g. gained in the course "Digital Communications"). Prior knowledge in biology and diffusion is **NOT** required.
Programming skills	Experience in MATLAB and/or C++ programming.
Supervisors	Vahid Jamali and Arman Ahmadzadeh `{vahid.jamali, arman.ahmadzadeh}@fau.de`