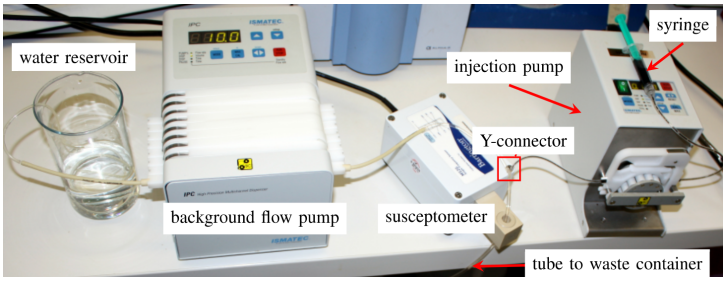
Master's Thesis

Coupling Computational Fluid Dynamics and Network Simulation for Molecular Communication



Molecular communication is a promising alternative to radio frequency communication, which is not possible in many industrial scenarios. Currently, signal particles are injected into a carrier fluid at the transmitter. At the receiver side, the concentration of signal particles is measured and the contained information demodulated. The MaMoKo project aims to explore this field of molecular communication at macroscopic scales for industrial scenarios. For this, simulators capable of predicting the performance of molecular communication systems are needed. Several simulators already exist for systems at the nano scale [1]–[3]. These appear to be largely unsuitable for the project because they lack the capability to consider the complex dynamics of particle transport both in fluids as well as gases at larger scales. Although particle motion based on diffusion, which these simulators are able to capture adequately, is one component of the expected motion, the flow of liquid in piping as well as ventilation-induced flow of air in indoor scenarios is not covered. An efficient and accurate simulator at macroscopic scales is therefore needed.

Goals of the thesis

In this thesis, we want to investigate whether coupling of a Computational Fluid Dynamics (CFD) simulator with a network simulator is feasible. We propose to use the output of the CFD simulation in the form of a vector field, which is then used to trace a large number of individual particles. Therefore, a model utilizing CFD simulations needs to be created. The simulator needs to be resource-efficient in order to be useful in evaluating several transmitters and receivers and a large number of particles. Metrics for comparing the model output and real-world measurements need to be investigated. Finally, the model will be compared to measurement results using these metrics and evaluated. Optionally, the model can be iteratively improved based on this comparison.

Keywords

Molecular communication, computational fluid dynamics, network simulation, modeling

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