Molecular Communication as a Wireless System

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Abstract

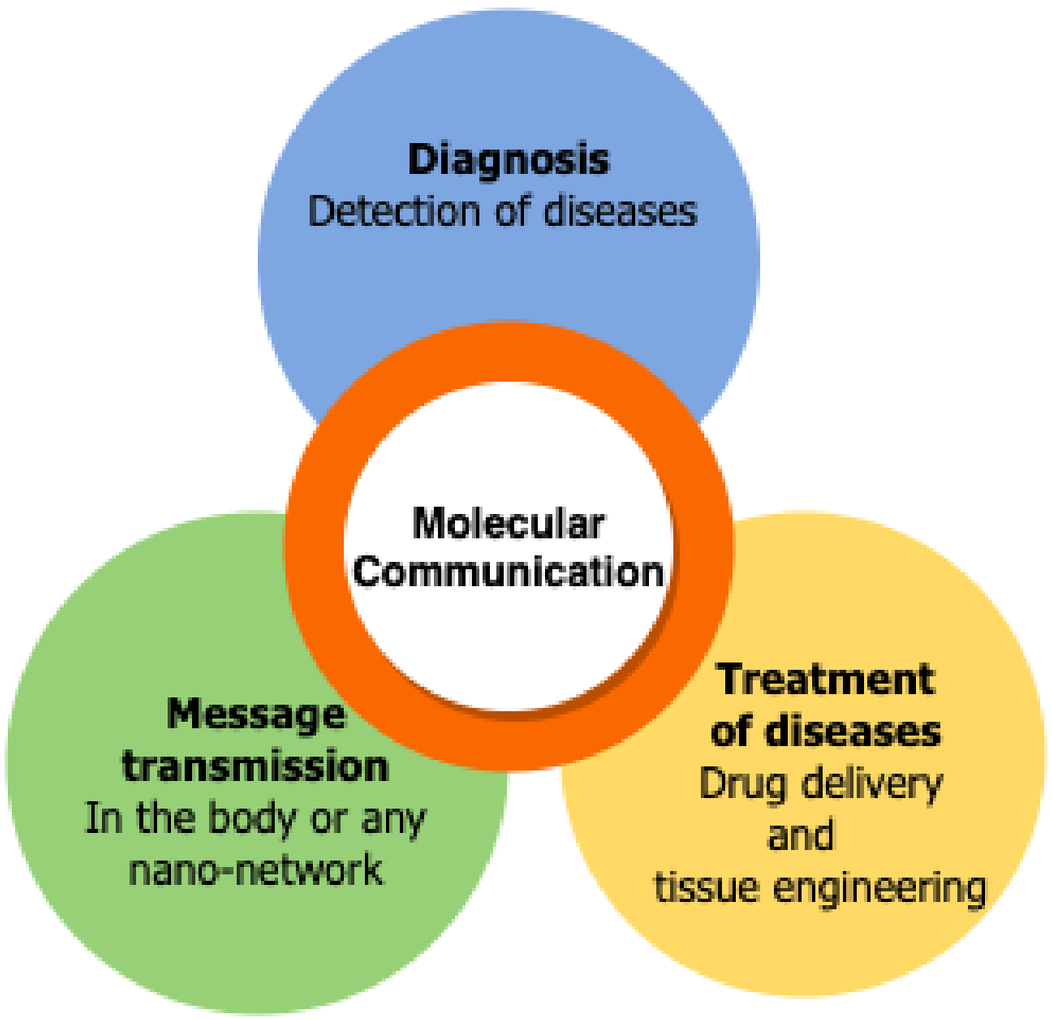
Molecular communication is a new field of communication where molecules are used to transfer information. Being in the domain of wireless communications, it can be studied and artificially simulated for a variety of applications, including in the human body.

MC systems are expected to enable new revolutionary applications such as sensing of target substances in biotechnology, smart drug delivery in medicine, and monitoring of oil pipelines or chemical reactors. One of the primary applications of this system deals with the human body.

Problem Formulation

- Among the existing methods, mass transfer based molecular communication via diffusion (MCvD) is particularly effective.
- One of the main goals in MCvD is to improve the quality of signal received and the intersymbol interference (ISI) is one of the factors that degrades it.
- Our goal was to study different methods to reduce this ISI as well as improve the detection at the receiver.

Applications of MC



MC Model

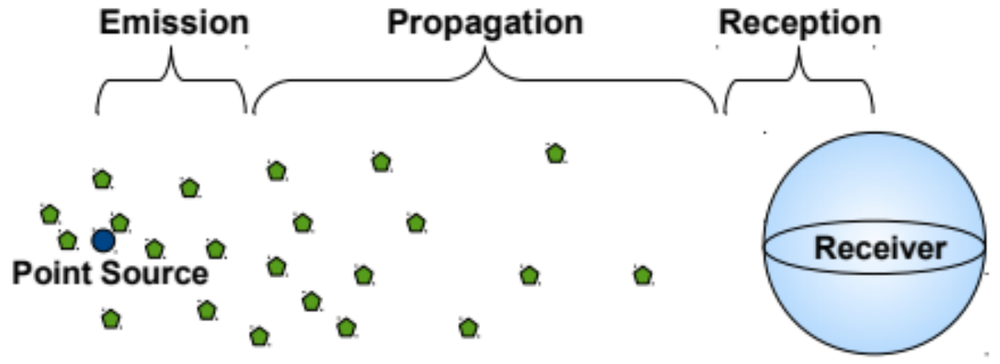
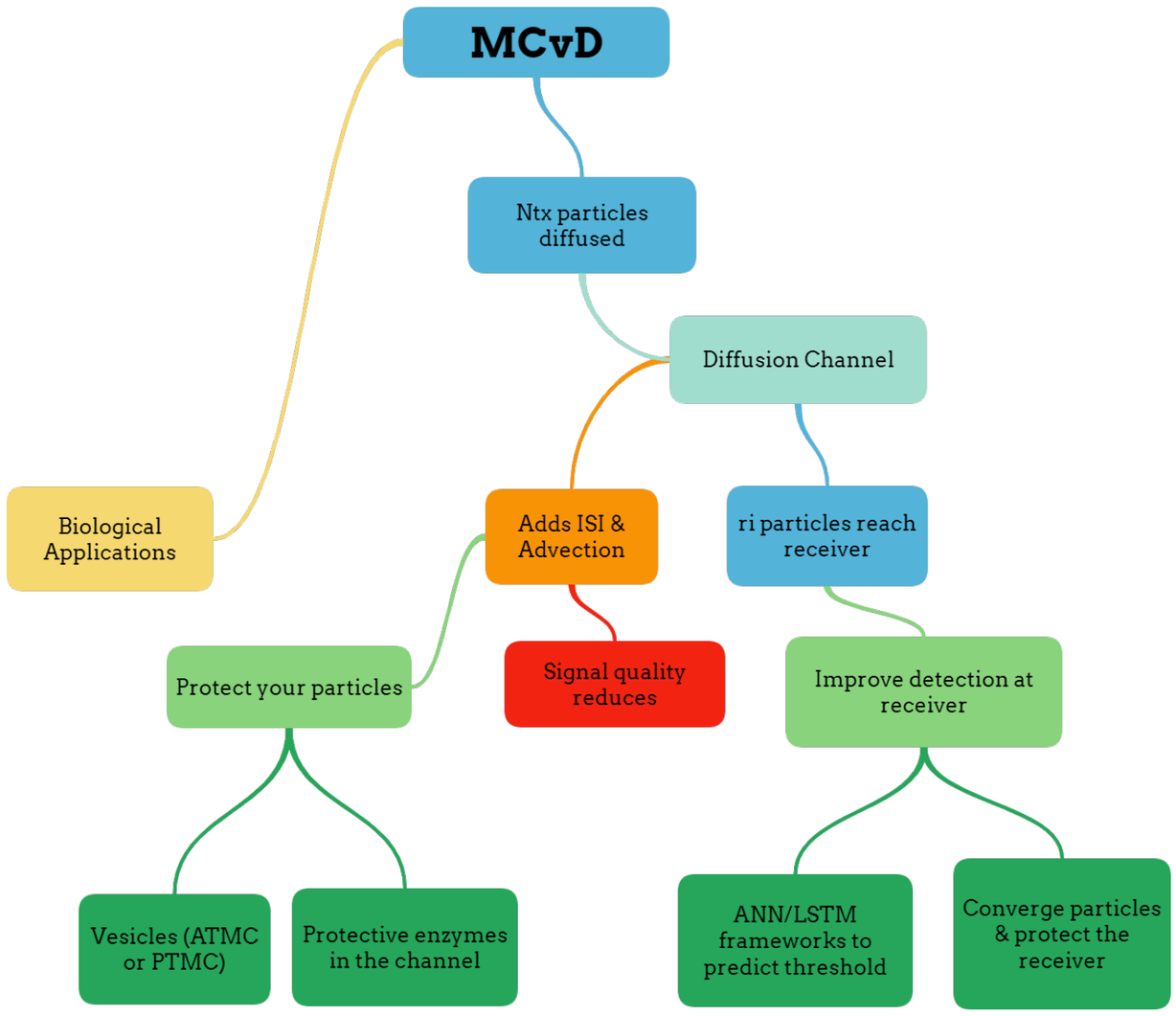


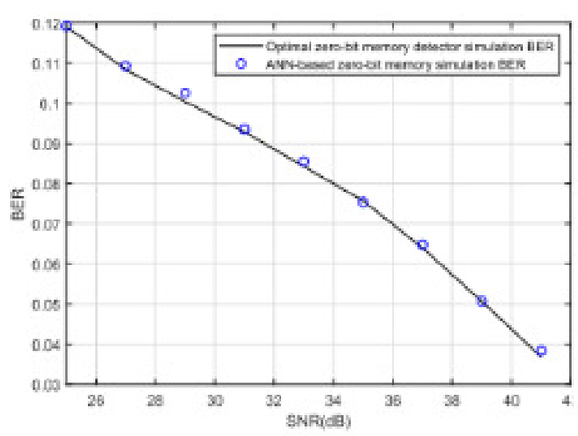
Fig. 1: MCvD system model including a point source and a spherical receiver.

Here the binary information signal is modulated and transmitted in the form of a certain number of particles. The signal is demodulated at the receiver based on the number of particles received.

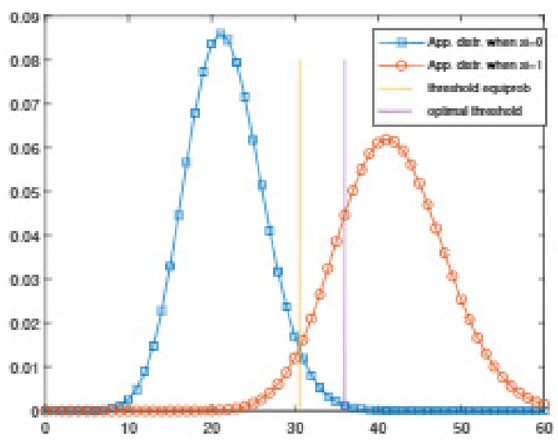
MC Model Flow



Results



(a) Comparison of optimal analytical and ANN-based receiver



(b) Distribution of particles and threshold

Conclusion

We see that by using different techniques such as PTMC enzyme degradation, vesicle based ATMC, and certain Deep Learning frameworks, we can improve the quality of received signal by reducing the ISI mitigation and the BER.

References

[1] Qian, Xuewen Di Renzo, Marco Eckford, Andrew. "Molecular Communications: Model-Based and Data-Driven Receiver Design and Optimization". *IEEE Access*. (2019).