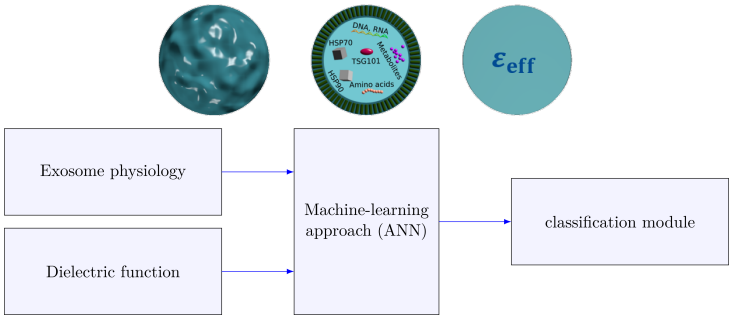
Master Thesis

Research-related and Interesting

Classifying the Health State of Exosomes via Implementing Artificial Neural Network



Exosomes are extracellular vesicles, with contents resembling their parental cell. Due to such resemblance together with the fact that they can be acquired from bodily liquids, exosomes are desirable agents for an early stage, non-invasive diagnosis in various diseases such as cancer. Hence, exosome characterization is became an active field of research, aiming at developing exosome based biosensors. However, detecting exosome's internal contents mainly requires biochemical agents as label, which results in time-consuming, costly sensing methods. Accordingly, in order to develop an label-free exosome based sensing method, the internal contents of a given exosome should be translated into an external characteristics such as an effective refractive index. Effective medium theories, either based on classical mixing formulas such as Maxwell-Garnett approach or based on full-wave simulations determining the mean fields, are established techniques for calculating the effective refractive index of a given multi-phase medium, and can be implemented to determine the effective refractive index of exosomes.

As a part of a DFG research project aiming at developing an ultra-sensitive biosensor for early stage, non-invasive, label-free cancer diagnosis, we intend to use exosomes as the detection agents. Correspondingly, a detailed exosome characterization and classification is required in order to distinguish among cancerous versus healthy exosomes. The exosomes effective refractive index will be determined based on classical mixing formulas, and then the resulting effective refractive indices will be fed into a machine-learning algorithm namely artificial neural network, to classify cancerous versus healthy exosomes.

The current master project will deal with the machine-learning approach namely the artificial neural network for classifying the cancerous versus healthy exosomes. An initial population of exosomes refractive indices should be prepared based on the classical mixing formulas taking into account the contribution of exosome's all major constituents, where the cancerous exosome will be characterized according to their slightly increased protein content. Afterwards, the artificial neural network algorithm should be taught to classify the exosomes based on only their effective refractive index.

Got curious? simply contact us for an informal meeting discussing the topic or send a thesis request per email to us.

Requirements:	Knowledge of electromagnetic field theory, interest in modeling of electromagnetic systems and bioelectromagnetics, knowledge of machine-learning algorithms is preferred.
Character of the project:	40% Theory / 60% Simulation
We offer:	An interesting master project at the edge of science in a friendly research environment.
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