Research focus of the department of “Physics of Molecular Imaging Systems” (PMI) is on exploring the physical limits of current and future molecular imaging technologies. These areas range from simulations of new detector concepts, hardware prototypes, high speed data processing, image reconstruction algorithms and applications using our research imaging prototypes. Our group consists of students and researchers from different disciplines: physics, engineering, computer science and medicine. PMI is part of a large international network with a close link to industry, particularly to Philips Research.

Bachelor’s Thesis: 
Prediction of Nanomedicine Accumulation in Tumors using Data Science Methods and Machine Learning Methods

A promising strategy for the treatment of tumors is the combination of nanotechnology and chemotherapy leading to the encapsulation of highly toxic chemotherapeutic drugs in nano-sized carrier systems (e.g., 10-100 nm sized polymers or liposomes). Ideally, nanomedicine formulations would surpass standard chemotherapeutic drugs regarding biodistribution, tumor accumulation and efficacy as well as reducing side effects. Due to the heterogeneity of cancer, there is also a large variability between individual patients in the accumulation of nanomedicine. Therefore, methods to stratify patients are from great interest to predict a tumor’s accumulation of a nanomedicine formulation to allow the exclusion of highly unlike responding patients (see Fig. 1). We want to employ imaging biomarkers and immunohistological stainings to predict the accumulated dose of nanomedicine. In a preclinical setup, we acquired several data points by employing hybrid Computed Tomography-Fluorescence Mediated Tomography, Ultrasound and Microscopy, and tried to correlate individual biomarkers with the accumulated dose of a tumor. Only by combining multiple biomarkers by data science and machine learning methods, we were able to achieve a reliable prediction of a tumor’s accumulation of nanomedicine.

Fig. 1: 
Rationale behind personalized nanomedicine. By screening individual patients, the individual accumulation is estimated to allow the decision about the inclusion of a patient in a nanomedicine-based treatment. Taken from [1].

Your thesis:

Based on already available experimental data, you will evaluate and explore the potential of different techniques to predict the nanomedicine accumulation. As a further aspect, a subset of all available biomarkers shall be identified which allow a reliable prediction. This is an important step, to potentially translate the findings into (pre-)clinical application. A basic routine is already implemented which can be used as a starting point for your research.

We are looking for a motivated student who wants to combine his/her interest in data science and biological/medical question. Programming skills in Python are advantageous.


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