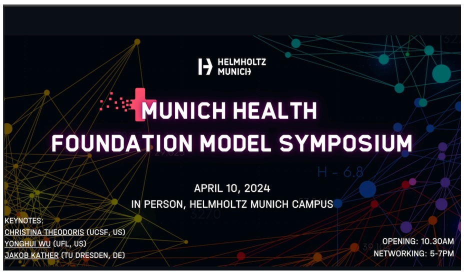

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Probabilistic quantification of high-dimensional structural features from tomographic sensing data

Biosensing technologies capture information on tissue in a time- and cost-efficient way. However, many complex, high-dimensional biomarkers that can be obtained from tomographic imaging cannot be easily extracted from sensing data due to the low dimensionality and the limited amount of information recorded.
We introduce an AI-empowered framework to quantify multi-dimensional tissue biomarkers from one-dimensional signal data that could previously only be obtained from imaging data. Using a generative model of tissue images and a mathematical model of the sensing system, the framework generates a multitude of plausible images that are consistent with the observed sensing signals. Analyzing the feature distributions in the generated images allows the probabilistic quantification of the features from the sensing data, simultaneously capturing the uncertainties arising from the limited number of measurements.
We demonstrate our framework in the context of optoacoustic sensing with optoacoustic mesoscopy as reference imaging modality. We show for the first time that structural vascular features can be quantified from optoacoustic sensing data in a probabilistic way. We further demonstrate that the framework can assist in evaluating different sensing setups with respect to their ability to capture tissue biomarkers of interest.
Our framework provides access to the same features obtained from imaging data through sensing, which can be performed at a much higher time resolution than imaging. Our method enables using optoacoustic sensing for studying rapidly evolving, transient changes in tissue with high temporal resolution and opens up a wide range of applications for the technology.

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