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Invertible Neural Networks for ECG-based Non-invasive Localization of Extrasystoles

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Motivation and Background

Sudden cardiac death can be caused by abnormal focal activation in the ventricles of the heart. Catheter ablation of these foci is a curative treatment to inactivate the triggering activity. However, the localization procedure is usually time-consuming. We recently presented convolutional neural networks (CNNs) to facilitate and expedite the treatment by localizing the excitation origin from the surface ECG (Pilia et al. 2023, https://authors.elsevier.com/c/1hP-x3KEGaNN7p).

Such localization is a classic example of inverse problems in cardiac electrophysiology. A promising yet so far unexplored class of tools for this class of problems are invertible neural networks, which learn the inverse problem jointly with the well-defined forward process and provide a full distribution of the model parameter space, thus supporting interpretability (Ardizzone et al. 2018, https://arxiv.org/pdf/1808.04730).
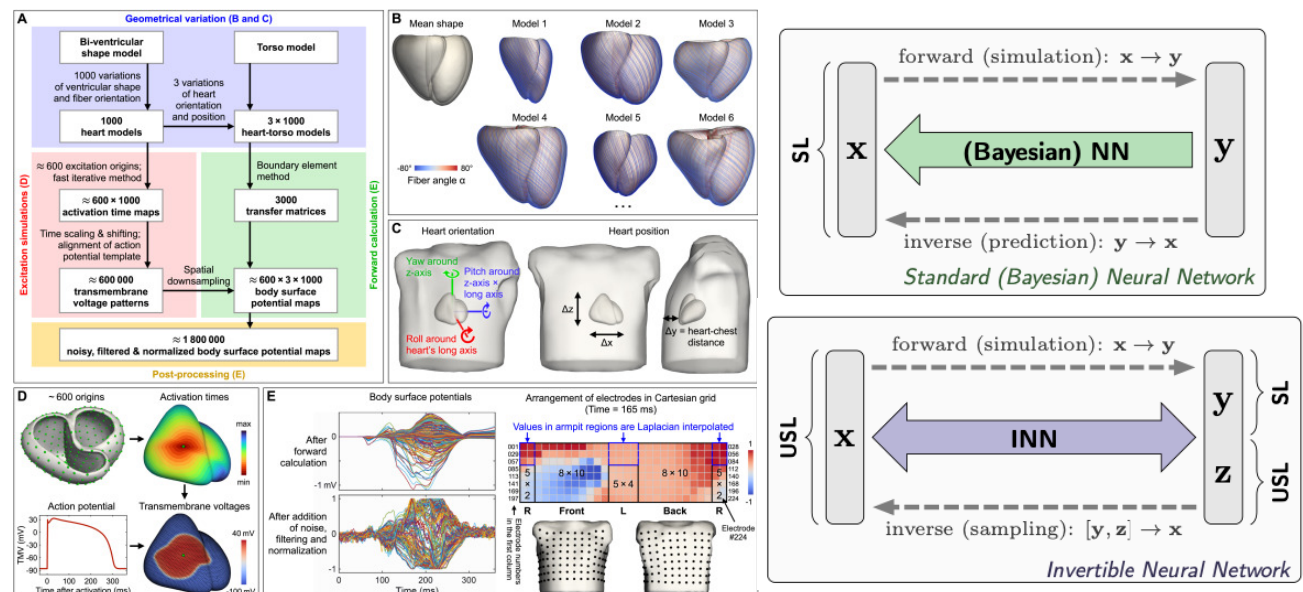
Student Project

This thesis project shall explore the potential of invertible neural networks for cardiac focal source localization. For this, the student will be integrated in the Cardiac Modeling Group at IBT/KIT (ECG simulation and application domain expertise) and the Explainable Machine Learning Group at IWR/UniHD (invertible neural network expertise) and benefit from the translational expertise of the Mannheim Institute for Intelligent Systems in Medicine. The details of the project can be tailored to your expertise, goals and type of thesis (Bachelor/Master).

If you are interested or have questions, send an email!