Master’s thesis:
GP-VAE based Human Motion Modelling with Sparse IMU sensors.

In the research group wearHEALTH, we want to capture human body kinematics agnostic of environmental conditions. The advent of microelectronics gave us miniaturized inertial measurement units (IMUs) that can be easily mounted on the human body, thus avoiding complex camera-based infrastructure. Commercial systems rely on the dense placement (17 or more) of IMUs to attain accurate skeletal reconstructions [1]. However, recent developments have shown that full-body kinematics can be recovered only from a small set of sensors (6 imu’s) [2] in real-time. Still, this approaches lack reliable confidence estimates for pose estimates like orientation and position of segments. Recent work by [3] shows promising results on medical datasets like Healing MNIST, SPRITES and the physionet challenge (in-hospital ICU patients) by combining Gaussian Processes to model the smooth latent state dynamics and the VAE architecture for handling multivariate time-series data imputation. This thesis aims to apply the GP-VAE model on the lower body human walking dataset by leaving out a few segments as shown in the skeletal figure below and trying to reconstruct the missing segments pose as part of the inference process.

Requirements:
• Basic to good knowledge about non-parametric approaches like Gaussian Processes(GP) and Variational Inference(VI)
• Good implementation skills in Python and familiarity with libraries like PyTorch/TensorFlow.

Suggested task:
• Read and understand the optimization approaches in [2] and [3]
• Transform and implement the GP-VAE architecture from [3] to adapt to the human walking dataset and perform tests and benchmarks

References: