Gaussian Processes for Prediction in Intensive Care

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Of all the available data the physician makes a selection of only a few variables for prediction.
Models deal with the large amount of data and make predictions (with a confidence value) of the patient’s future state.
Application – Intensive Care

Develop models to predict the future values of variables that are considered interesting by the physicians to determine the future state of the patient

Individual Patient Characteristics

• Remain constant for a given patient during I.C.U. stay
• Different amongst individual patients
• Define ‘normal’ or ‘typical’ state of a patient
• Deviations from typical value is important information for prediction
• Unknown upon admission to ICU but can be estimated from measurements
Application – Intensive Care

Individual Patient Characteristics

Heart Rates for different patients

Normal distributions of HR for different patients
Methods – Gaussian Processes

• GPs for regression have been used to model and forecast real dynamic systems, because of their flexibility and high predictive performances

• Allow for multi-dimensional inputs

• Assign a confidence value to predictions

• Predictions can be made with noisy (uncertain) inputs, such that the uncertainty propagates to the confidence of the predicted value.

  • Allows for the direct use of the estimated individual patient characteristics

  • Predictions can not be over-confident since they are used for critical decision making processes on the physician’s part
Methods – Gaussian Processes

First Experiments

Prediction without IPC
MSE = 4.97

Prediction with IPC
MSE = 2.27
Future Work and Challenges

• Define (learn) and select a set of Individual Patient Characteristics that are relevant for the prediction tasks

• Verify that models are not over-confident and real values are within predicted variances

• Determine appropriate time-scales for the different variables according to the predictive task

• Make use of sparse methods and aggregation to deal with the large amount of data available

• Preprocessing to deal with the specific type of noise for the application
Thank You