Aortic Pressure Forecasting with Deep Sequence Learning

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Mean aortic pressure (MAP) is a major determinant of perfusion in all organ systems. The ability to forecast MAP would enhance the ability of physicians to estimate prognosis of the patient and assist in early detection of hemodynamic instability. However, forecasting MAP is challenging because the blood pressure (BP) time series is noisy and can be highly non-stationary. The aim of this study was to forecast the mean aortic pressure five minutes in advance, using the time series data of previous five minutes as input.

We provide a benchmark study of different deep sequence learning models based on the pump performance metrics of a left ventricular dwelling transvalvular micro-axial device in patients undergoing high-risk percutaneous intervention. Our dataset and its clinical application is unique in the field of blood pressure forecasting. The percutaneous, catheter-based heart pump provides hemodynamic support, thus aiding in native heart function recovery and is also equipped with pressure sensors to capture highly sampled MAP measurements at origin, instead of peripherally. Thus, our dataset and the clinical application is novel in the BP forecasting field. We performed a comprehensive study on time series with increasing, decreasing, and stationary trends. The experiments show promising results with the recurrent neural network with Legendre Memory Unit architecture achieving the best performance with an overall RMSE of 1.8 mmHg.

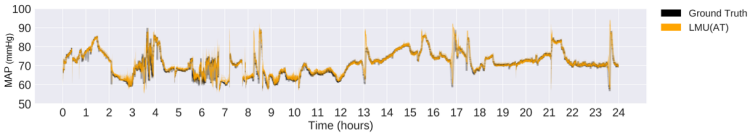

Figure 1: Aortic pressure predictions from the best performing model `Legendre Memory Units` (LMU)

Figure 2: Prediction error in mmHg of select models: Each barplot shows models' prediction errors for each test time series dataset: increasing trend (I), decreasing trend (D), stationary (S) with N=50,000 sequence per set. "I-D-S" set contains equal proportions of all three types of sequences, N=150,000 sequences.