University of South-Eastern Norway

Reconstruction of 10-Second 12-Lead Electrocardiograms from Fragmented 2.5-Second Digitized Paper Tracings

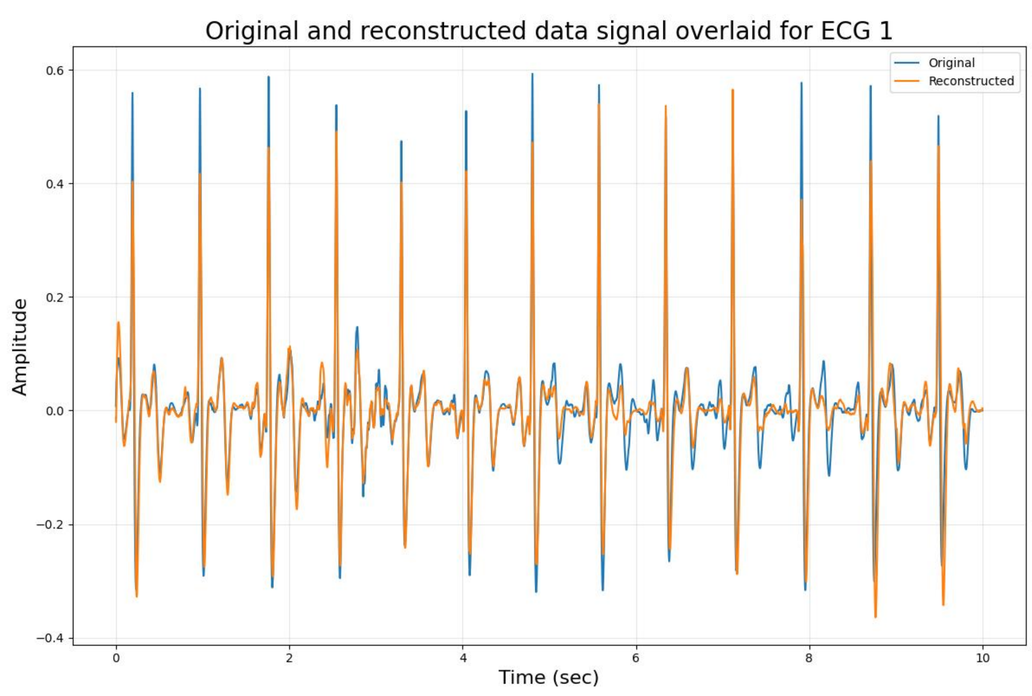
Purpose and aim

Electrocardiograms (ECGs) have traditionally been stored as paper printouts. However, when the original high-resolution waveform data is transferred to paper, the quality is reduced through the steps:

1. The 10-second recording is cropped to just 2.5 seconds per lead to display all 12 leads on a single page.
2. The signal is plotted and printed on paper which lowers its resolution.

However, recent research have shown that paper ECGs can be digitalized to recover 2.5 seconds of every lead. **This project aims to reconstruct the full 10-second ECG signals from these 2.5 second fragments.**

Results and important findings



A convolutional neural network with U-net architecture was used to reconstruct the remaining 7.5 seconds of ECGs using 2.5 second fragments with a sample-wise root mean square error (RMSE) of 80μV. Beyond sample-wise RMSE the reconstructed ECGs showed moderate agreement with the features of the original ECGs with Pearson correlations for the amplitude detection of 0.48 (R-peak), 0.72 (T-peak), 0.75 (P-peak), 0.64 (Q-peak) and 0.54 (S-peak) and the intervals 0.92 (RR-interval), 0.69 (QT-interval) and 0.46 (PR-interval) across all leads.

This suggests that the model is able to reconstruct the signal, however, the peak amplitudes are consistently reduced.

Emil-Alexander Thoresen Motrøen
236845@usn.no
Cybersecurity and Digitalization

Supervisor: Bjørn-Jostein Singstad (bjosin@siv.no)