Deep learning neural network can measure ECG intervals and amplitudes accurately

Jorgen K. Kanters[a], Steven A. Hicks[b], Jonas L. Isaksen[a], Niels Grarup[a], Niels-Henrik Holstein Rathlou[c], Jonas Ghouse[a], Gustav Ahlberg[a], Morten Salling Olesen[a], Allan Linneberg[a], Christina Ellervik[d], Torben Hansen[a], Claus Graff[e], Paal Halvorsen[b], Michael Riegler[b]

[a]*University of Copenhagen, Denmark*
[b]*Simula, Oslo, Norway*
[c]*Novo Nordisk Foundation, Hellerup, Denmark*
[d]*Harvard Medical School, Boston, USA*
[e]*Aalborg University, Denmark*

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Background

The aim of this study was to develop a deep neural network that can be used to reliably measure electrocardiograms (ECG) both in the voltage (amplitudes) and time (intervals) domain.

Methods

We used three parallel residual convoluted networks concatenated to a fully connected network with two layers, using the raw ECG waveforms as input (either 10 sec ECG (5000 samples $\times$ 8 leads) or 1.2 sec median beat (600 samples $\times$ 8 leads). For training (80% of GESUS ECGs) and validation (20% of GESUS ECGs), we used the GESUS population study with ECGs from 8944 subjects to be trained with the GE 12SL parameters (intervals and amplitudes). The findings were replicated in the Inter99 population study consisting of 6783 subjects using the weights from the GESUS trained neural network applied on the Inter99 ECGs and compared with the 12 SL values.

Results

As seen in the table, both intervals and amplitudes could be measured accurately by the neural network close to the sampling rate and the voltage resolution.

Conclusions

We found that our deep network performed very well in predicting amplitudes and intervals. Median ECGs were slightly easier to predict except for heart rate.

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