

Symmetric Projection Attractor Reconstruction: Inter-individual Differences in the ECG

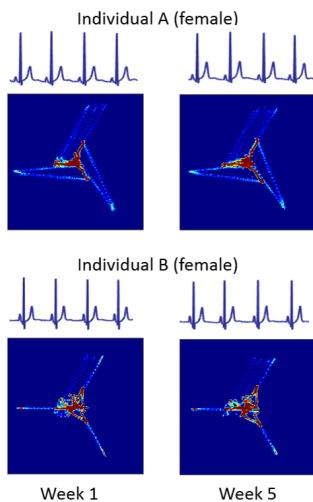
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Aims: An individual’s anatomy, endocrinology, autonomic regulation and genetics all contribute to the presentation of their electrocardiogram (ECG). With increasing automated analysis to support clinical decision-making and the application of machine learning, there is a growing focus on the subtle differences observed between individuals. The recently developed Symmetric Projection Attractor Reconstruction (SPAR) method uses time delay embedding to transform any approximately periodic waveform into a two-dimensional image called an ‘attractor’. We therefore applied the SPAR approach with the objective of visualising and quantifying inter-individual differences in the ECG.

Method & Results: We obtained 600 lead II ECG signals from 40 healthy, young adults across two Physionet datasets where multiple recordings had been taken in separate sessions. The SPAR method was applied to the signals and we observed that the attractor amplified subtle features of the ECG waveform, which gave a unique visualisation between individuals. A simple quantification of the attractor and clustering techniques allowed us to identify an individual, and indicated when significant changes had occurred for a given individual after dosing with a cardioactive drug.

Conclusion: The SPAR method was developed in response to the challenge of making better use of existing physiological waveform data, and its simple implementation overcomes many of the traditional barriers to clinical uptake. Our successful visualisation and quantification of inter-individual differences in the ECG supports further development of this novel approach in the areas of patient stratification and risk management.



Lead II ECG from two sessions. The attractor emphasises intra-individual similarity and inter-individual differences