Improving Atrial Fibrillation Prediction With Recurrence Matrix Analysis

Santiago-Ortiz, Sergio (School: Escuela Superior Isidro A. Sanchez)

Atrial fibrillation (AFib) is an arrhythmia that can lead to serious health complications. Chaos theory, particularly recurrence matrices, can help distinguish between normal (SR), pre-arrhythmic (Pre-AFib), and arrhythmic (AFib) heart rhythms. However, predictive models still have room for improvement. This study demonstrates that filtering recurrence matrices based on recurrence rate enhances machine learning model accuracy. RR intervals from the SHDB dataset were vectorized using time delay embedding, and Euclidean distances were calculated to identify recurrence patterns. These were represented as binary recurrence matrices, of which approximately 6,000 samples of SR, Pre-AFib, and AFib were generated. A convolutional neural network (CNN) was trained using these samples, each classified based on recurrence rate. Model A included only samples where dataset classification matched recurrence rate classification, while Model B did not. Model A achieved 93% accuracy, significantly outperforming Model B's 60%. This means filtering training data by recurrence rate reduces noise, improving model performance and potentially benefiting AFib patients. Future work could further refine accuracy by increasing sample size and exploring more complex models.

Awards Won: