

An Active Role for Machine Learning in the Diagnosis of Cardiac Arrhythmias, Year Two

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Cardiac arrhythmias occur when the electrical impulses that coordinate heart beats don't work properly. In the U.S., they cause over a million hospitalizations and over 200,000 sudden cardiac deaths per year, while also increasing the risk of stroke and heart failure.^{3,3a} Accurate and early diagnosis is key, however, the disease is significantly under-diagnosed. Monitoring devices can acquire large amounts of real-time ECG images but evaluating this big data remains a challenge. Diagnostic accuracy with current technologies is high but false positive rates are between 27-90%. There is a growing need for automated image analysis. This study aims to create a supervised machine learning algorithm to identify five deadly arrhythmias – Afib, Atrial Flutter, VF, VT and AVNRT – while reducing the false positive rate. 8,786 pre-classified ECG images were collected, augmented and classified. An algorithm was created using a multilabel classifier CNN that was specifically trained to diagnose multiple discrete, structured diagnostic ECG images that includes adjustments to the learning rate and a gradient optimization algorithm. It was hypothesized that a machine learning algorithm could be built to diagnose these arrhythmias, maintaining sensitivity while significantly reducing the false positive rate. The optimal model included six CNNs, the RMSprop optimizer, 7 dense layers and a dropout rate of 4 (Sensitivity 94.4%, false positive rate 5.6%). With a consecutive-image trigger, the false positive rates are dramatically reduced (< one per 10 years). Using this algorithm to diagnose arrhythmias can potentially achieve similar accuracy and a significantly lower false positive rate than algorithms used today.