Signal Analysis of Atrial Flutter EKGs Using the Discrete Fourier Transform

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Introduction

Many methods for detecting atrial flutter (AF) have been described in the literature, however, the Discrete Fourier Transform (DFT) has not seen significant application. The DFT is routinely used in signal analysis to decompose a signal into its constituent frequencies. In assessing EKGs, the DFT could be used to identify unique pathological features such as AF. Our study applied the DFT to AF EKGs to find distinct signatures that could be used to develop alternate detection methodologies.

Methods

The PTB-XL ECG dataset was imported and analyzed using Python 3.11. We analyzed 10 random AF EKGs from the dataset that did not display any other electrical abnormalities. High pass and low pass filtering were employed to minimize baseline drift and high frequency interference. A decomposition of each EKG signal was performed using the DFT, and analysis of the frequency components was performed.

$$X(k) = \sum_{n=0}^{N-1} x(n) e^{-j2\pi kn/N}$$

Results

The Fourier decomposition showed no visually distinguishable pattern that allowed differentiation of AF from sinus rhythm.

Discussion

Our expectation was that the frequency components corresponding to atrial flutter would have shown noticeable differences from sinus rhythm in the DFT decomposition. Initially, this study aimed to use a KNN classifier to help distinguish the EKGs independent of visual analysis. However, due to limited data of AF EKGs we were unable to train the classifier. Future, studies will incorporate a wider array of EKG data so a more robust analysis can be undertaken.