

Comparative Study of Algorithms for Atrial Fibrillation Detection

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Eight algorithms for detection of Atrial Fibrillation (AF) were evaluated using the same protocol. These algorithms are based on the analysis of two characteristics observed in ECGs with AF: irregularity of RR intervals (RRI) and a chaotic atrial activity (AA). This AA can be analyzed in frequency (FAA) and/or in time domain (P wave absence, PWA).

Five algorithms based on RRI were considered: Markov Models (*Moody et al*), autoregressive modeling (*Cerutti et al*), Kolmogorov-Smirnov test (*Tatento et al*), and statistical frameworks (*Logan et al* and *Linker et al*). Other algorithm was based on PWA and FAA (*Slocum et al*), while two algorithms combined both analysis of RRI with AA (*Babaezaideh et al* and *Schmidt et al*). MIT-BIH Arrhythmia database was used for training the algorithms and MIT-BIT AF database was used for evaluation. The optimal time window length that each algorithm needed for an accurate detection was determined. In addition, the performance of the algorithms under different levels of motion artifacts was studied by using a simulated dataset with artificial noise with different SNR values.

Results of comparative study

| METHODS | Submethods | Se | Sp | +P | Err |
|-------------|-------------|-------|-------|-------|-------|
| Moody | RRI | 87.55 | 95.15 | 92.29 | 7.88 |
| Logan | RRI | 87.30 | 90.31 | 85.72 | 10.89 |
| Linker | RRI | 97.64 | 85.55 | 81.81 | 9.61 |
| Tatento | RRI | 74.68 | 94.59 | 66.49 | 4.90 |
| Cerutti | RRI | 86.10 | 81.56 | 75.76 | 16.61 |
| Slocum | PWA/FAA | 62.80 | 77.46 | 71.18 | 18.02 |
| Schmidt | RRI/FAA | 89.20 | 94.58 | 91.61 | 7.56 |
| Babaezaideh | RRI/PWA/FAA | 87.27 | 95.47 | 92.76 | 7.80 |

Results showed that the highest Sensitivity (Se=97.64) was achieved with a method based on RRI analysis (*Linker et al*) while combining RRI, FAA and PWA (*Babaezaideh et al*) gave the highest Specificity

(Sp=95.47) and Positive Predictive Value (+P=96.54). The lowest error (Err=4.51) was obtained with the method from *Tatento et al*. AF detection based only on the analysis of AA obtained the lowest performance (*Slocum et al*, Se=62.8, Sp=77.46).

When the level of noise increased, the algorithms that had the highest robustness were the ones based on RRI (*Cerutti et al*, Se=82.52 and Sp=40.47 for SNR=-5dB). However, in these methods, the Sp decreased due to the higher number of false positives in the beat detection.