# Acceptable Heart Rate Variability Inaccuracy for Reliable Atrial Fibrillation Continuous Monitoring

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**Background and Aim.** Wearable devices have the potential to continuously monitor cardiovascular diseases, but in the presence of noise they may provide unreliable heart rate variability (HRV) signals. Since HRV has been traditionally used to detect atrial fibrillation (AF), the maximum error tolerated in these signals to avoid confusing AF with noise remains poorly studied. This work addresses that gap, providing a necessary step toward reliable continuous AF monitoring.

**Methodology.** Six public datasets with high-quality ECG, including AF, normal sinus rhythm, premature beats, atrial and ventricular flutter, were used. Four were long-term monitoring datasets. Data underwent quality assessment, R-peak detection, and splitting into 30-second and 60-second windows. Various levels of random errors, with maximums fixed and relative to the heart rate, were added to HRV intervals, and existing AF detection methods were evaluated. Methods included index-based (pRRX, SDRR, SD1, SD2, SD2/SD1, meanRR, RRdif, relRRdif, spectral power by bands, and ratios) and machine learning (SVM, DT, KNN, MLP, RF, AdaBoost, SGBoost).

**Results.** On datasets common in previous works, like the MIT-BIH Arrhythmia dataset, DT and RF achieved 97% F1 with balanced AF and control classes. With long-term datasets (17% AF), recall fell under 35% while sensitivity remained over 98%. Fixed errors (3, 6, or 12 beats per minute) had little impact on AF detection. Relative errors (2, 5, or 10% of heart rate) strongly decreased performance, with 10% errors causing over 30% F1 decrease.

**Significance.** This work first quantifies the inaccuracy levels for HRV signals still usable for AF detection. Errors relative to the heart rate can mask AF detection from HRV and must be detected and removed for an effective AF detection. Achieving reliable continuous monitoring has the potential of improving patient survivability, reducing comorbidity, and lowering treatment costs.