# Variational Mode Decomposition features for heartbeat classification

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***Aim***: Automatic heartbeat classification is required to detect abnormalities in the electrical activity of the heart and in applications such as the analysis of Heart Rate Variability. In this study, Variational Mode Decomposition (VMD) is used to describe heartbeats regarding their origin. A single-lead approach is considered, aiming to apply it to wearable devices.
***Methods***: The features were evaluated on the first lead of the MIT-BIH Arrhythmia Database. Heartbeats were segmented in windows of 0.65s, and the annotations were sorted in 3 groups following AAMI standards: Normal, Supra-ventricular and Ventricular. Paced and fusion beats were not considered. Each heartbeat was decomposed in 5 variational modes, which correspond to the bands of frequency with higher power. Those modes were sorted to exclusively keep the modes corresponding to 2-5Hz ($\approx$ T wave), 6-9Hz ($\approx$ P-wave), 10-15Hz ($\approx$ QRS), 16-23Hz and 24-30Hz (other information). Five features were extracted from each of the bands: the power, the bandwidth, the symmetry of the wave around the R peak, the number of zero-crossings and the amplitude difference between the two lowest minimums. The features were fed to an LS-SVM classifier, using 10-fold cross-validation and 50% of the balanced data as training.
***Results***: Preliminary results report an overall accuracy of 79.14% using an intra-patient paradigm. Regarding the performance for each class, Normal, Supraventricular and Ventricular heartbeats obtain a Sensitivity of 78.83%, 73.84% and 84.02% respectively.
***Conclusion***: These results are in line with the state-of-the-art for heartbeat classification using single-lead, and they show promising performance for Supraventricular and Ventricular beats. The discrimination between Normal and Supraventricular beats could be improved by including rhythm features, which were not considered in this study. Future work will focus on frequency bands above the QRS complex and their role in heartbeat classification.