Technical challenges on High Frequency Oscillations automatic detection.

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The visual detection of High Frequency Oscillations (HFO) is an extremely time demanding task and the agreement between reviews is low due to its subjectivity. Furthermore, with the increase of recording time and number of channels this task became humanly impossible. For this reason, there is a necessity to develop reliable automatic detectors, preferably robust, fully automatic and with low computational cost.

This work aims to compare different types of automatic algorithms.
The algorithms were tested by a combination of following steps. (1) The use or not of whitening; (2) Filter Design windows (Hamming, Hann, Gaussian, Kaiser); (3) The feature extraction (Root Mean Square, Line Length, Short-Time Energy, Teager energy, Hilbert envelope and Hilbert Energy); and (4) classification (Standard Deviations, Tukey Test, Percentile).
Simulated signal contained white noise contamination, sharp transient, clipping, interictal spike or HFOs with different central frequency and amplitude were generated, each lasting 1 second (Sampling Rate 2kHz) with the same brown noise background. A set of 10 minutes signals with different HFO occurrence rate was used to evaluate the threshold selection.
A combination of Whitening, Gaussian window filter and both Teager Energy or Line Length showed a higher specificity, without compromising the sensibility, reaching accuracy above 80%. The use of a non-parametric threshold, as seen in the Tukey method, was much more stable when the occurrence rate was increased.
These results point to the use of features that respond to both frequency and amplitude in association to whitening, gaussian filter and Tukey threshold.