A computer vision approach to automatic detection of high frequency oscillations

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Rationale: High frequency oscillations (HFOs), are brief events which can be recorded on the EEG as oscillatory activity with frequencies between 80 and 250 Hz. HFOs are considered a potential biomarker for epileptogenic tissue, even though their occurrence in normal tissue has been previously reported. One of the most common ways of visually identifying HFO is by band-pass filtering the raw EEG in the 80-250Hz frequency band. This method is prone to false HFO detection due to filtering artifacts resulting from filtering sharp transients and is unable to provide information about the frequency, amplitude and duration of HFOs.

Methods: To address this issue, we first present an analytical model of the HFOs and associated time-frequency map and we use simulated data to show how time-frequency representation can improve HFO identification, by clearly separating the HFOs from the background activity. Secondarily, we describe an automatic HFO detector that combines time-frequency analysis with a computer vision approach. The detector identifies potential HFO events as blobs on the time-frequency representation, which are then validated as real HFOs if criteria regarding the HFO's frequency, amplitude and duration are met.

Results: We provide a flexible automatic HFO detector, which can reliably operate on a wide range of frequencies, covering both ripples (80-250Hz) and fast ripples (250-600Hz).

Discussion: The HFO's frequency, amplitude and duration characteristics may help classifying HFOs as physiological or pathological.

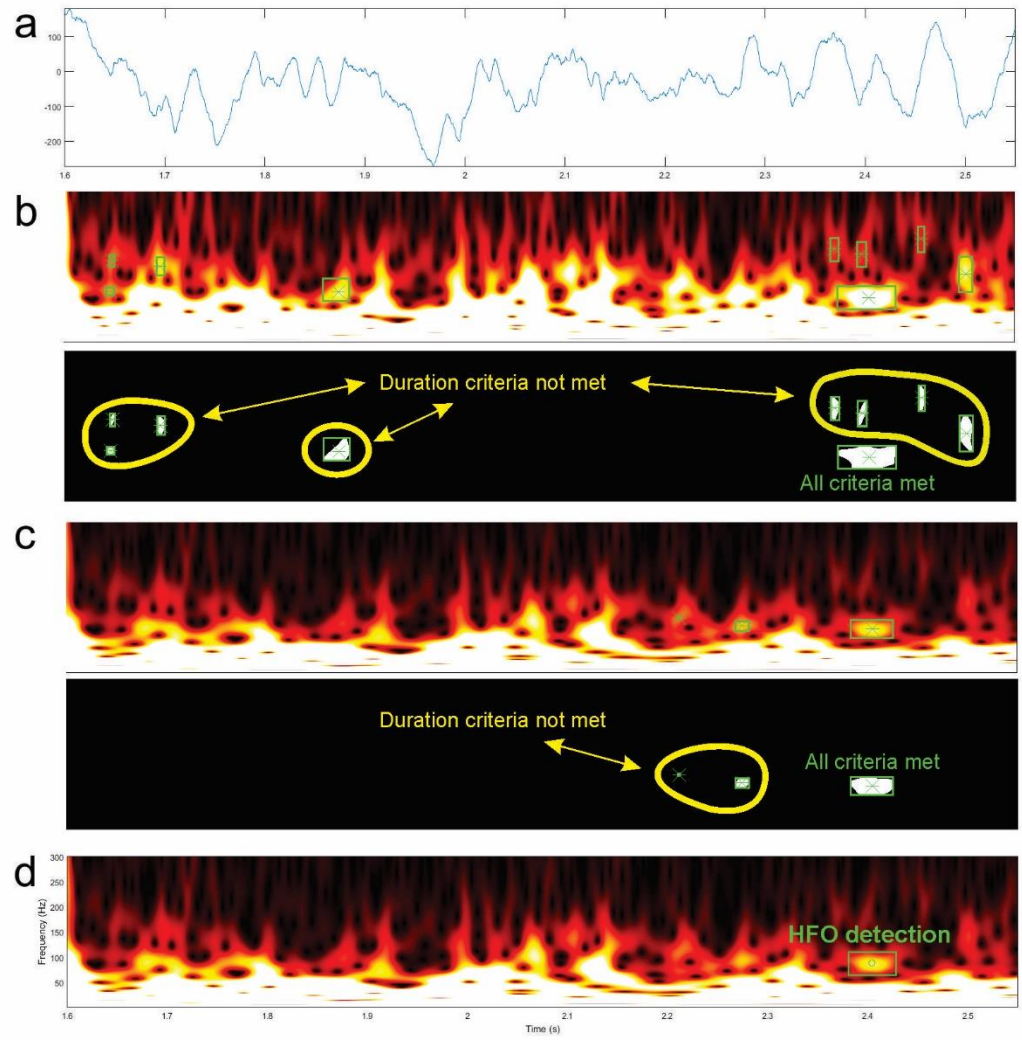

Figure: Automatic HFO detection. a) EEG signal; b,c) time-frequency representations at two amplitude thresholds, showing detected blobs in white; d) HFO detection