Project: HFO (Some Facts)

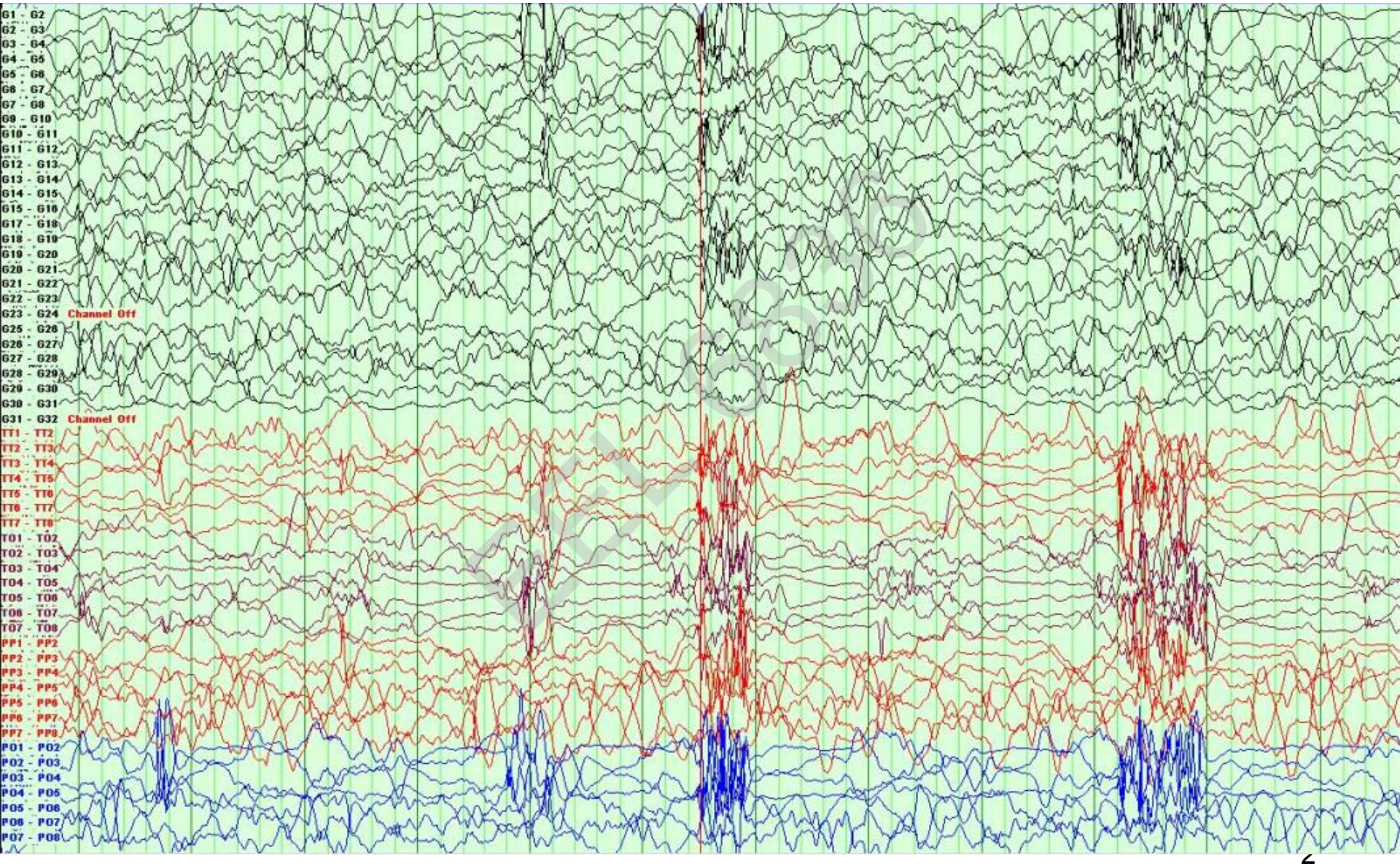
Fast ripples are considered reliable biomarkers (like interictal EEG spikes).

Allow us to make a definitive diagnosis and localize the area of the brain that needs to be resected with a single test. This would greatly increase the number of patients who would receive and benefit from surgery.

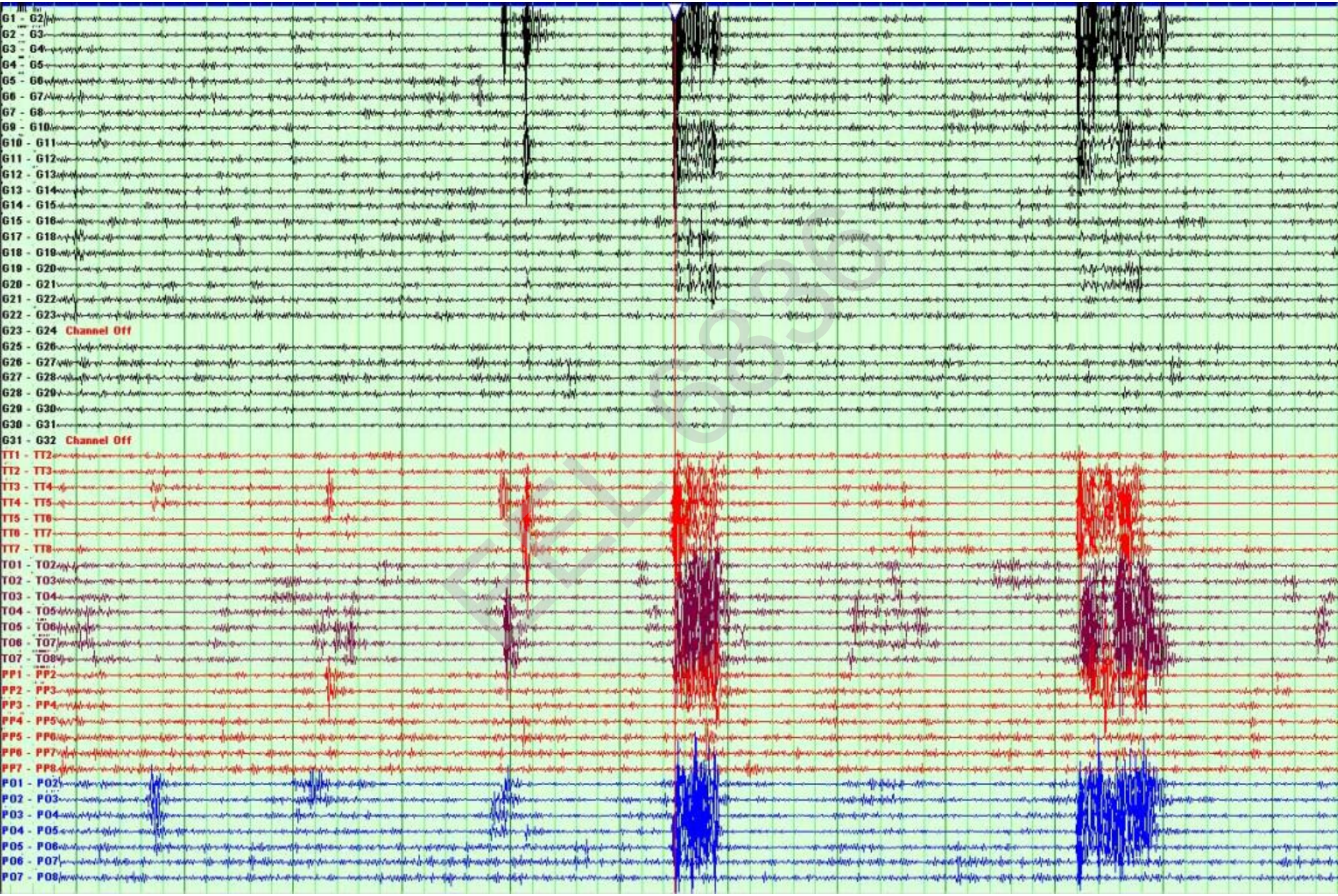
250-500 Hz---Fast Ripples
80-250 Hz (Ripples)

HFOs occur frequently at the time of interictal spikes, but are also found independently

Plain Subdural EEG



80-250 HZ


G1 - G2
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G3 - G4
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G9 - G10
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G11 - G12
G12 - G13
G13 - G14
G14 - G15
G15 - G16
G17 - G18
G18 - G19
G19 - G20
G20 - G21
G21 - G22
G22 - G23
G23 - G24 Channel Off
G25 - G26
G26 - G27
G27 - G28
G28 - G29
G29 - G30
G30 - G31
G31 - G32 Channel Off
TT1 - TT2
TT2 - TT3
TT3 - TT4
TT4 - TT5
TT5 - TT6
TT6 - TT7
TT7 - TT8
TO1 - TO2
TO2 - TO3
TO3 - TO4
TO4 - TO5
TO5 - TO6
TO6 - TO7
TO7 - TO8
PP1 - PP2
PP2 - PP3
PP3 - PP4
PP4 - PP5
PP5 - PP6
PP6 - PP7
PP7 - PP8
PO1 - PO2
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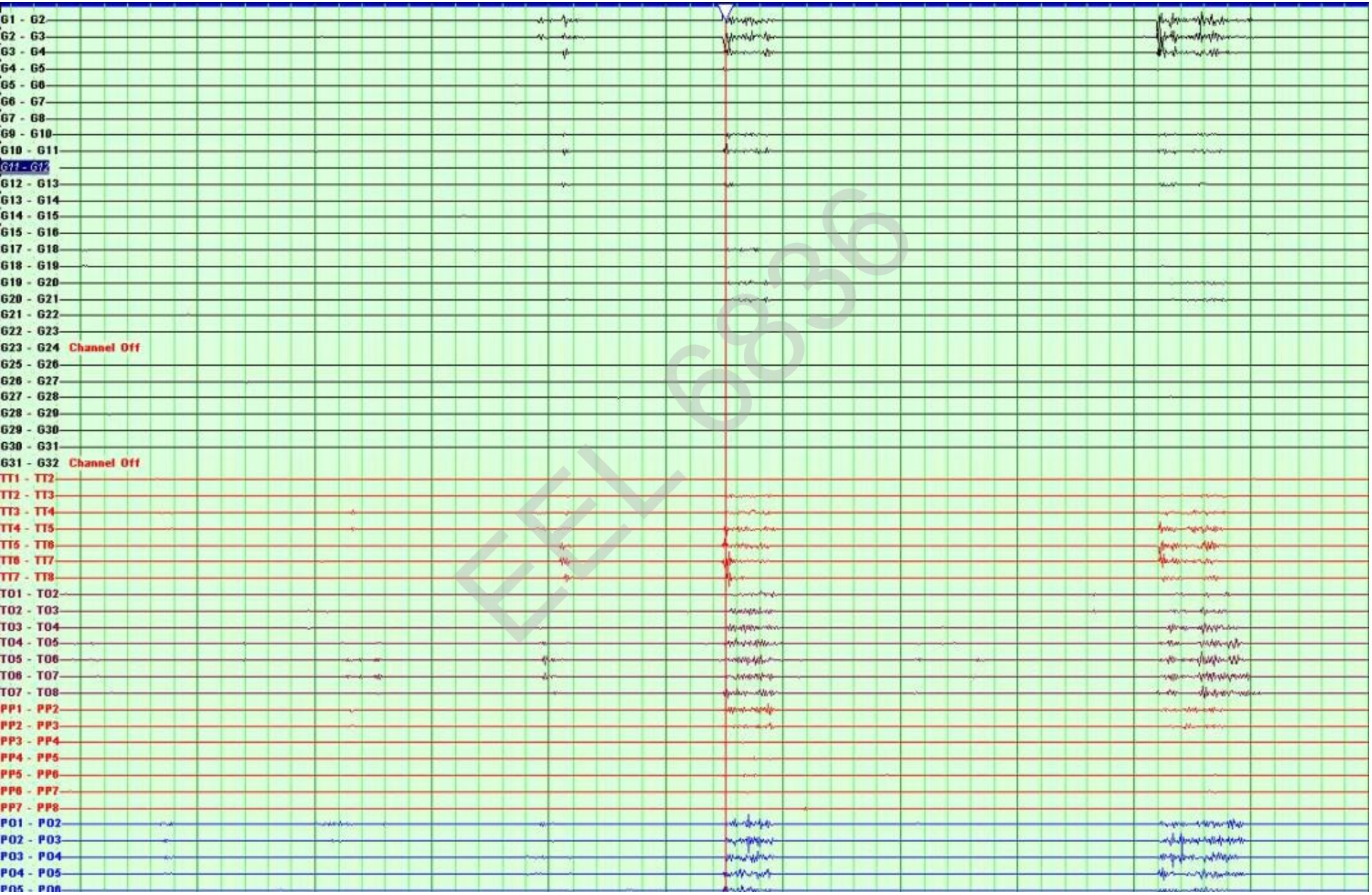
PO5 - PO6
PO6 - PO7
PO7 - PO8

250-500 HZ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G17 - G18
G18 - G19
G19 - G20
G20 - G21
G21 - G22
G22 - G23
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G27 - G28
G28 - G29
G29 - G30
G30 - G31
G31 - G32 Channel Off
TT1 - TT2
TT2 - TT3
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TT6 - TT7
TT7 - TT8
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TO3 - TO4
TO4 - TO5
TO5 - TO6
TO6 - TO7
TO7 - TO8
PP1 - PP2
PP2 - PP3
PP3 - PP4
PP4 - PP5
PP5 - PP6
PP6 - PP7
PP7 - PP8
PO1 - PO2
PO2 - PO3
PO3 - PO4
PO4 - PO5
PO5 - PO6

Main Objective

1. Raw number of fast ripples (FR)/ channel - as fast ripples distinguished the seizure onset zone better than ripples.
2. Mean duration of FR/channel.
3. Graph that include an ANOVA to determine which channels have a statistically significant greater # and duration of FRs.

The results will would provide another tentative quantitative measure to include in the pre-resection analysis.

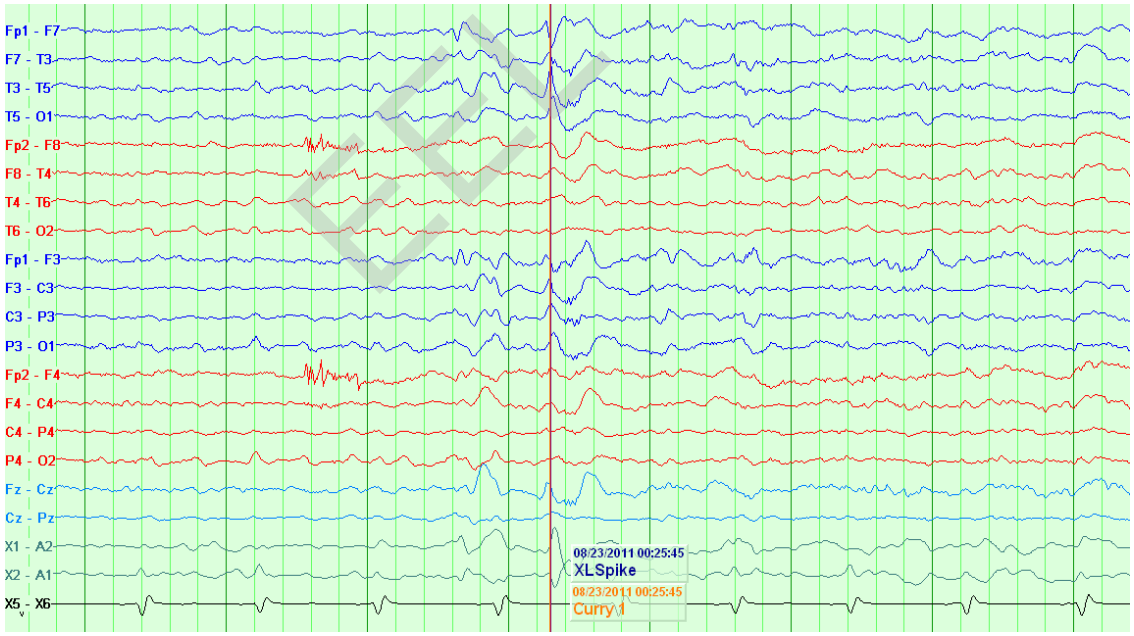
HFO (ripples and fast ripples) in pediatric patients
HFO in resection cases and correlate it with seizure outcome
HFO in different types of intractable seizure disorders.
HFO in pediatric patients in different states/during different tasks

10 minute data segment and do the filtering and FR counting

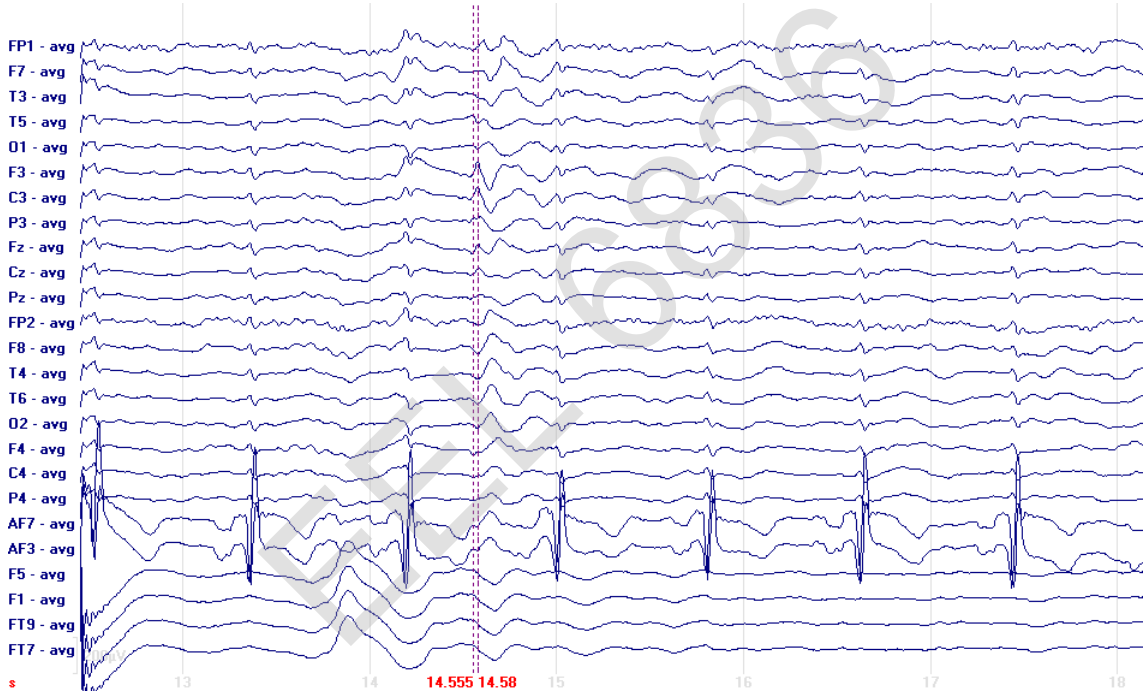
Project: Interictal Spikes Detection

Objective:

An integrated design that identifies and localizes interictal spikes while automatically removing or discarding the presence of different artifacts such as EMG, EKG, and eye blinks.

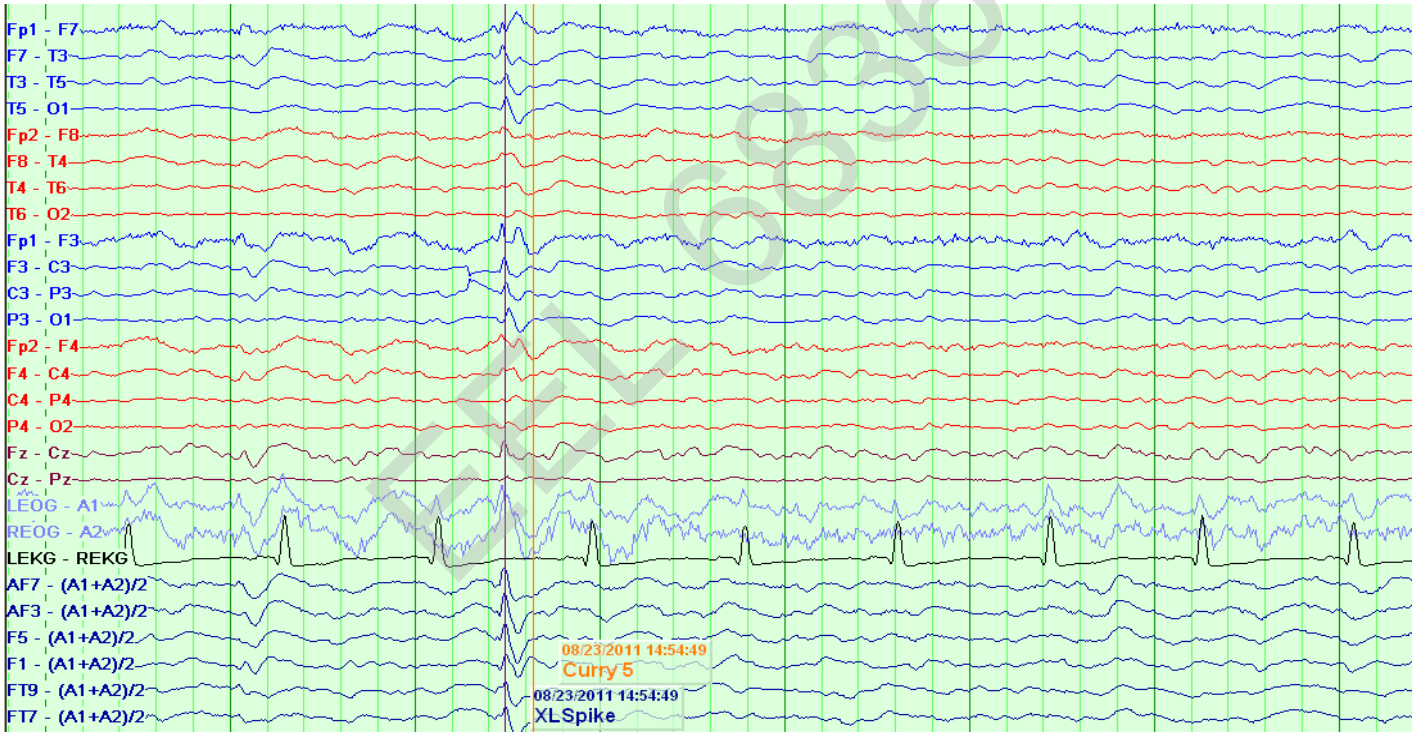


Project: Interictal Spikes Detection



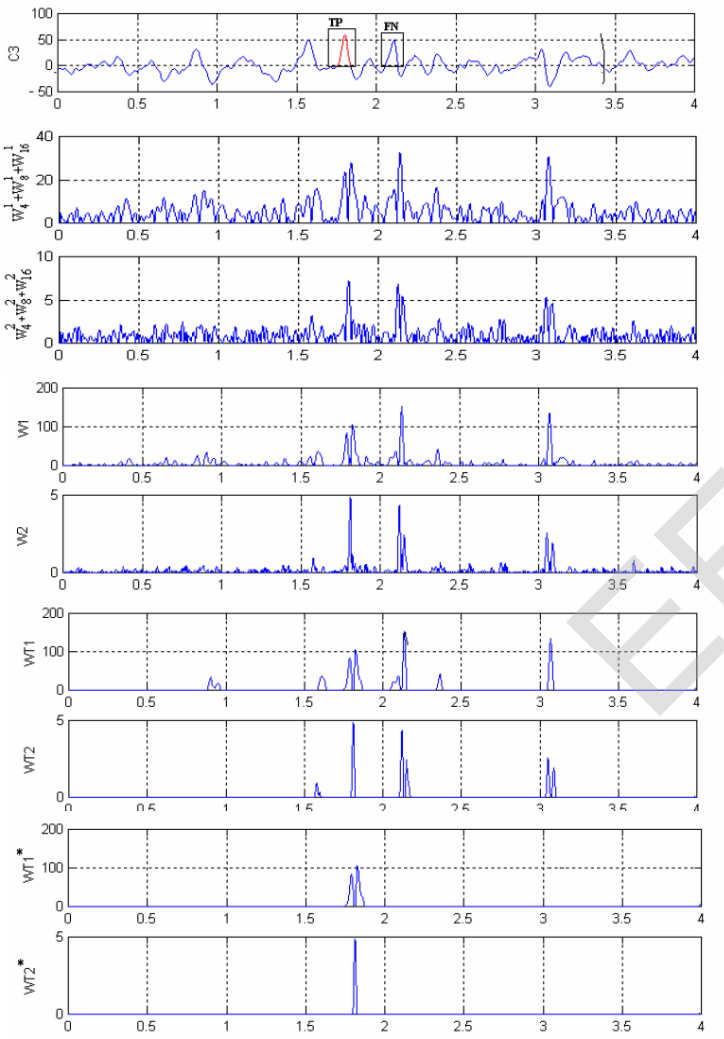
Note: Discarding the presence of different artifacts such as EKG is really important in this procedure.

Project: Interictal Spikes Detection



EKG artifact

Project: Interictal Spikes Detection

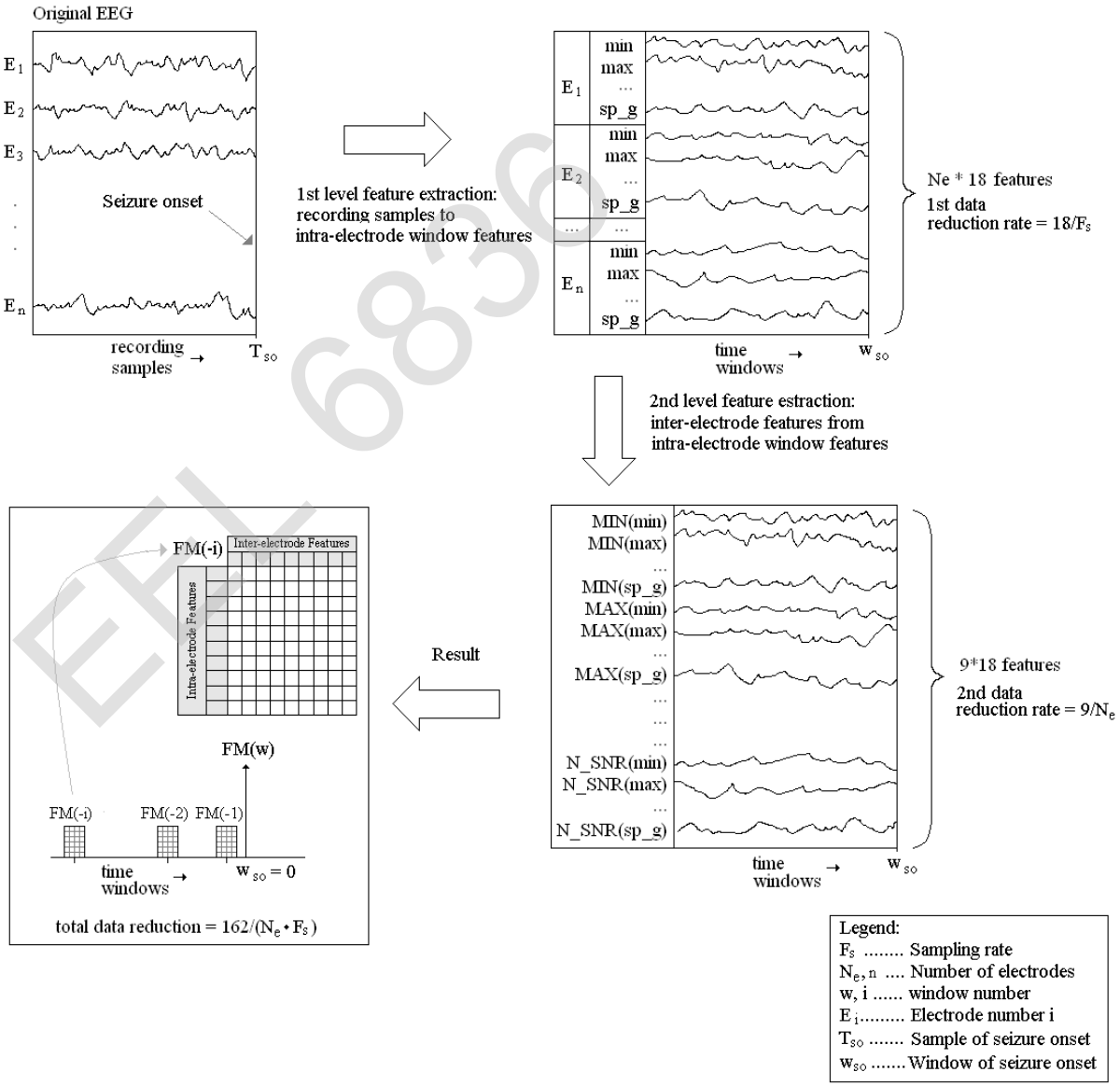


Several methods for spike detection have been proposed based on single and multichannel approaches:

- Template matching algorithms based on finding events that match previously selected spikes.
- Parametric approaches based on traditional signal processing techniques.
- Neural networks (NNs) techniques.

Project: Seizure Prediction

- This study provides an analysis of trends in EEG activity prior to seizure onset



Objectives

- To extract as many parameters as possible from the EEG and statistically analyze their behavior prior to seizure in a search for potential trends.

- To create a model that works regardless of the number of electrodes and their localization by combining intra-electrode features with inter-electrode features.

State of the Art in Seizure Prediction

Research devoted to particular features mostly using multichannel EEG data streams:

- Short term maximum Lyapunov exponent
- Residual sub-band wavelet entropy
- Correlation dimension
- Coherence
- Dynamical similarity index
- Accumulated energy
- etc

Current Problem

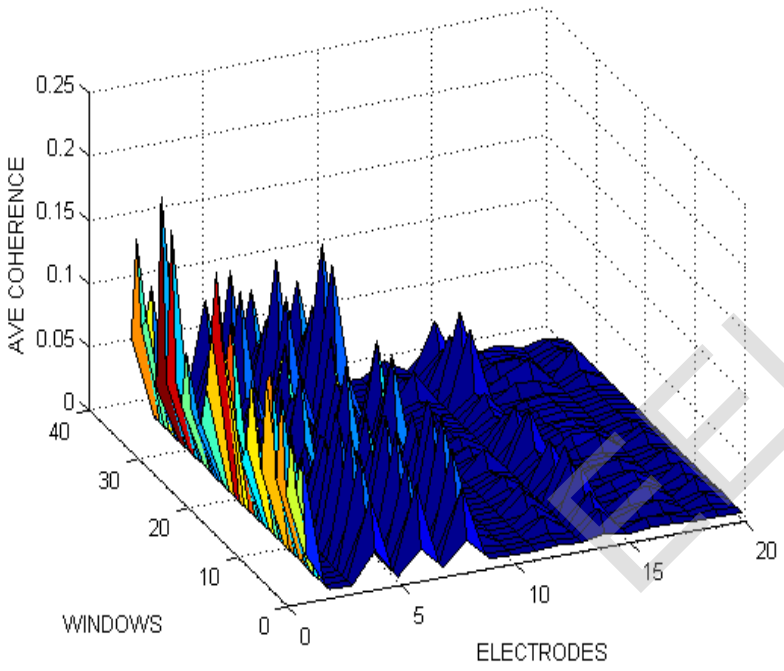
- Despite patents etc, no method has been implemented that clearly predicts a seizure.

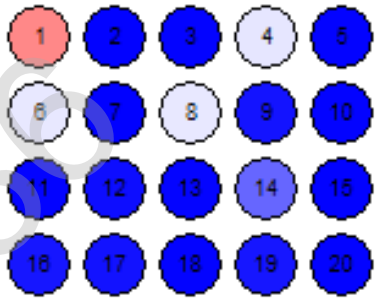
Starting Point: Windowed Features

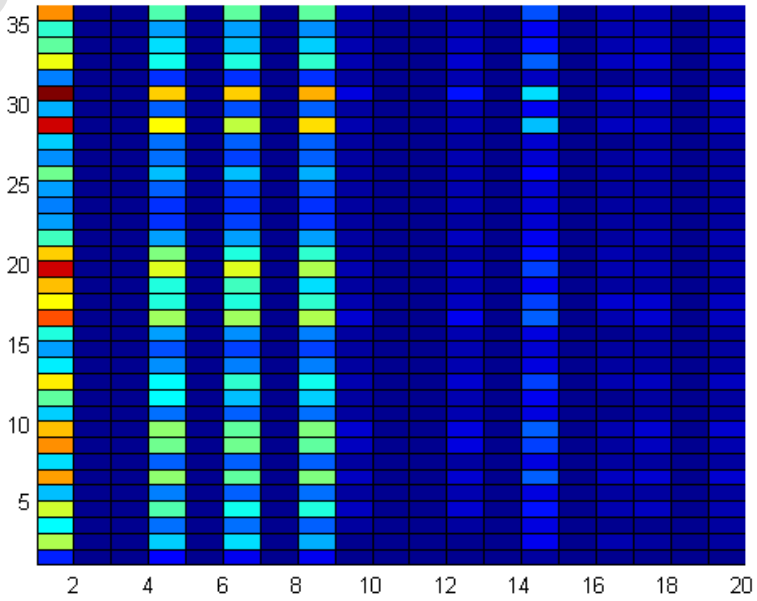
From each electrode, the following features can be extracted for each time window (1, 2, … sec):

- The Horth's parameters (activity, mobility and complexity)
- the minimum value
- the maximum value
- the average value
- the standard deviation
- the difference max-min
- the kurtosis
- the skewness
- the signal to noise ratio
- the norm of the SNR components
- the correlation sum
- the spectral power in the different frequency bands (alpha, beta, delta and theta)

Seizure Prediction using coherence

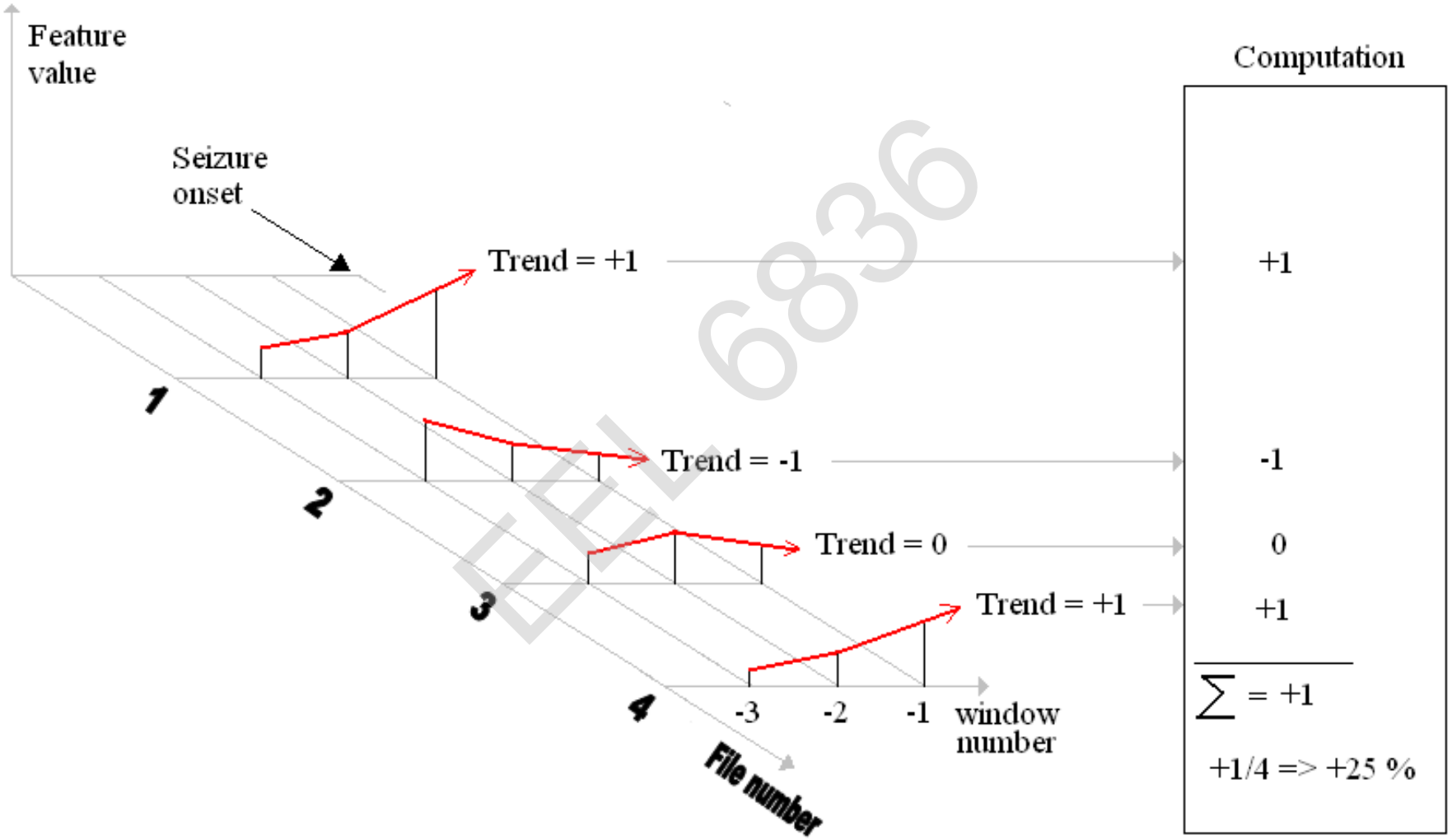






Seizure Prediction -Trend Validation (4)

Mental image:

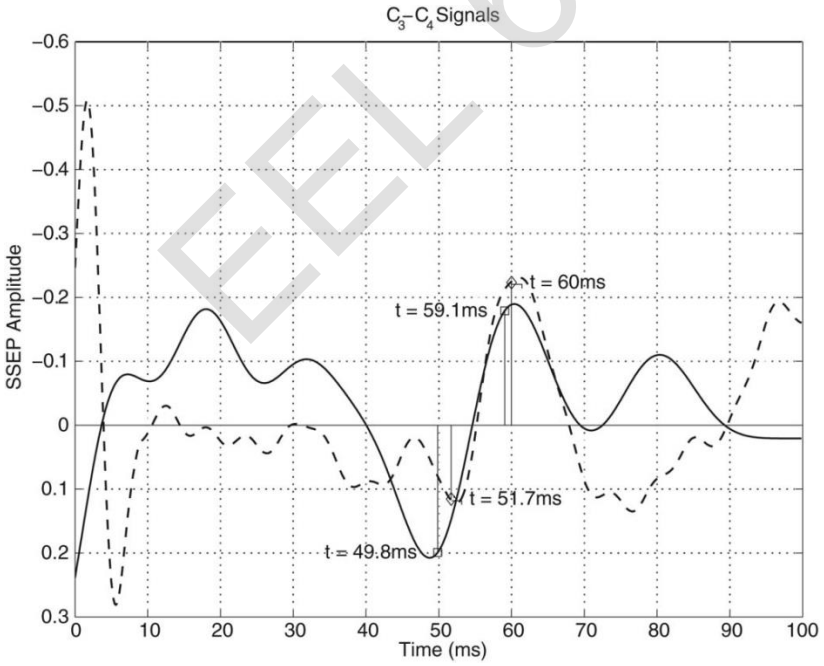


Project: SSEP

The data only has 2 electrodes, so it would be composed by two columns only.

SSEPs are characterized by the peaks and the valley of the waveform denoted by N and P respectively.

The *P37* and *N45* peaks of the bipolar recordings are thus used for the monitoring purposes of the surgical procedure.



Project: SSEP

- SSEP recordings at different stages of the surgical procedure are provided from two bipolar channels, C_3-C_4 (right and left median nerve stimulation) and C_Z-F_Z (right or left tibial nerve stimulation) using the international 10-20 system for the positions of the electrodes.
- The SSEP signals are recorded by applying stimuli to the posterior tibial nerve of the right leg.

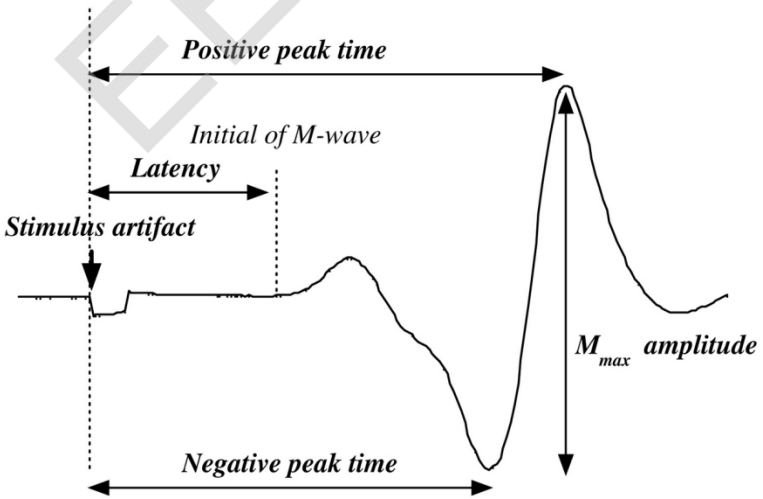
- The data is recorded at 6400Hz sampling rate with duration of 100msec, yielding 640 samples per signal.

- The raw trial signals are band-limited from 10Hz to 1000Hz, and the clinical average is obtained using frequencies between 30Hz and 500Hz.
- One hundred to 250 trials were averaged depending on the signal to noise ratio of the single trials.

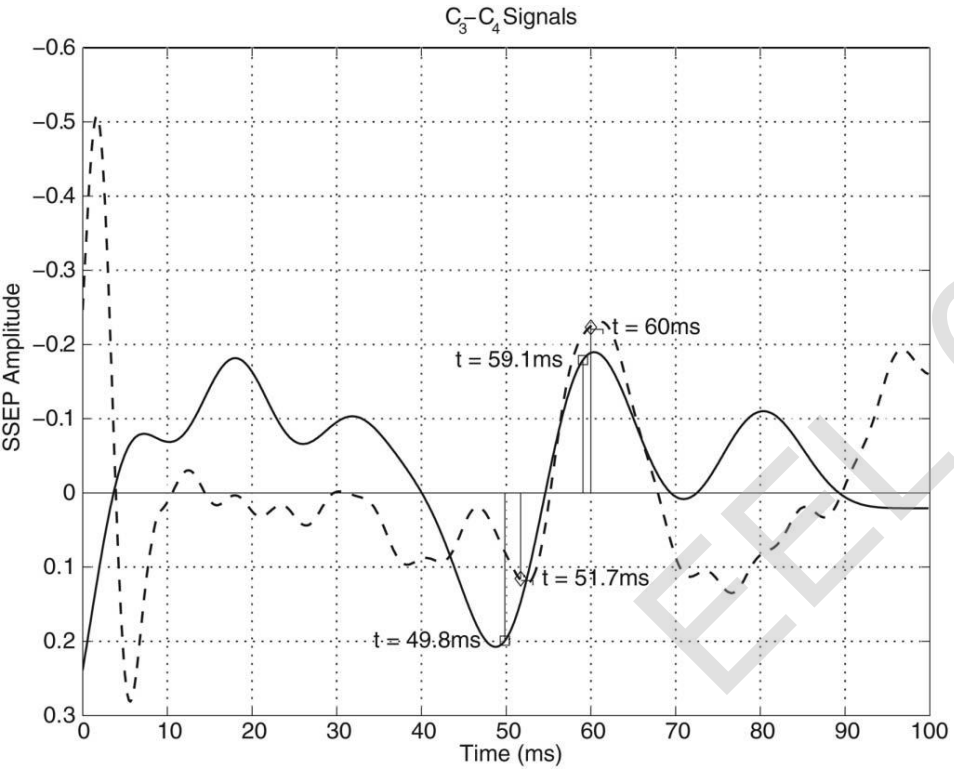
SSEP

- The process aims to detect the *P37* and *N45* peaks in the SSEP signal maintaining a 10% time latency deviation and a 50% peak-to-peak amplitude deviation with a minimum number of trials.

- The choice of 10% and 50% for the time latencies and peak-to-peak amplitude is based on generally adopted clinical standards



SSEP



Comparison between the results (C3-C4) of the algorithm using fewer trials (solid line) and the clinical data using 200 trials (dotted line).

The time values on the solid line markers are the time instances of the SSEP selected by clinical experts.

SSEP

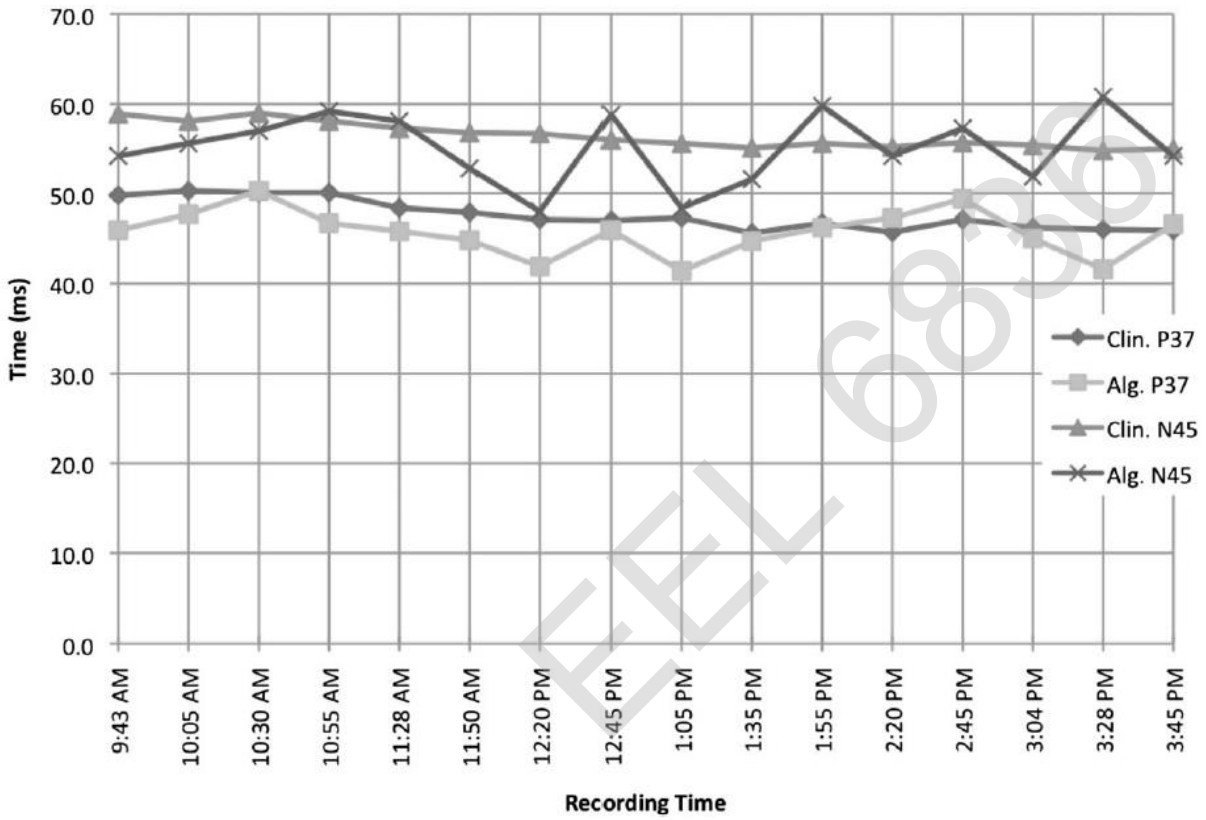


Figure shows the consistency in detecting P37 and N45 peak latencies from the CZ-FZ recording (algorithm vs. clinical)