PRE-COME ON EVENT

WIDE-BAND EEG WORKSHOP

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How to Analyze Wide-Band EEG

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Analysis recommendations

- Ictal DC shift
  - Display condition (intracranial EEG)
  - Practical (operational) definition of ictal DC/ slow shifts
  - DC shift analysis by EEG Review Software
  - Analyzing DC shift with Scalp EEG
  - EEG potential by EOM
  - Reproducibility
- Ictal HFO
  - Time frequency analysis on the EEG review software
  - Select appropriate frequency resolution
  - Hum (AC) artifact
  - Baseline for TFR

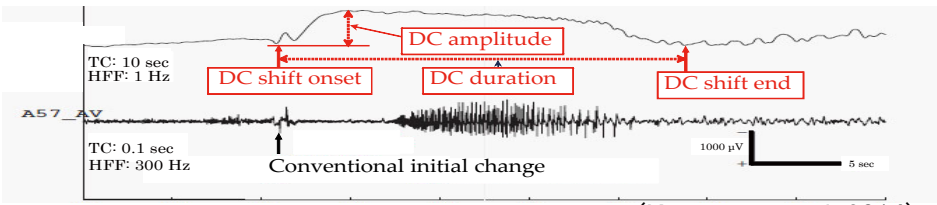
Display condition (intracranial EEG)

1) Referential montage is recommended as display montage
2) System reference electrode should not be epileptically irritative and the metal should be identical to that of recording electrode, i.e., platinum scalp electrodes,
3) System reference electrode and display reference electrode are initially identical in order to avoid any mis-reformating, i.e., mastoid process skin electrodes.
4) Once initial, display reference electrode was not suitable (i.e., motion artifacts, etc.), it could be changed to 1) non-irritative subdural electrode or 2) averaged electrode activity.

(Ikeda et al., 1999; Kanazawa et al, 2014)

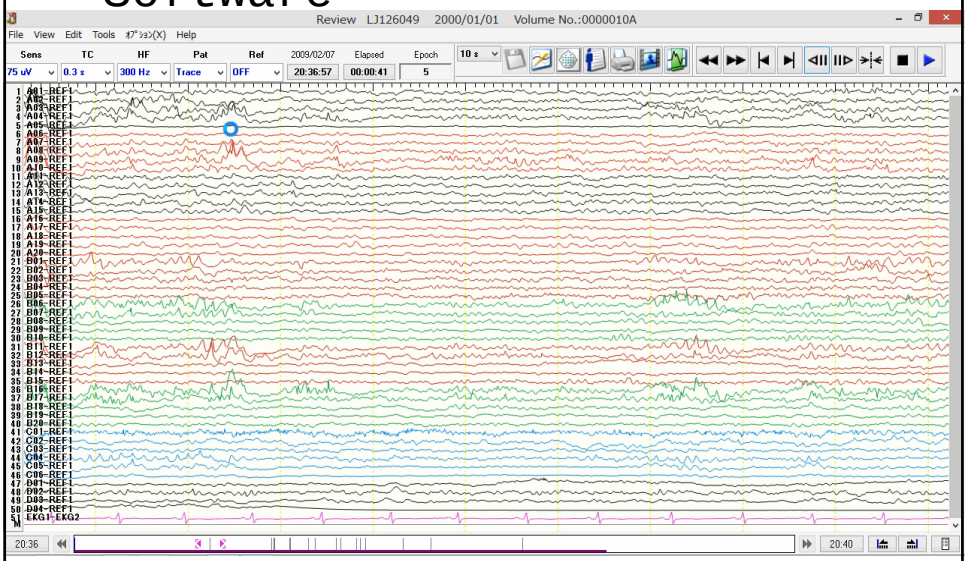
Practical (operational) definition of ictal DC/ slow shifts (Ikeda et al.,1999)

1) Not detected by TC 0.1 s, but only detected by opened LFF (=becomes clearer with longer time constant, i.e., by changing from 0.1 to 10)
2) Usually negative (or infrequently positive) in polarity, >3sec in duration, peak to peak amplitude along the entire waveform of at least 200 microV, preferably >1mV.
3) Reproducible in waveforms, duration and location.



(Kanazawa et al, 2014)

DC shift analysis by Review Software

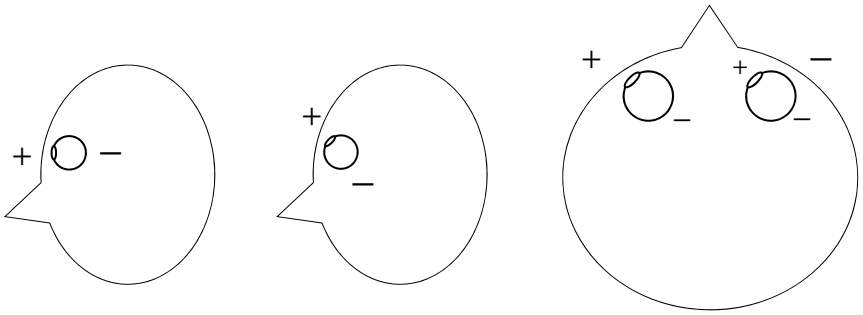


Recording condition: Sampling rate=2kHz, TC=10s, HFF=300Hz

Analyzing DC shift with Scalp EEG

- Time Constant 2 seconds
- Use Transverse Bipolar montage to exclude roving eye movement.
- Use Average Reference montage to detect focal infra-slow activity.
- Check reproducibility, as scalp EEG is more prone to artifacts like body movement, perspiration, DC drift, etc.

EEG potential by EOM



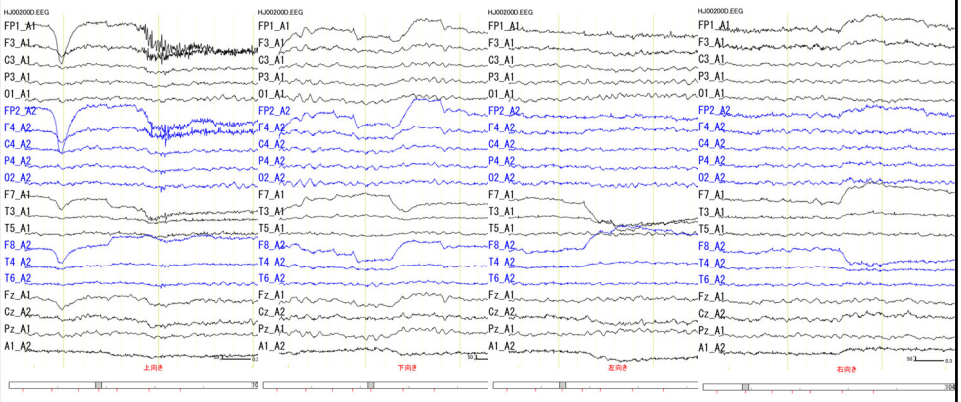
Eyes Open

Eyes Closed
(Bell's phenomenon)

Left gaze

Eye Movement

Time Constant = 2.0 s, Earlobe Reference



Up

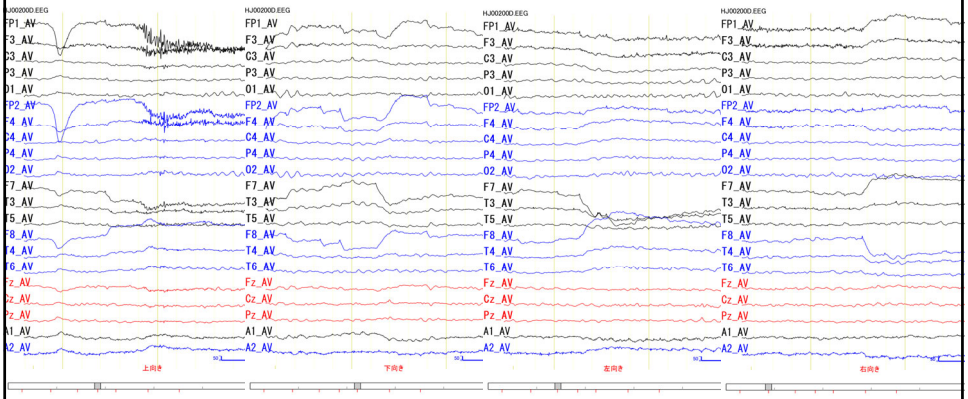
Down

Left

Right

Eye Movement

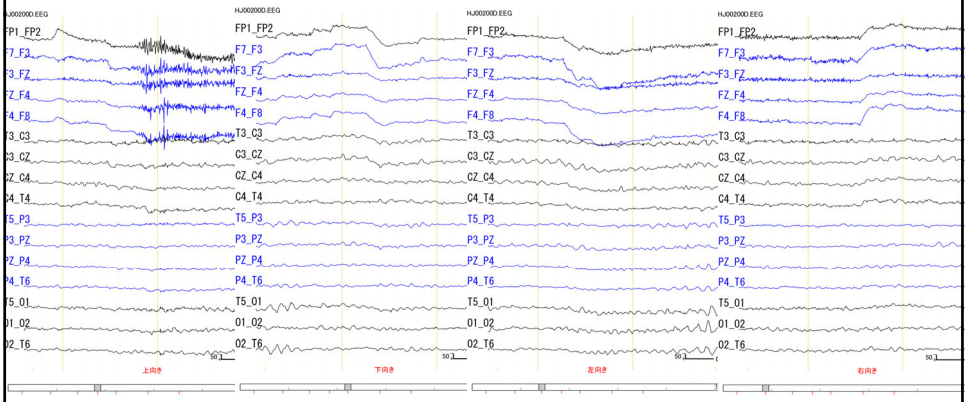
Time Constant = 2.0 s, Average Reference



Up Down Left Right

Eye Movement

Time Constant = 2.0 s, Transverse Bipolar montage



Up Down Left Right

Eye movement to Left, not ictal DC shift

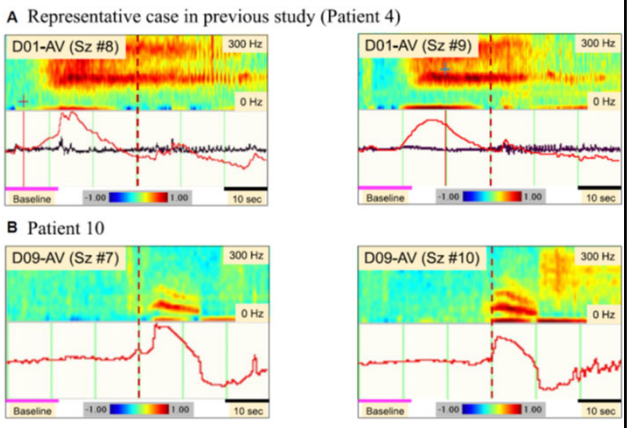
Sens 10uV, TC 2s, HF 15Hz, Average Refference, 30s display

Eye movement to Left, not ictal DC shift

Sens 10uV, TC 2s, HF 15Hz, Transverse Bipolar, 30s display

Reproducibility

- Confirmation through multiple events (Seizures)
- Patients may show more than one patterns



Nakatani et al, 2022, Brain Commun

Ictal HFO (High frequency oscilation)

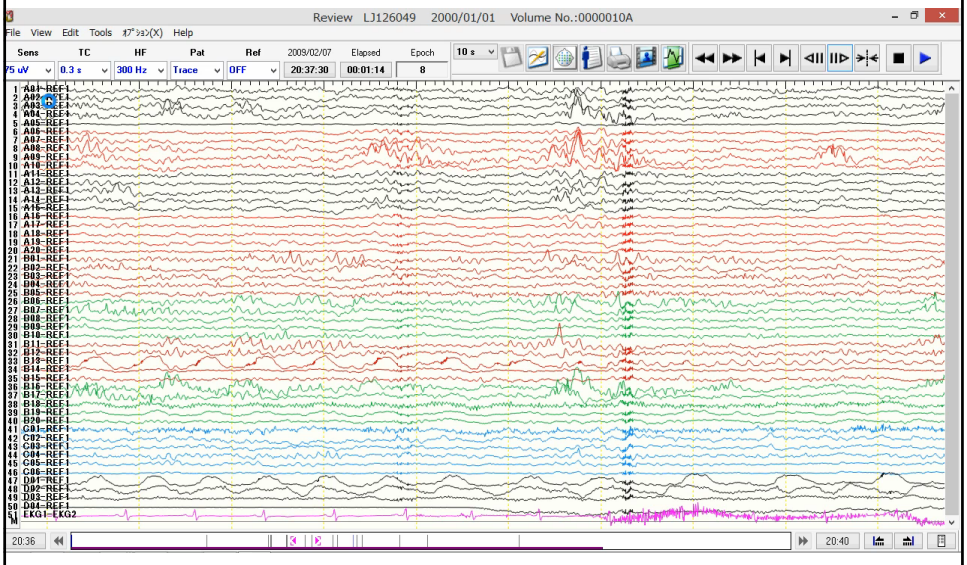
- Ripple – 80–200(250) Hz
  - Fast postsynaptic potentials
- Fast Ripple – 250–400 Hz
  - Bust of action potentials
- Typically, band-like sustained power increase above 80 Hz.
- Reproducibility of HFO pattern

Ictal HFO by scalp EEG

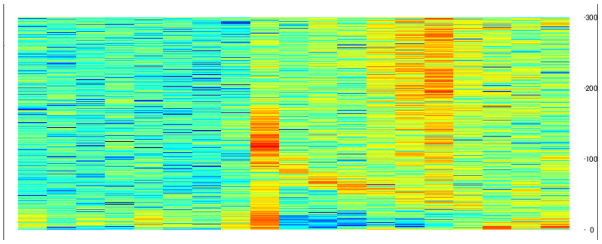
- Fast Activities (FAs): > 30 Hz
- HFOs: > 80 Hz
- These are clearly distinguishable from pre-seizure background activity.
- Persists in bands in Time-Frequency display.
- Reproducibility of HFO pattern

Time frequency analysis on the EEG review station (+-60sec)

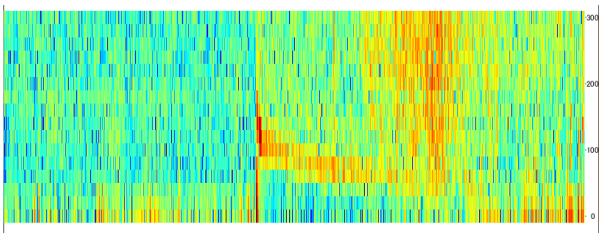
Collaboration with Nihon Kohden （HFO up to 600Hz and DC shifts shown together in the review station)



Select appropriate frequency resolution

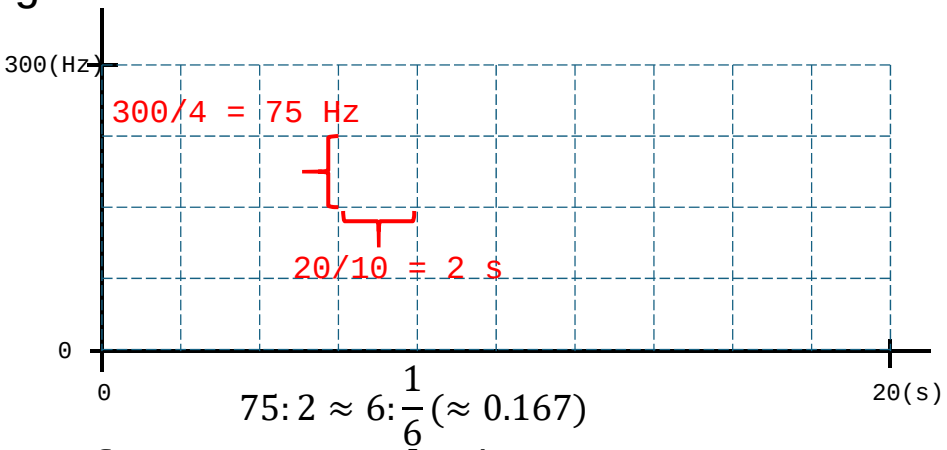


Time resolution too low



Frequency resolution too low

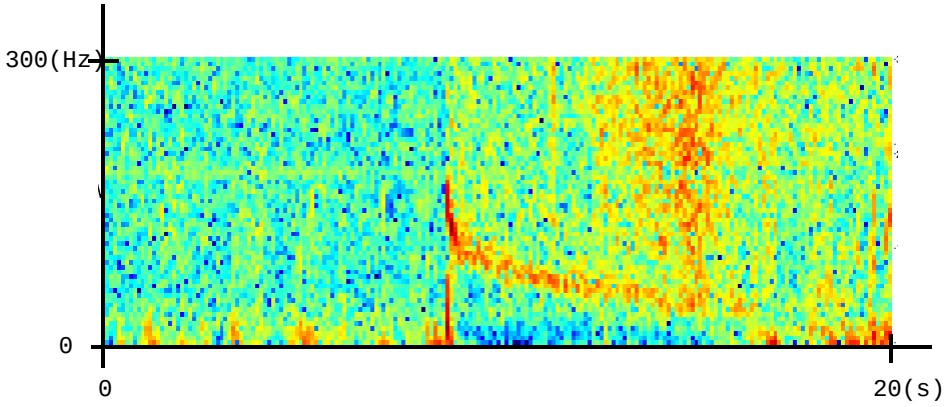
Fill the area with square grids. Choose frequency and time resolution the same ratio as the grid size.



$75:2 \approx 6:\frac{1}{6} (\approx 0.167)$

⇒ frequency resolution ≒ 6Hz ⇒ try 5Hz

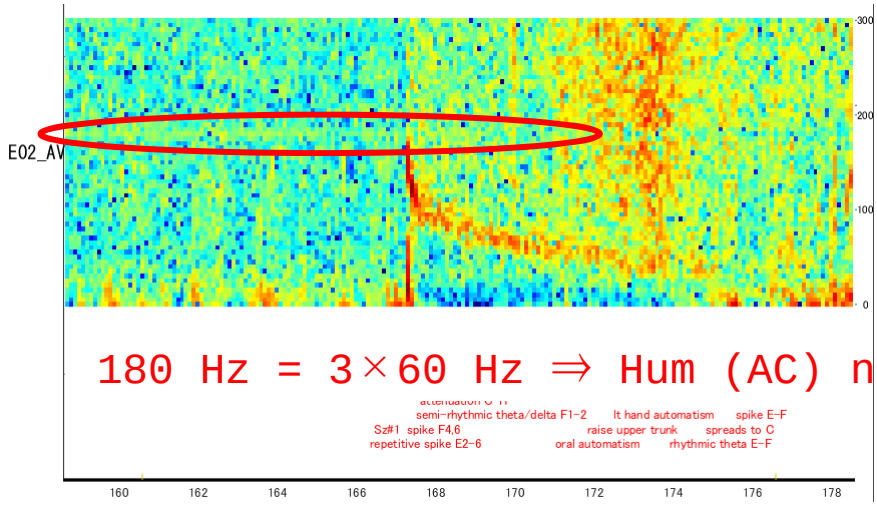
Draw a graph area of your target phenomenon



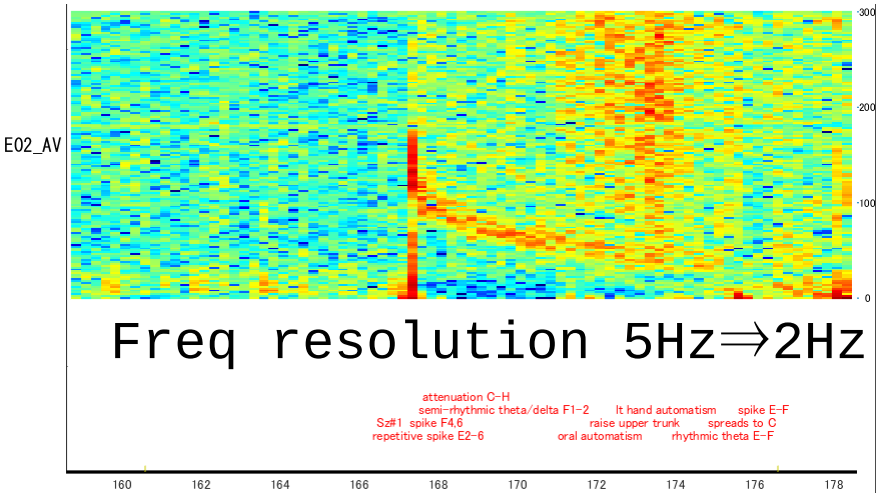
Hum (AC) artifact

- There may be artifacts in harmonic frequencies in addition to fundamentals.
  - 50 Hz, 100 Hz, 150 Hz, ...
  - 60 Hz, 120 Hz, 180 Hz, ...
- Long FT size (fine frequency resolution) may reduce the effect of artifact.

Hum (AC) artifact



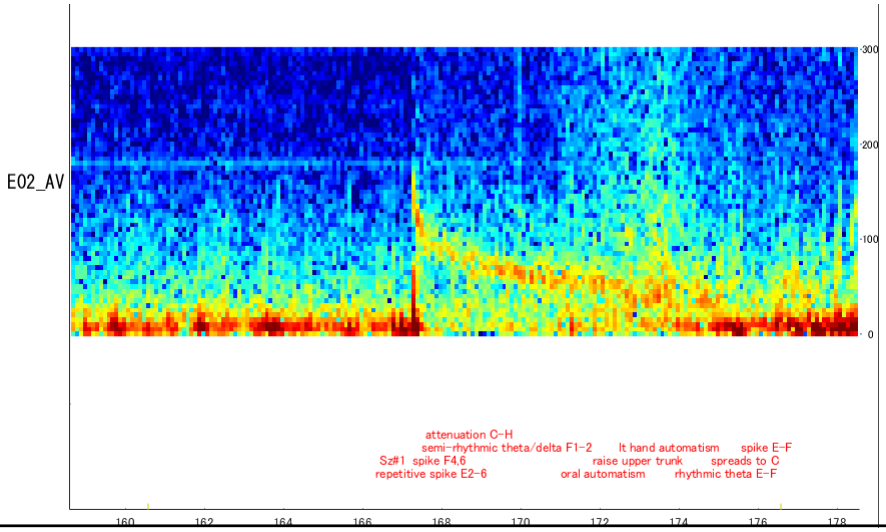
Use longer FT size to make the effect smaller



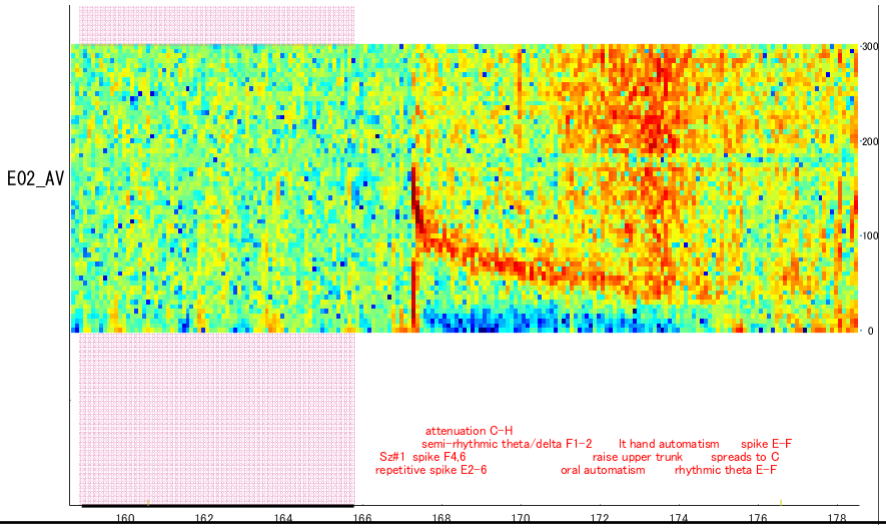
Baseline for TFR

- Baseline before TFR calculation is not useful (affects 0Hz value only)
- Appropriate baseline for display, after TFR calculation, is important.
- $10 \times Log_{10}$ of power is sometimes used for baseline correction. Unit is dB (“decibel”.)
- Selection of Baseline period— Commonly pre-ictal period.

Without baseline correction



Baseline in pre-ictal period



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