

Specific Aims for SPSF EEG Solution

- SA1: Based on the concept of Striatal Beat Frequency (SBF) we will define a bank of single-period single-frequency sinusoids (SPSF) to detect dominant SBFs within publicly available data sets.**
- SA2: Produce an SPSF-based SBF visualization tool for clinician appraisal and commercial transition partners.**
- SA3: Determine to what level of validity, specificity, and accuracy the SBF method can detect Non-Convulsive Status Epilepticus (NCSE auras) or seizures at large.**
- SA4: Determine to what level the patient is more responsive to earlier intervention with medicine due to aura detection through identifying patient-personalized periods of SPSFs, pre/post-epileptic seizure; goal > ten seconds.**

Potential Product use cases for EEGs

Post Traumatic Stress Disorder (PTSD) \$232.2 billion annual costs as of 2018

(<https://www.apa.org/monitor/2023/01/staggering-ptsd-costs>)

- \$232.2 billion annual costs as of 2018, \$26K/\$18K per military/civilian
- Occurs more frequently among active-duty military than civilians, but less among veterans than civilians
- • **PTSD split 66.4% share of women, 33.6% of men**
- What are anticipated savings? (lives and money)

Early-onset detection of nonconvulsive status epilepticus (NCSE)

- • **SBF oscillations are short lived**, only lasting for one or two oscillations before rest and re-bursting.
- Determine level of validity, specificity, and accuracy the SBF method can detect NCSE or seizures at large.
- Determine to what level the patient is more responsive to earlier intervention with medicine.
- Determine to what level the neurocritical care unit is able to administer care to the patient in a timely-manner

The efficacy of this uniquely fundamental approach offers:

- • **Earlier personalized detection** and characterization which may lead to lowering staggering treatment cost
- Lowering suicide rates and improving quality of life for family members.
- A positive way for Veterans to see their own improvements

EEG data acquired courtesy of through G-Tec's Albany, NY Lab and a Data "Basis" each from MIT and Temple U

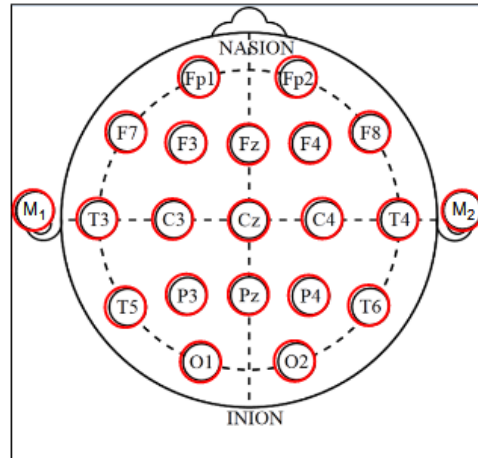
g.tec medical engineering GmbH

Out of Austria, office in Albany, NY
Guger had me meet up with Fan Cao,
Tech/Sales Rep Fan Cao,
he recorded my own EEG,
just three electrodes, for 30 seconds,
sample rates: 512 Hz, 2KHz, 19KHz.

Noise FREE of 60 Hz (yes, it's possible)

This data was basis for the patent,
and yes,
it took a long time to calculate
the SPSF matrix of CCs.

10/20 Montage



Channel 1: FP1-F7	Channel 13: FP2-F8
Channel 2: F7-T7	Channel 14: F8-T8
Channel 3: T7-P7	Channel 15: T8-P8
Channel 4: P7-O1	Channel 16: P8-O2
Channel 5: FP1-F3	Channel 17: FZ-CZ
Channel 6: F3-C3	Channel 18: CZ-PZ
Channel 7: C3-P3	Channel 19: P7-T7
Channel 8: P3-O1	Channel 20: T7-FT9
Channel 9: FP2-F4	Channel 21: FT9-FT10
Channel 10: F4-C4	Channel 22: FT10-T8
Channel 11: C4-P4	Channel 23: T8-P8
Channel 12: P4-O2	Channel 24: ECG

Chb-mit-scalp-eeG-database (seizure)

File Name: chb08_21.edf, fs=256 Hz

Start	Stop	Label
1679	1781	seiz
3782	3898	seiz

Temple University (Picone)

Seizure Detection Corpus

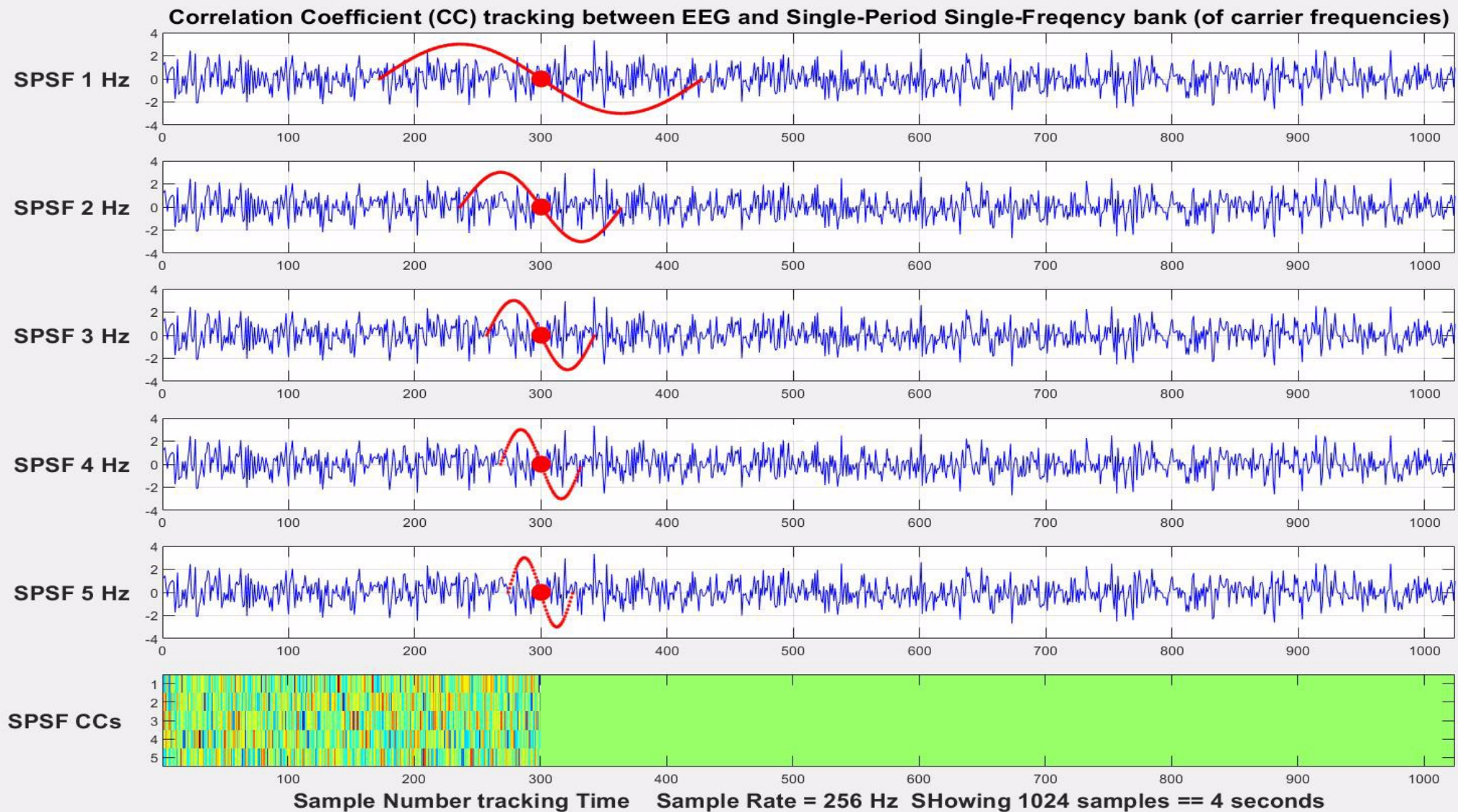
01_tcp_ar, aaaaaarq_s017_t001

2014_06_29

601.00 secs, fs=256

Start	Stop	Label
179.02	198.98	seiz
289.00	311.98	seiz
327.02	337.83	seiz
365.03	385.00	seiz
436.01	448.05	seiz

SPSF Demo (click by arrow)



Contrasting DFT, Wavelets, and SPSFs

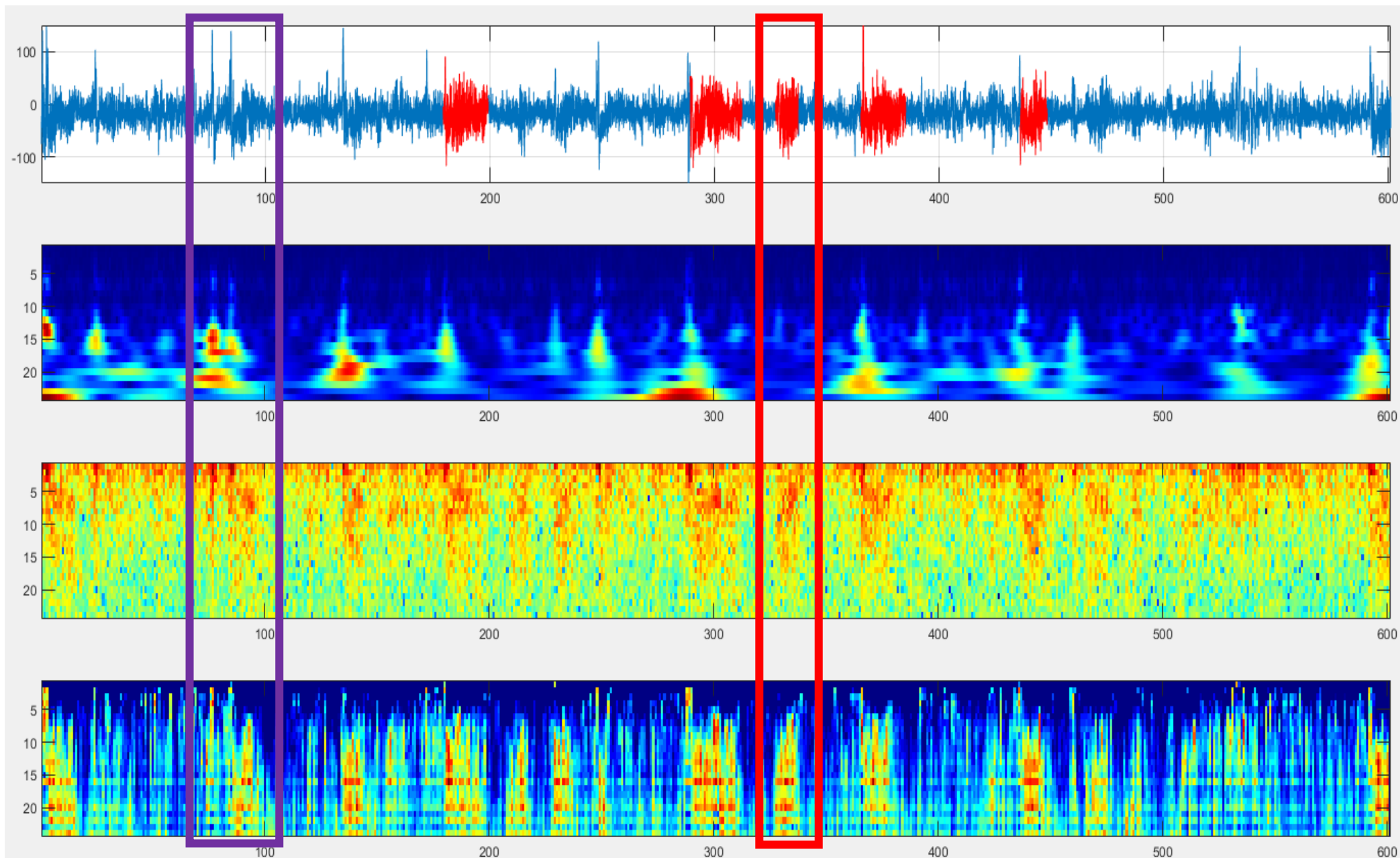
(Temple data set)

aaaaaarq
s017_t001
256 Hz

Morlet Wavelets
Selecting 25 of 40
“convolutions”
which ARE NOT
Correlation coefficients

Window FFT
1 Hz resolution
no-overlap

SPSF
which are
Correlation Coefficients
covering 1:25 Hz



Drawing from SPSF matrix, Clinician **reads** the beats (like an ECG tape)

Recorded 8000 pts. at 256 pts./sec ~ 31 seconds

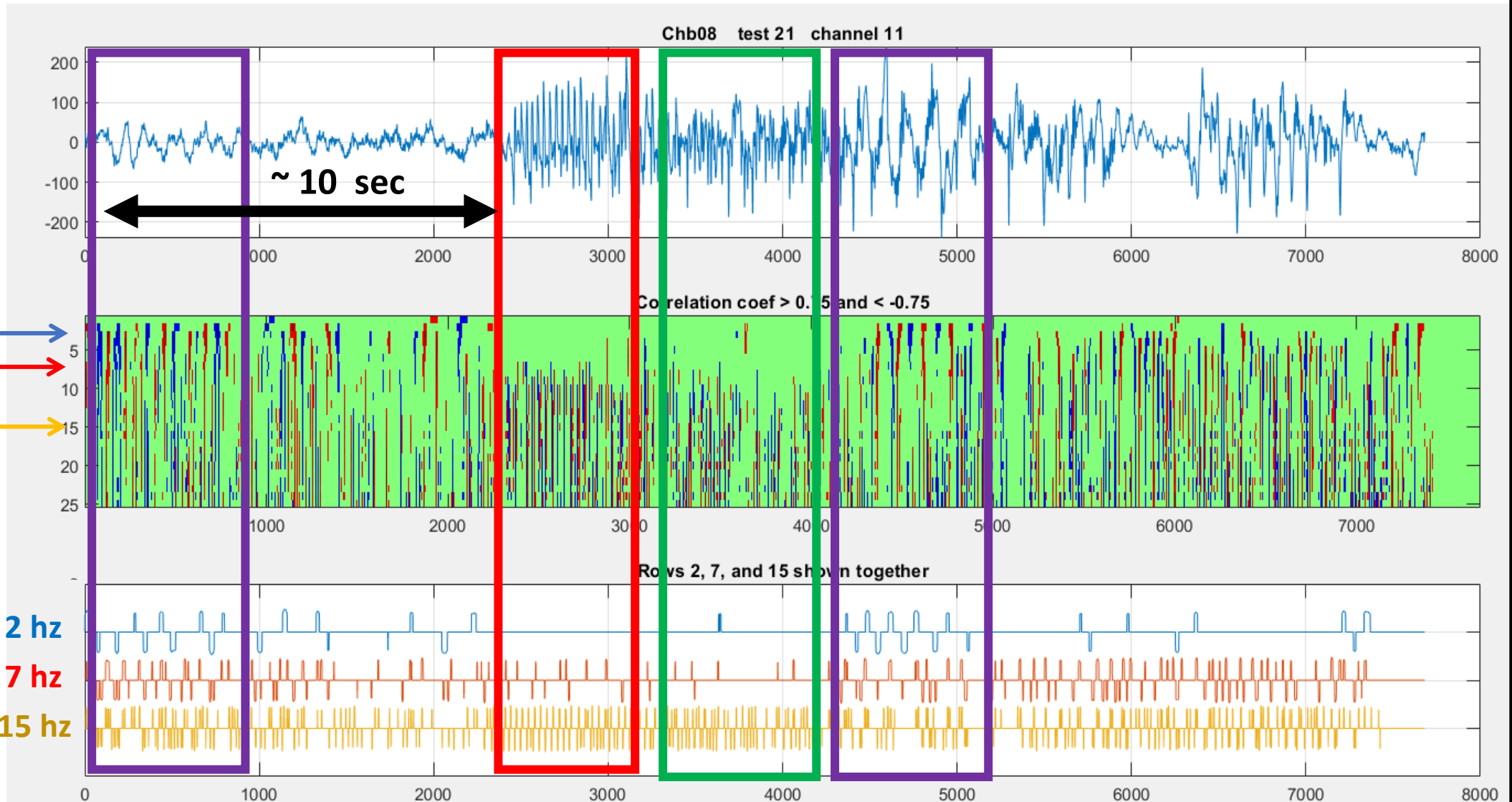
MIT data base

Case
chb08_21

SPSF
matrix
25 x 7680

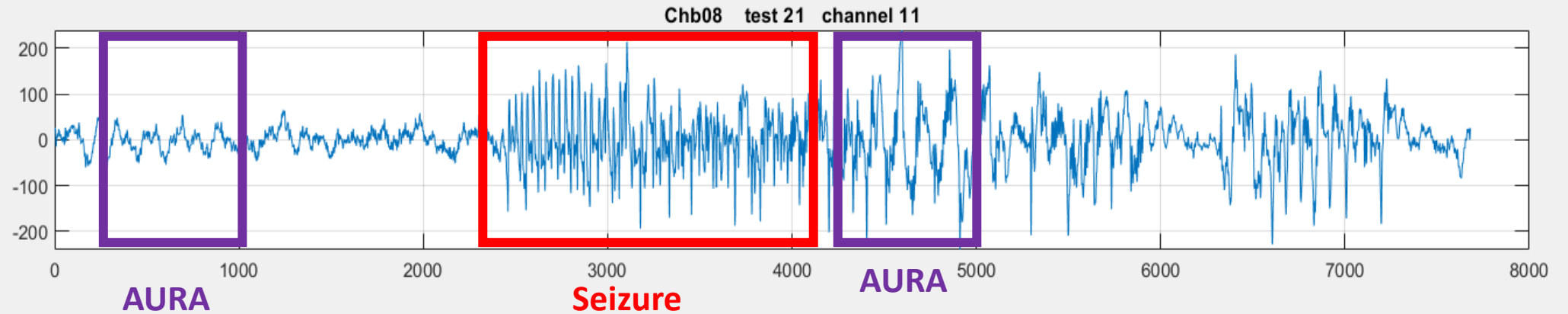
Reading
the
beats

Row 2 hz
Row 7 hz
Row 15 hz



"ON/OFF beating" features of a 30 second Epileptic seizure, using data from MIT EEG data base

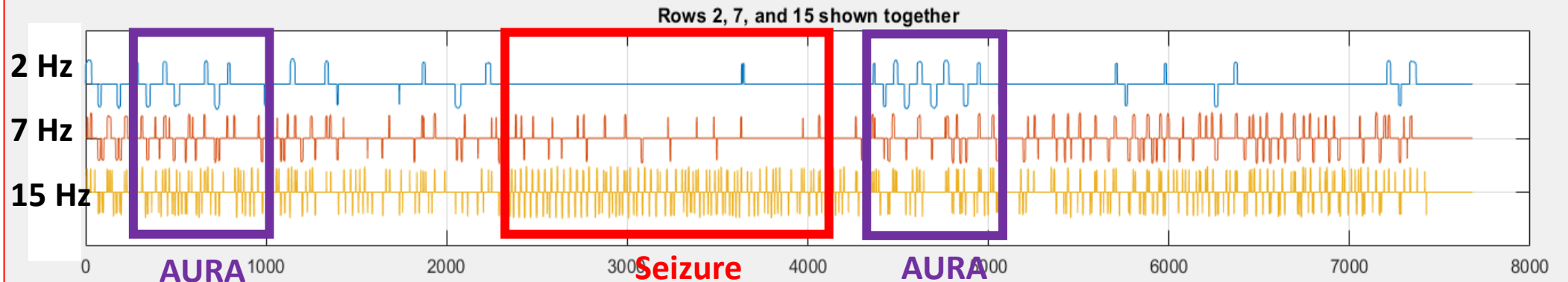
RAW EEG



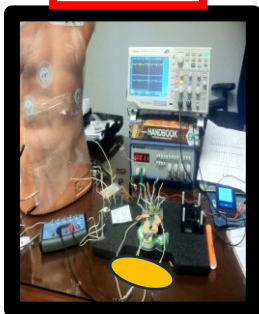
SPSF
Single
Frequency
Single
Period

Purple boxes represent pre/post auras of EEG contrasting Raw to SPSF monitoring
Beat pattern at 2 Hz equally spaced in Aura #1, off during Seizure, back on in Aura #2
Beat pattern at 15 Hz shows random beat intervals during aura, but then takes on regular spacing pattern during seizure, the returns to non-regular spacing at second aura.

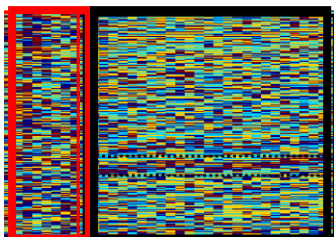
SPSF
Monitoring
Patient
Chb08



Heart



NC002695
Genomes 'talk'



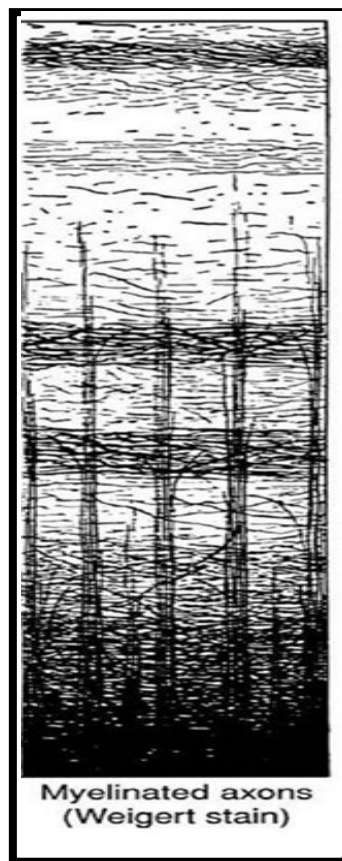
inspired by
John Butler
DNA Forensics

“Real” neurons produce beat patterns

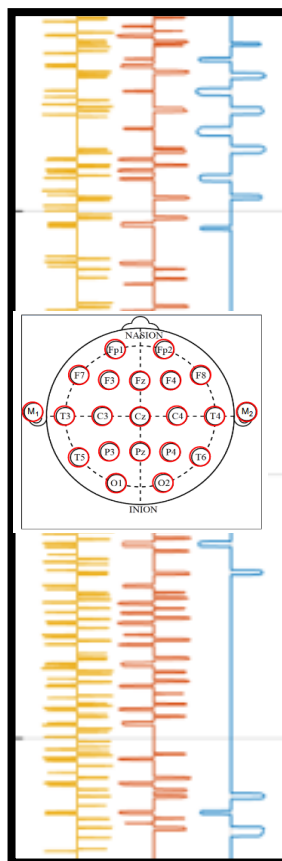
Analyzing EEG with Single-Period Single-Frequency Sinusoids

Patent No.: **US 11,179,085 B2**

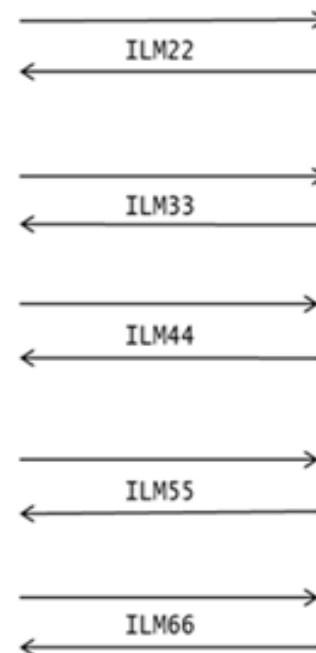
Date of Patent: **Nov. 23, 2021**



Myelinated axons
(Weigert stain)



Bridging
Real2Imag



“Imaginary” neurons produce classes (sight, sound, touch, taste, smell)

JPAT for Neural Networks

Patent No.: **US 10,242,313 B2**

Date of Patent: **Mar. 26, 2019**

Left Eye

Bridging
CNN2CNN

Right Eye

