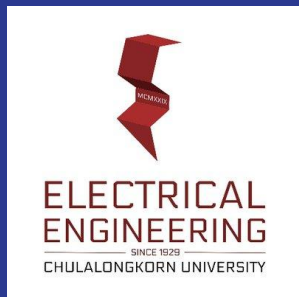
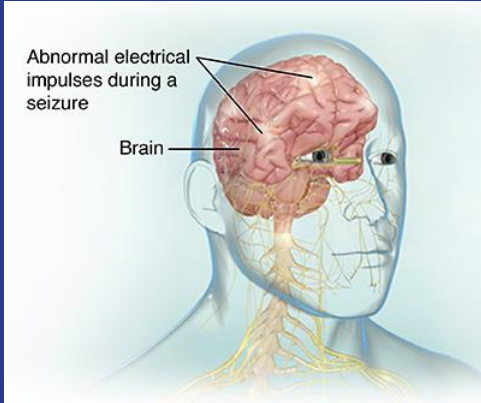


AUTOMATIC EPILEPTIC SEIZURE ONSET-OFFSET DETECTION BASED ON CNN IN SCALP EEG

Poomipat Boonyakitanont, Apiwat Lek-utai, Jitkomut Songsiri
Electrical Engineering, Chulalongkorn University, Thailand.



IMPORTANCE



- More than 65 million affected people
- Seizure duration required for treatments
- Time-consuming and laborious process

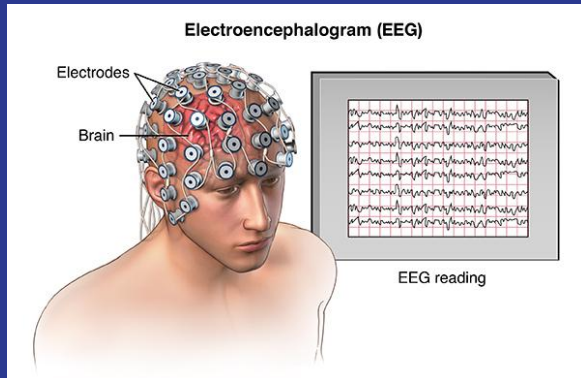


Figure source: <https://www.hackensackumc.org/>

CHALLENGE

- No consensus, unpredictability, rarity, and variety

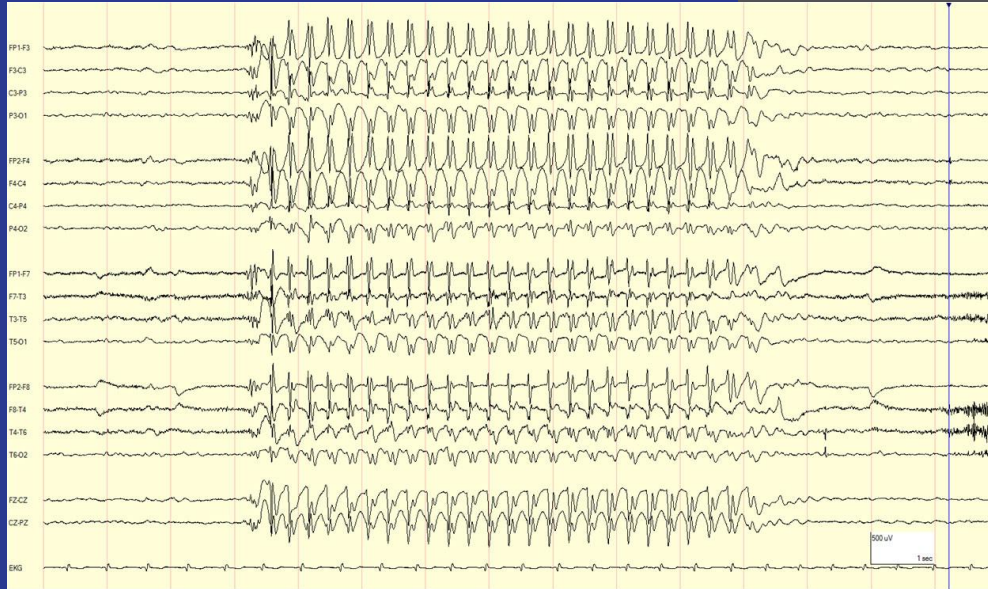


Figure source:

<https://www.epilepsydiagnosis.org/seizure/absence-typical-eeeg.html>

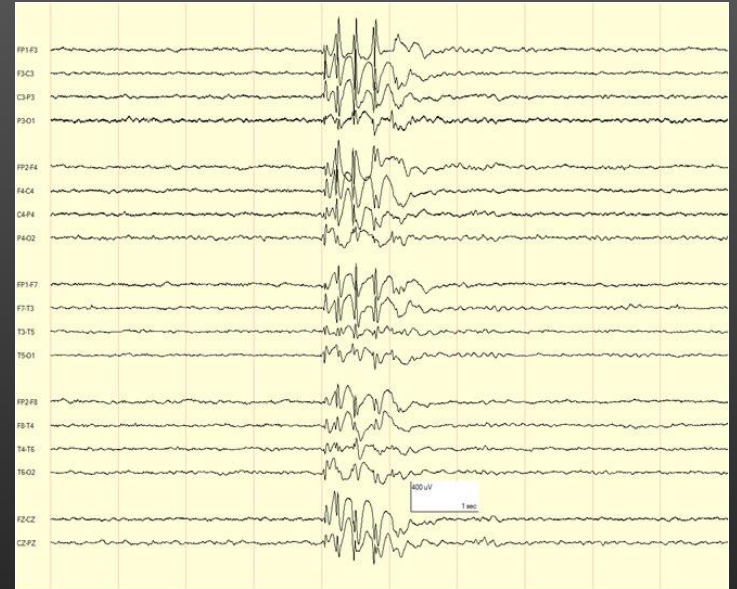
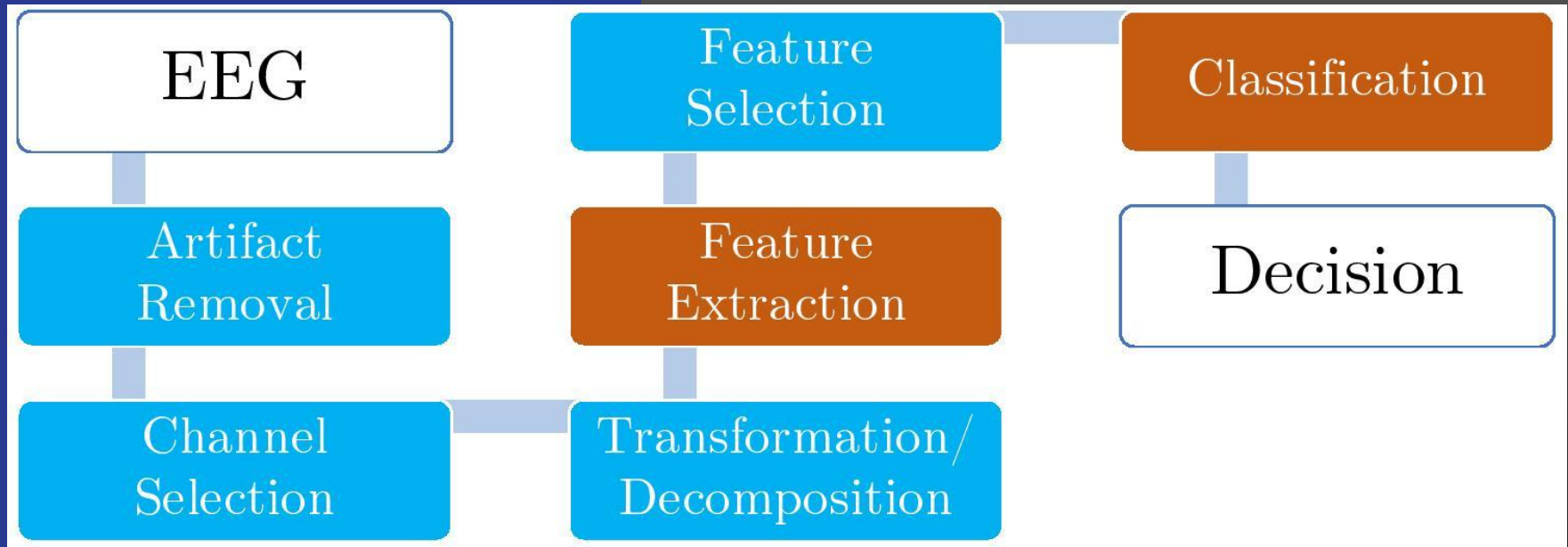


Figure source:

<https://www.epilepsydiagnosis.org/syndrome/jae-eeeg.html>

SEIZURE DETECTION

- Seizure detection from EEG segment
[Boonyakitanont et al. \(2020\)](#)
- Individual detection



ONSET/OFFSET DETECTION

Shoeb et al (2011)	Spectral energy + SVM	Requiring onset detection
Orosco et al (2016)	Stationary Wavelet Transform + Relative energy + LDA	High FPR/h, large latency ranges
Chandel et al (2019)	Triac Wavelet Transform + Statistical features + LDA	High FPR/h, large latency ranges

- No method based on clinical criteria
- Misleading metrics

METHODOLOGY

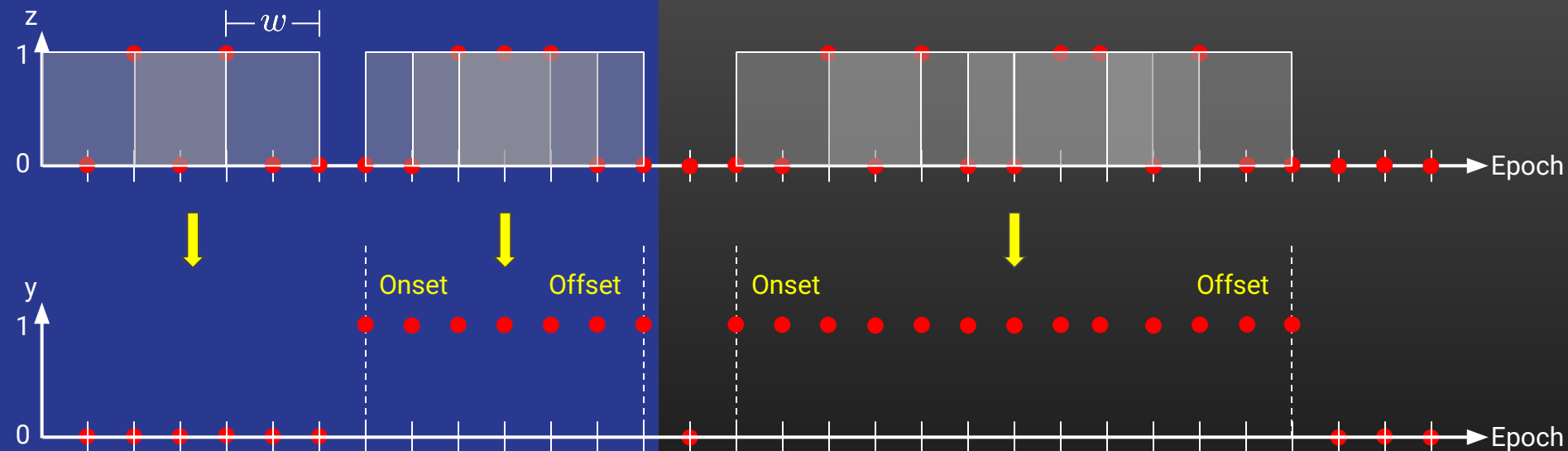
Post-process

Clinical criteria

- No too small isolated seizure event
- Combine near seizure neighbors

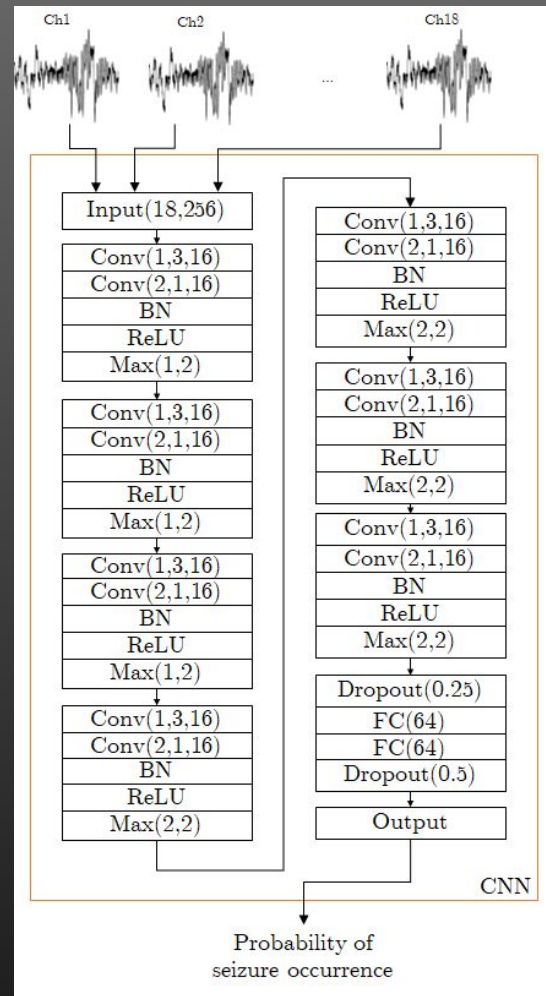
Method

- Group windows having more than p overlaps and disregard the others



EXPERIMENT

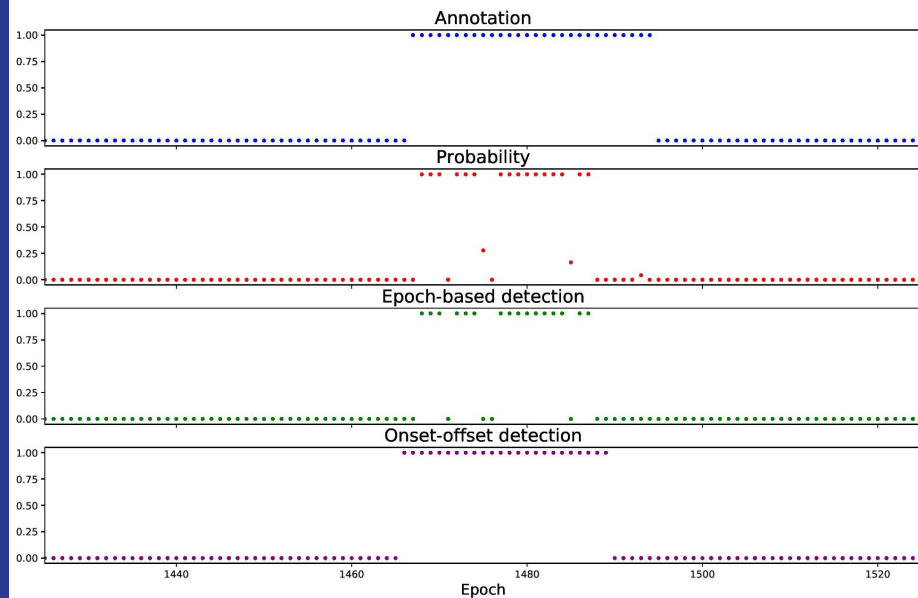
- **Full** CHB-MIT database with patient-specific scheme
- Channels: FP1-F7, F7-T7, T7-P7, P7-O1, FP1-F3, F3-T3, T3-P3, P3-O1, FP2-F4, F4-C4, C4-P4, P4-O2, FP2-F8, F8-T8, T8-P8, P8-O2, FZ-CZ, and CZ-PZ
- Metrics
 - Event-based: GDR and FPR/h
 - Epoch-based: Acc, Sen, Spec, and F_1
 - Time-based: Onset and offset latencies



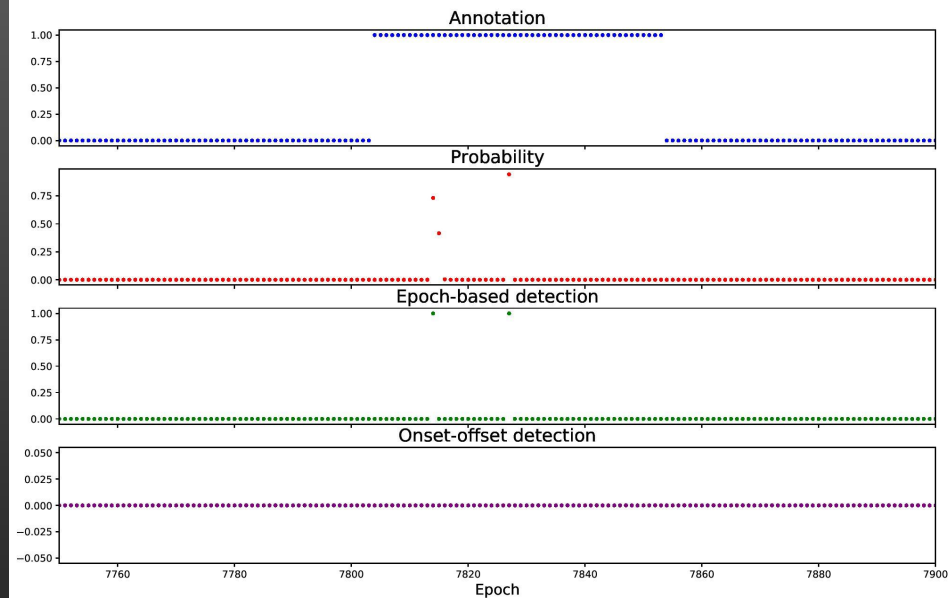
RESULT

When $w = 2, p = 2$

Results from chb01_04



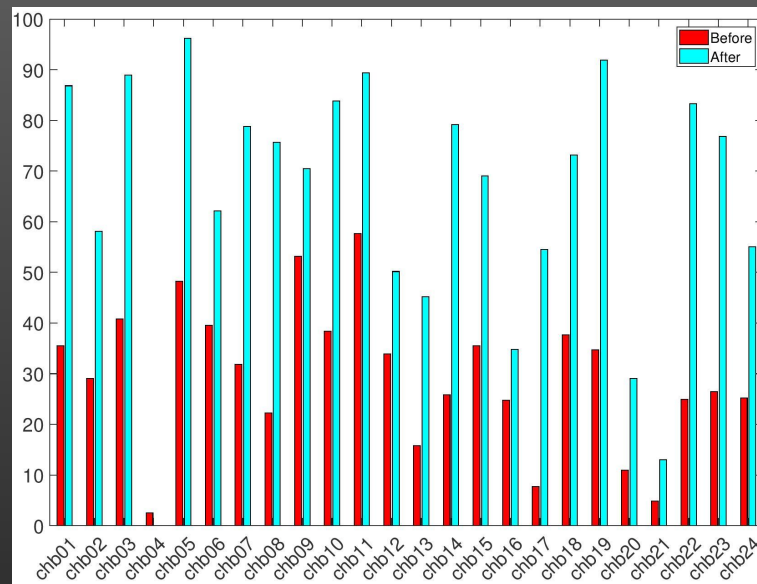
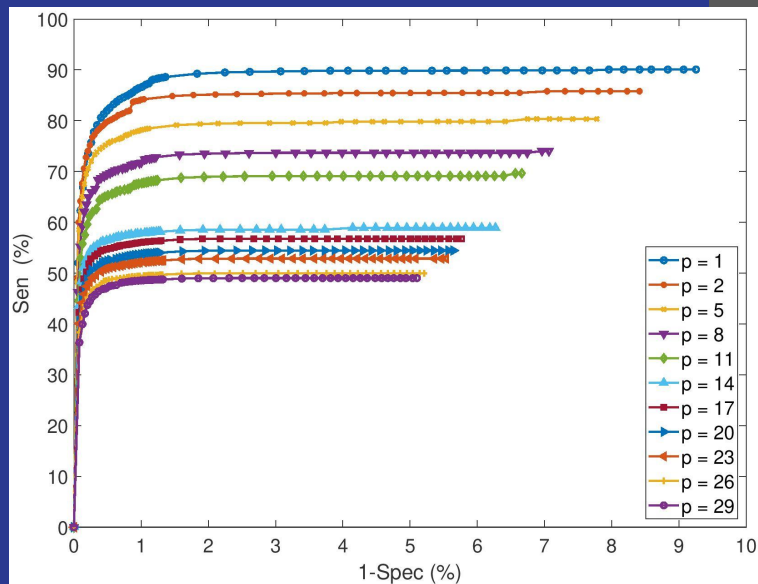
Results from chb04_05



Fix epoch-based classification

Ruin epoch-based classification

RESULT



- Sen is improved when increasing w and decreasing p
- Spec is slightly affected by w and p
- $w = 6, p = 2$ maximize F_1

COMPARISON

Before/after post-process

Metrics	Before	After
GDR (%)	91.38	83.41
FPR/h	1.99	0.12
Acc (%)	99.67	97.72
Sen (%)	42.34	72.78
Spec (%)	99.91	99.82
F_1 (%)	29.47	64.40

Previous studies

		Our work	Orosco et al (2016)	Chandel et al (2019).
Onset lat.	Min	-9.00	-28.00	-10.00
	Max	12.00	14.40	9.67
Onset lat.	Min	-39.20	-24.20	-6.00
	Max	9.33	60.20	52.67
Abs onset lat.	Mean	5.83	-	-
	Min	1.50	-	-
	Max	13.33	-	-
Abs offset lat.	Mean	10.12	-	-
	Min	2.00	-	-
	Max	40.00	-	-

RECAP

- Seizure onset and offset detection.
- Post-processing technique based on clinical criteria.
- Significant improvement on epoch-based detection
- Comparable onset latency range and less offset latency range

THANK YOU



Poomipat Boonyakitanont



Apiwat Lek-utai



Jitkomut Songsiri

Electrical Engineering,
Chulalongkorn University, Thailand