

# DETECTION ALGORITHM OF EPILEPTIC DISCHARGES AND SLEEP SPINDLES IN RATS IN EARLY POSTTRAUMATIC PERIOD

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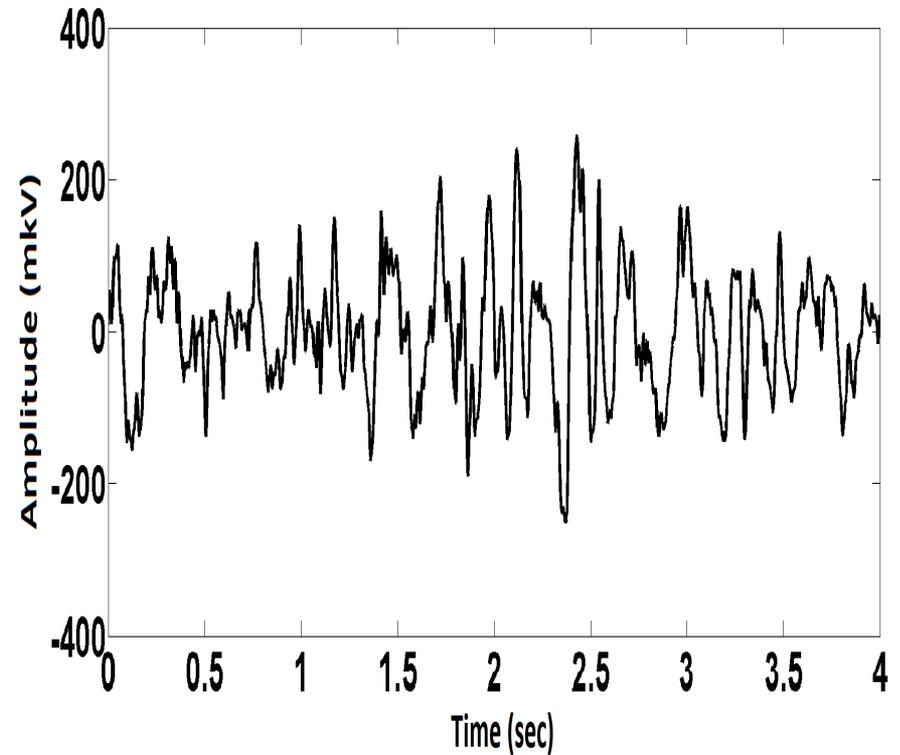
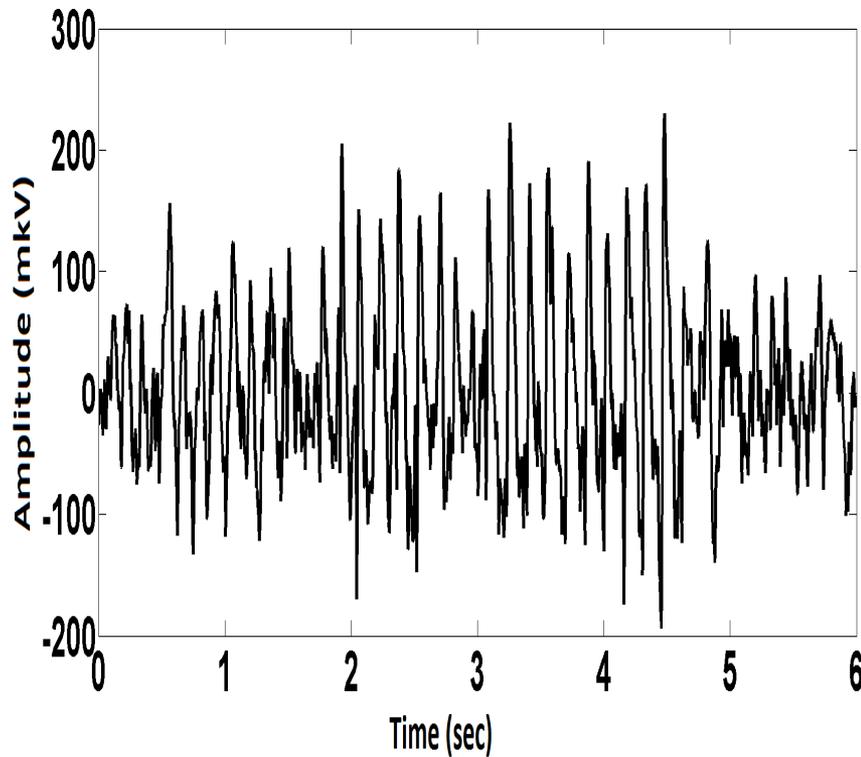
# Introduction

- Posttraumatic epilepsy is a serious medical and social problem.
- Prediction of posttraumatic epilepsy in clinical practice is the unsolved problem.
- There is the problem of recognition of sleep spindles and epileptic discharges in the study of early post-traumatic period

# Types of signals

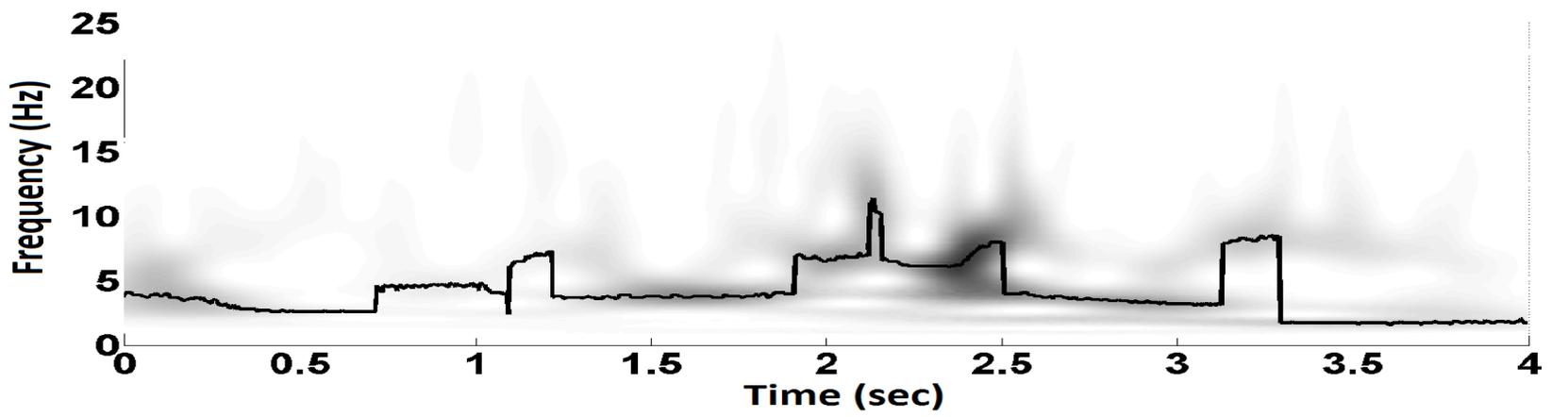
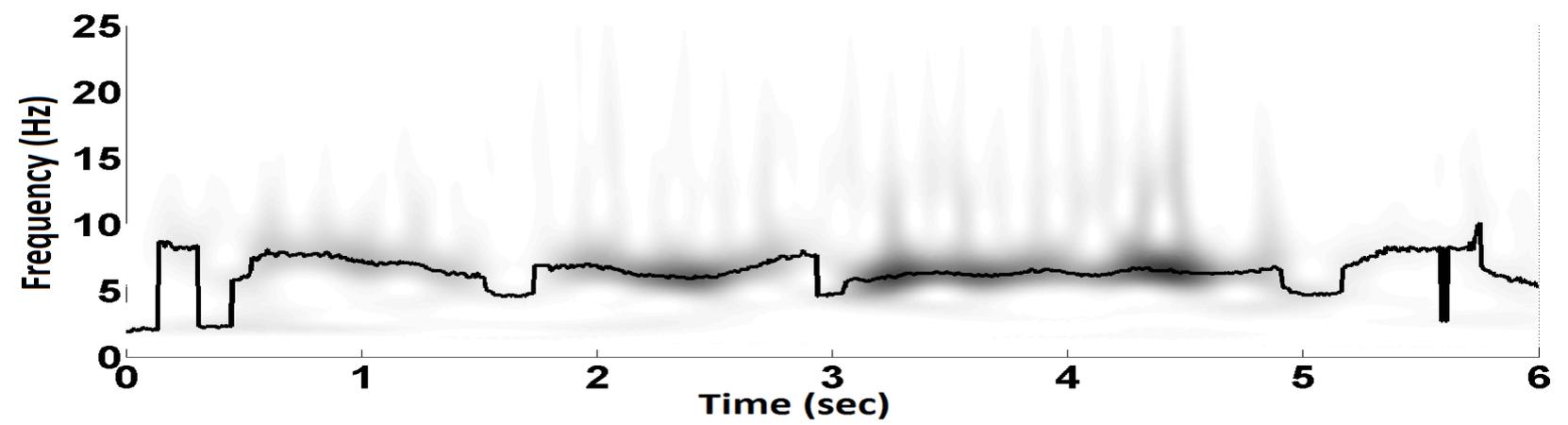
*epileptic discharges (left figure)*

*sleep spindles (right figure)*



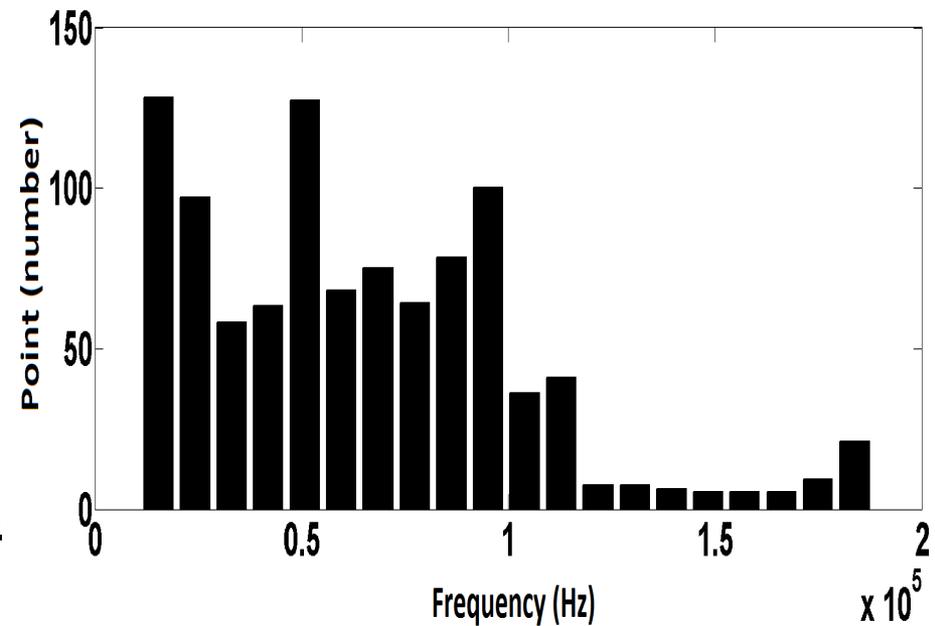
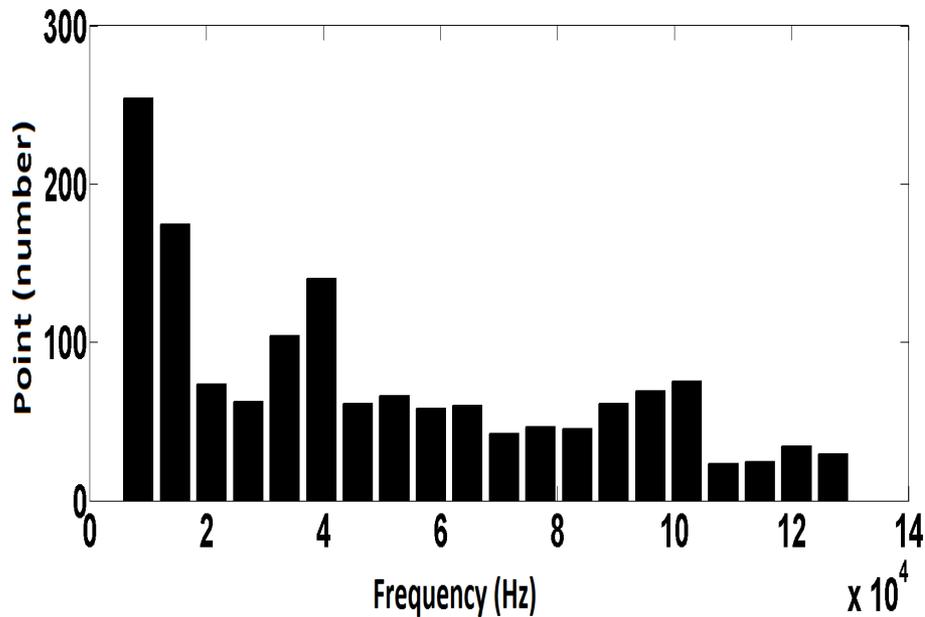
# The ridges of the wavelet spectrograms

*epileptic discharges (upper figure)*  
*sleep spindles (lower figure)*



# Histograms of power spectral density (PSD)

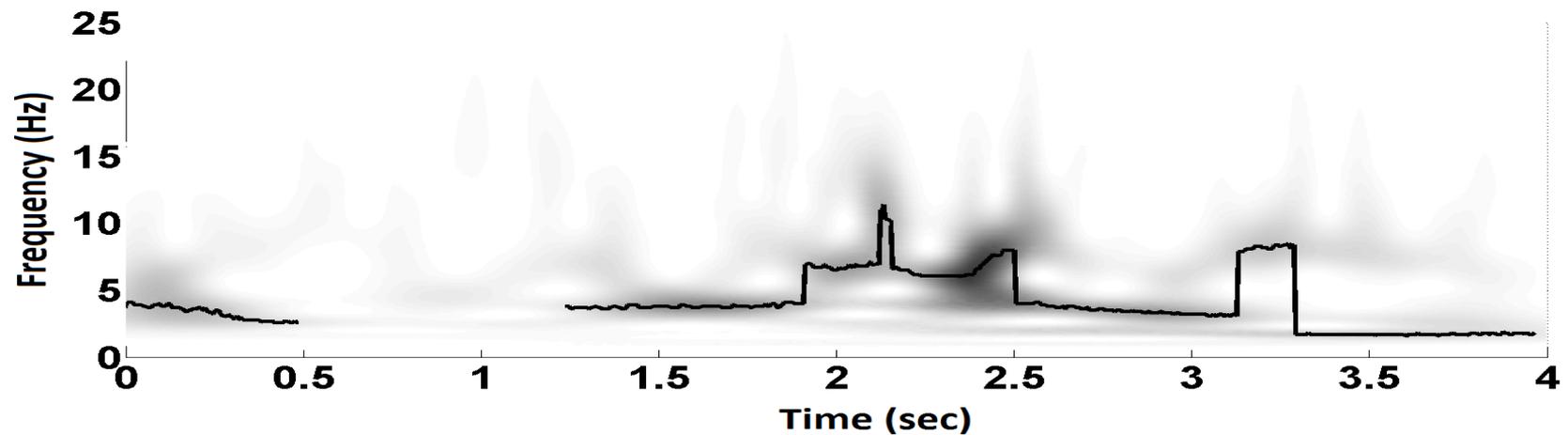
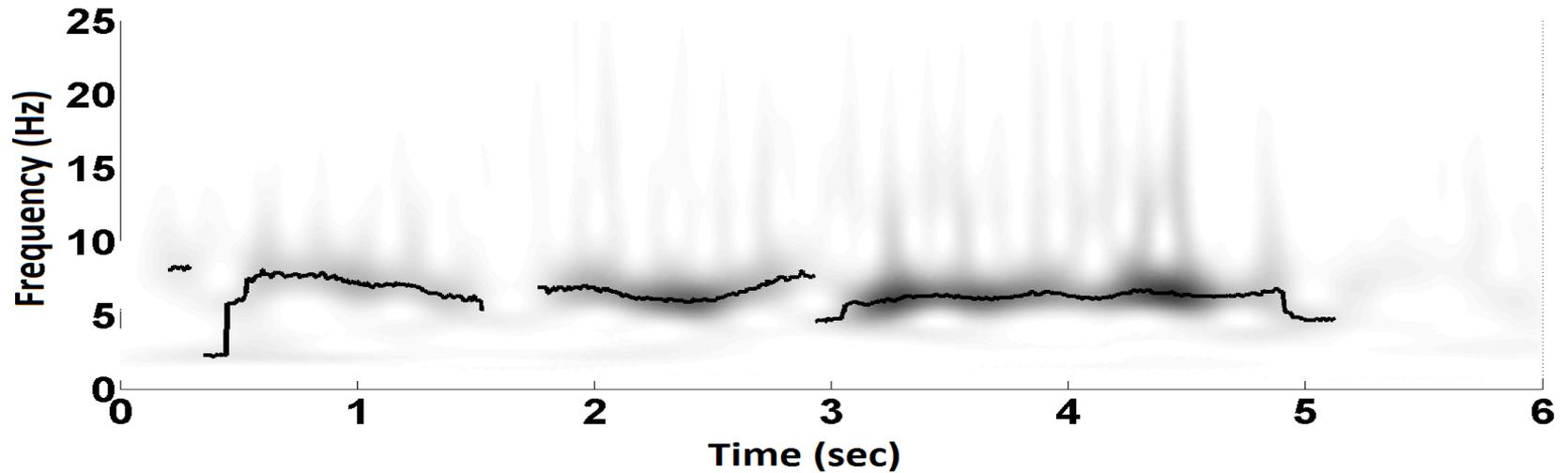
epileptic discharges (left figure)  
sleep spindles (right figure)



# Segmented ridges on wavelet spectrograms

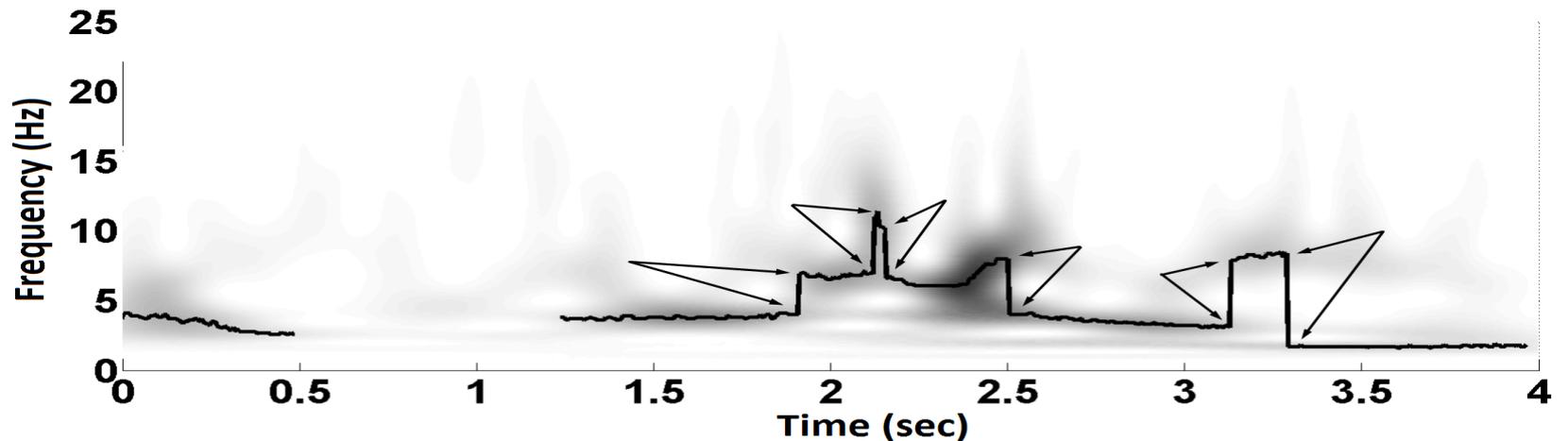
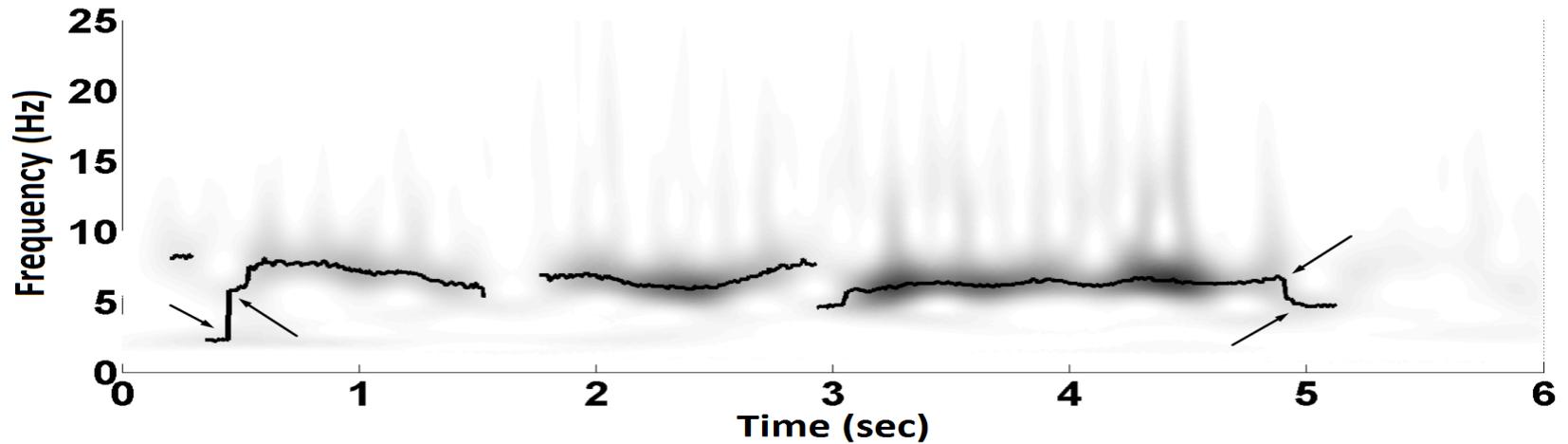
*epileptic discharges (upper figure)*

*sleep spindles (lower figure)*

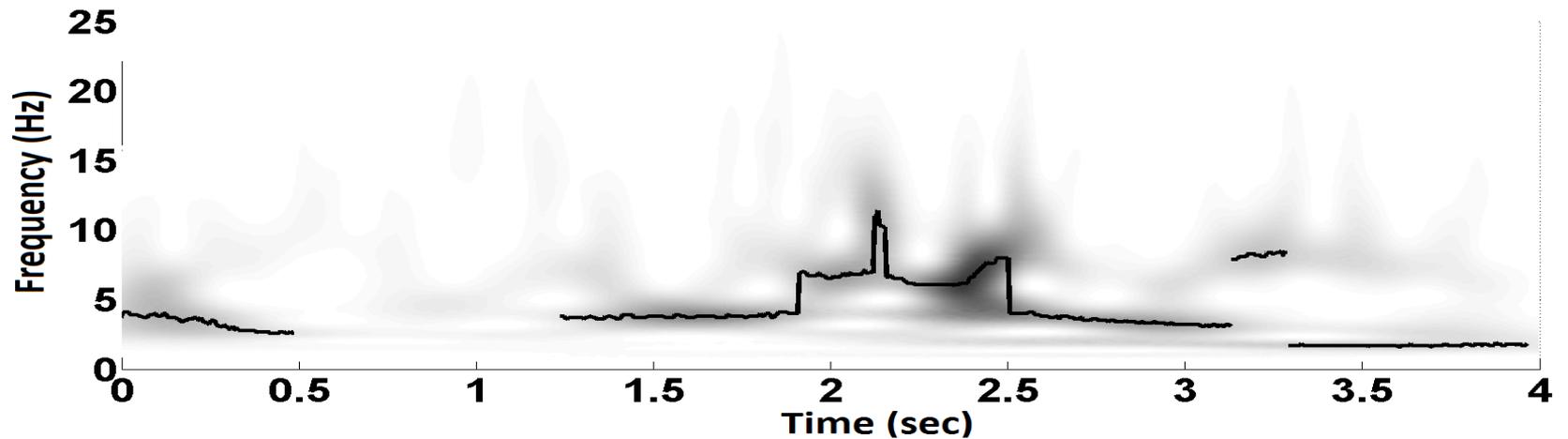
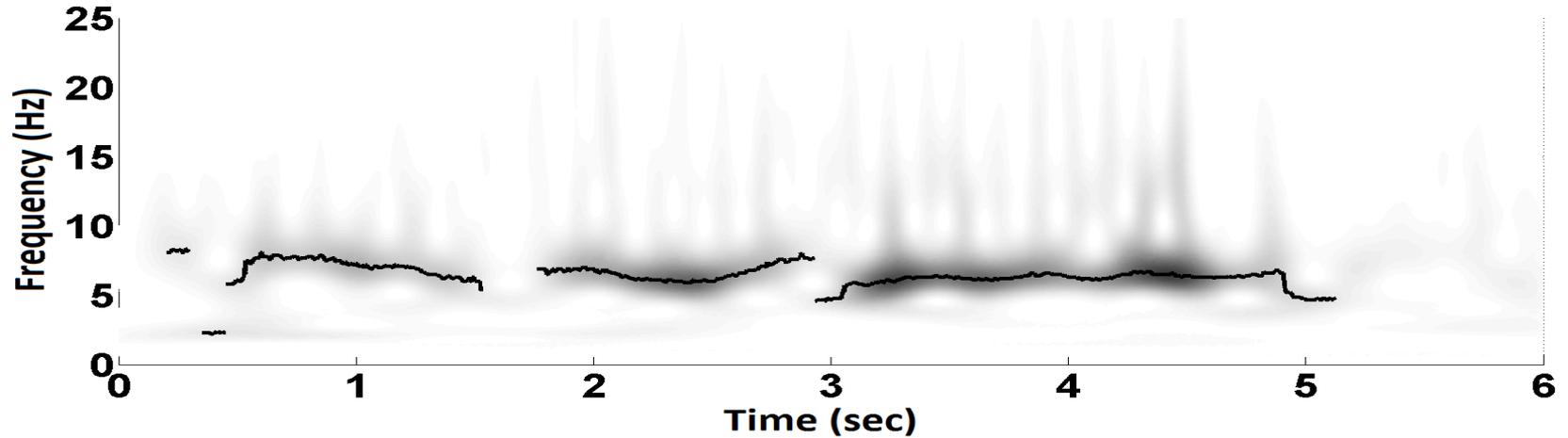


# Frequency hopping points of segmented ridges in wavelet spectrograms

*epileptic discharges (upper figure)*  
*sleep spindles (lower figure)*



# Segmented ridges on wavelet spectrograms *epileptic discharges (upper figure)*



# An example of the values obtained

## for epileptic discharges

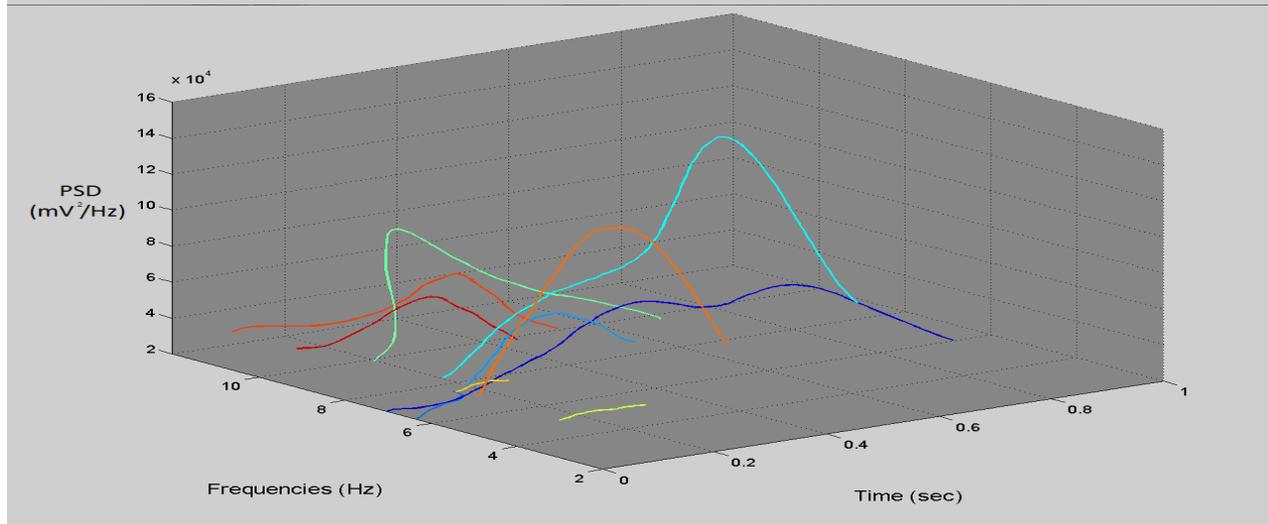
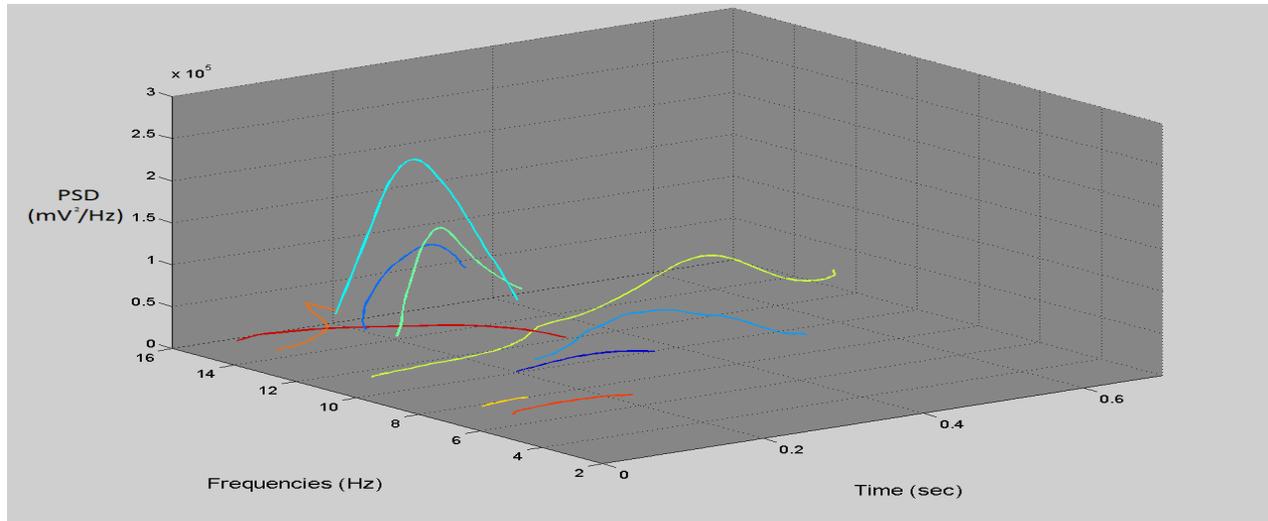
FName	Min_f	Max_f	del_f	bg_Time	end_Time	delta_t	Power_max	Ch-1
1	5.20	9.60	4.40	0.88	1.48	0.60	2.68e+004	1
1	7.50	9.00	1.50	2.71	3.02	0.31	3.34e+004	1
1	6.80	8.70	1.90	3.71	3.83	0.12	1.67e+004	1
2	2.40	5.10	2.70	0.06	0.91	0.86	2.94e+004	1
2	3.90	6.30	2.40	2.64	3.06	0.42	1.63e+004	1
2	8.60	9.40	0.80	3.54	3.67	0.13	1.33e+004	1
3	7.20	7.70	0.50	2.84	3.00	0.15	1.69e+004	1
3	6.60	7.50	0.90	3.16	3.39	0.23	2.58e+004	1
3	4.00	4.40	0.40	3.44	3.54	0.10	1.88e+004	1
3	4.10	4.80	0.70	3.60	3.75	0.14	1.94e+004	1
3	4.70	7.60	2.90	3.89	4.22	0.34	1.95e+004	1
3	6.90	8.50	1.60	5.22	5.41	0.19	2.35e+004	1
3	8.40	11.00	2.60	5.56	5.82	0.26	3.62e+004	1
3	6.50	10.70	4.20	5.94	6.19	0.25	4.61e+004	1
3	10.00	16.40	6.40	6.34	6.52	0.18	2.39e+004	1
3	5.50	6.10	0.60	7.28	7.49	0.20	2.13e+004	1
4	2.90	4.00	1.10	0.10	0.21	0.11	2.11e+004	1
4	8.80	9.70	0.90	0.22	0.62	0.40	3.95e+004	1
4	4.00	7.00	3.00	1.14	1.58	0.44	4.56e+004	1
4	3.20	6.50	3.30	2.12	2.33	0.22	2.08e+004	1
5	8.90	9.40	0.50	0.72	0.84	0.11	9.78e+003	1
5	3.30	5.00	1.70	1.09	1.48	0.39	1.34e+004	1
5	3.60	4.70	1.10	2.18	2.54	0.36	2.15e+004	1
5	2.40	8.50	6.10	2.55	3.28	0.73	2.34e+004	1
5	9.30	10.20	0.90	3.34	3.42	0.09	9.27e+003	1
5	7.90	10.00	2.10	3.48	3.94	0.47	1.50e+004	1
6	6.30	6.70	0.40	0.50	0.56	0.06	2.34e+004	1
6	6.80	7.90	1.10	0.80	0.90	0.10	2.52e+004	1
6	7.20	9.10	1.90	1.24	1.48	0.24	6.07e+004	1
6	2.90	5.00	2.10	1.48	1.95	0.46	6.96e+004	1
6	12.00	12.90	0.90	1.96	2.08	0.12	2.74e+004	1
6	6.00	6.60	0.60	2.23	2.39	0.16	3.27e+004	1
7	3.00	7.30	4.30	0.14	0.76	0.62	7.69e+003	1
7	10.80	11.40	0.60	0.76	0.84	0.08	4.58e+003	1
7	7.90	8.70	0.80	1.42	1.52	0.10	4.30e+003	1
7	3.10	5.20	2.10	2.29	2.67	0.38	8.79e+003	1
7	2.80	3.20	0.40	2.68	2.88	0.19	8.17e+003	1
7	5.40	10.30	4.90	2.88	3.10	0.22	9.15e+003	1
7	2.90	3.40	0.50	3.11	3.20	0.08	5.63e+003	1
7	3.00	6.30	3.30	3.87	3.95	0.08	3.97e+003	1
8	6.10	7.60	1.50	2.78	3.08	0.30	5.73e+004	1
9	3.20	4.30	1.10	0.52	0.89	0.36	1.08e+004	1
9	9.10	10.90	1.80	0.99	1.10	0.11	7.92e+003	1
9	2.80	3.90	1.10	1.43	2.44	1.01	1.44e+004	1
9	6.70	7.60	0.90	2.67	3.04	0.37	1.52e+004	1
9	2.90	3.40	0.50	3.22	3.38	0.16	9.81e+003	1
9	3.10	6.50	3.40	3.39	3.76	0.37	1.48e+004	1
10	5.80	6.40	0.60	1.47	1.60	0.13	1.53e+004	1

# An example of the values obtained for epileptic discharges

FName	Min_f	Max_f	del_f	bg_Time	end_Time	delta_t	Power_max	Ch-1
1	3.60	5.40	1.80	0.84	1.91	1.07	4.77e+004	1
1	2.70	20.20	17.50	1.97	3.40	1.42	7.47e+004	1
1	7.60	10.40	2.80	3.40	3.56	0.16	6.78e+004	1
1	3.30	6.50	3.20	4.05	4.69	0.64	7.71e+004	1
1	4.20	5.40	1.20	5.73	5.99	0.26	4.33e+004	1
2	3.10	4.00	0.90	1.46	1.79	0.33	1.28e+005	1
2	3.60	4.50	0.90	2.37	2.72	0.34	1.25e+005	1
2	3.00	4.30	1.30	3.27	3.91	0.64	2.45e+005	1
3	3.70	5.00	1.30	0.15	0.51	0.36	1.97e+004	1
3	2.70	3.60	0.90	0.52	1.09	0.57	2.81e+004	1
3	3.20	7.30	4.10	1.56	2.12	0.55	2.55e+004	1
3	13.40	14.70	1.30	2.40	2.55	0.16	4.35e+004	1
3	5.10	5.40	0.30	2.56	2.66	0.10	2.13e+004	1
3	7.40	14.60	7.20	2.66	2.86	0.20	2.49e+004	1
4	2.50	5.00	2.50	2.06	2.66	0.61	5.18e+004	1
4	4.30	4.80	0.50	2.80	2.89	0.09	3.16e+004	1
4	7.30	15.10	7.80	2.90	3.37	0.46	6.36e+004	1
4	4.90	5.90	1.00	4.14	4.74	0.60	6.08e+004	1
5	4.50	5.10	0.60	0.12	0.26	0.14	1.11e+005	1
5	2.20	3.00	0.80	1.60	2.58	0.98	3.07e+005	1
5	3.20	3.40	0.20	4.32	4.44	0.12	9.97e+004	1
6	4.60	5.20	0.60	0.11	0.23	0.12	4.29e+004	1
6	3.40	4.00	0.60	0.54	1.15	0.61	6.68e+004	1
6	4.00	5.90	1.90	1.38	1.80	0.43	1.21e+005	1
6	4.90	5.90	1.00	2.58	2.74	0.17	4.96e+004	1
7	4.00	4.40	0.40	1.52	2.17	0.65	6.64e+004	1
7	4.30	5.10	0.80	2.36	2.75	0.39	8.17e+004	1
7	3.10	3.60	0.50	2.90	3.98	1.07	1.09e+005	1
7	8.80	12.10	3.30	3.99	4.20	0.20	8.93e+004	1
7	6.80	7.90	1.10	4.57	4.91	0.34	1.06e+005	1
7	3.50	6.50	3.00	5.44	5.88	0.44	5.82e+004	1
8	2.90	3.80	0.90	0.40	0.86	0.46	3.66e+004	1
8	2.90	4.70	1.80	1.90	2.40	0.50	6.02e+004	1
8	7.00	10.70	3.70	2.66	2.78	0.12	3.14e+004	1
8	6.50	7.50	1.00	3.07	3.19	0.12	2.94e+004	1
8	4.20	6.10	1.90	3.88	4.35	0.48	7.23e+004	1
9	3.30	5.70	2.40	1.42	2.46	1.03	7.26e+004	1
9	11.70	13.60	1.90	2.48	2.64	0.16	3.40e+004	1
9	11.00	12.10	1.10	3.60	3.70	0.10	3.14e+004	1
9	4.20	5.00	0.80	3.71	4.04	0.34	3.30e+004	1

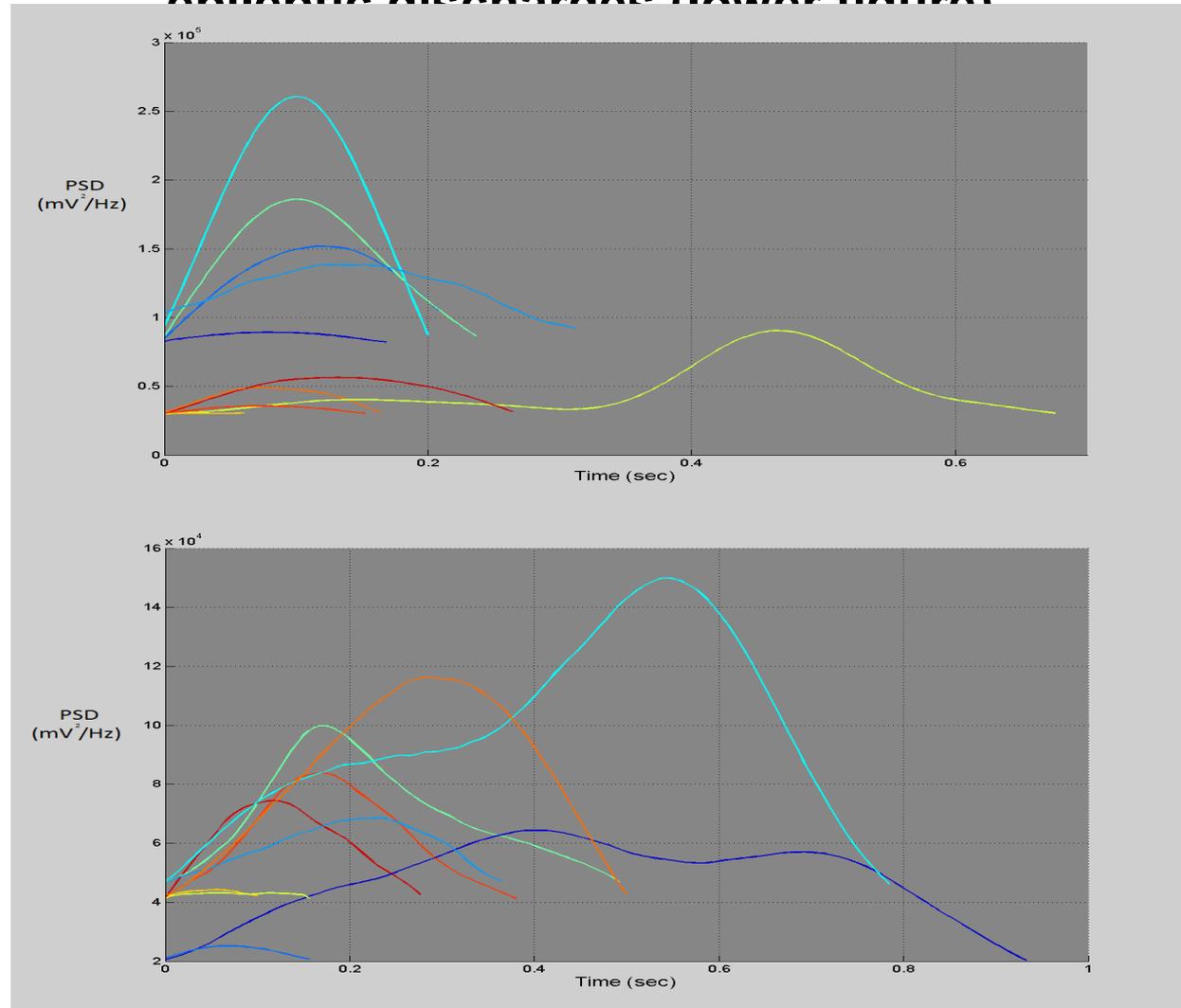
# Illustration of 10 segmented ridges in 3-D.

sleep spindles (upper figure)  
epileptic discharges (lower figure)



# Illustration of 10 segmented ridges in a projection on PSD-time plane.

sleep spindles (upper figure)  
epileptic discharges (lower figure)



# Conclusions

- Algorithm for detecting epileptic discharges and sleep spindles from the background activity was developed.
- EEG records with 36 sleep spindles and 39 with epileptic discharges were processed using this algorithm
- The parameters of ridges from processed records were calculated.

**Thank you for your attention!**