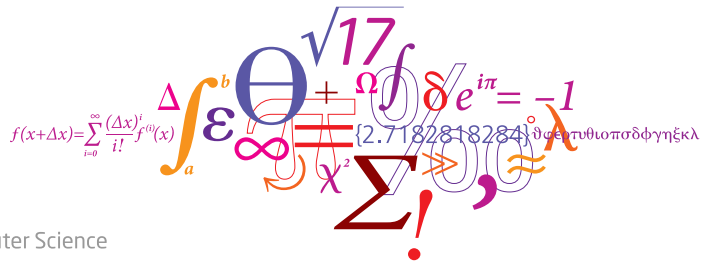
Deep Convolutional and Recurrent Neural Networks for Interpretable Analysis of EEG Sleep Stage Scoring

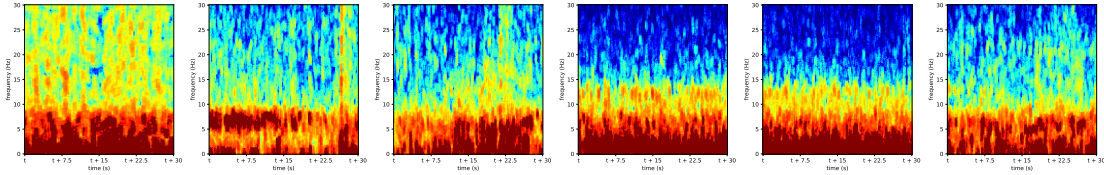
Anders Launer Baek

DTU Compute, Technical University of Denmark



DTU Compute
Department of Applied Mathematics and Computer Science

Sleeping Stages



(a) W (b) N1 (c) N2 (d) N3 (e) N4 (f) R

Figure: This figure illustrates a random epoch of the multi-taper spectrum for each sleeping stage. There is high similarity between sleeping stage N3 and N4.

Sleep Stage	W	N1	N2	N3	N4	R
Dist. (in %)	12	7	46	9	6	20

Table: This table summerises the aggregates the distribution of the labels for all 20 Subjects. The distribution of the labels illustrates the sleep stages of subjects during the recordings.

Confusion Matrices

		Predicted						Normalized pred. (in %)					
		W	N1	N2	N3	N4	R	W	N1	N2	N3	N4	R
CNN	W	495	145	29	11	1	20	71	21	4	2	0	3
	N1	25	211	43	0	0	62	7	62	13	0	0	18
	N2	4	51	1313	104	17	68	0	3	84	7	1	4
	N3	0	2	11	164	64	0	0	1	5	68	27	0
	N4	0	0	0	54	91	0	0	0	0	37	63	0
	R	17	80	46	0	0	591	2	11	6	0	0	81
RNN	W	578	39	26	7	1	43	83	6	4	1	0	6
	N1	38	107	64	0	0	132	11	31	19	0	0	39
	N2	8	13	1314	102	28	92	1	1	84	7	2	6
	N3	3	0	18	125	95	0	1	0	7	52	39	0
	N4	0	0	1	60	84	0	0	0	1	41	58	0
	R	19	36	43	0	0	636	3	5	6	0	0	87

Table: Confusion matrix and normalized confusion matrix for the CNN and RNN network.

Bootstrapped Performances Metrics

Study	Precision	Sensitivity	F_1-score	Accuracy
CNN	65-**68**-70	71-**71**-72	67-**69**-70	92-**92**-92
RNN	62-**65**-67	63-**66**-69	62-**64**-67	92-**92**-92

Table: **Mean** and corresponding 95% confident values computed by 100.000 bootstrap iterations with replacement.

Sensitivity Maps

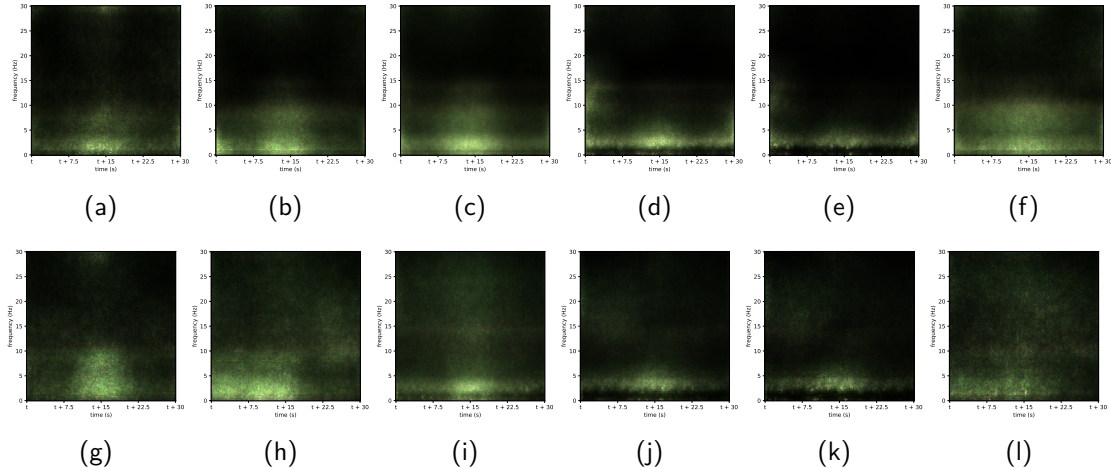


Figure: This figure illustrates a random epoch of the multi-taper spectrum for each sleeping stage. There is high similarity between sleeping stage N3 and N4.

Conclusion

- Watch the frame number.
- It doesn't change!

Conclusion

- Watch the frame number.
- It doesn't change!

Future Research

- Watch the frame number.
- It doesn't change!

Future Research

- Watch the frame number.
- It doesn't change!

Anders Launer Baek
s160159@student.dtu.dk
DTU Compute, Technical University of Denmark