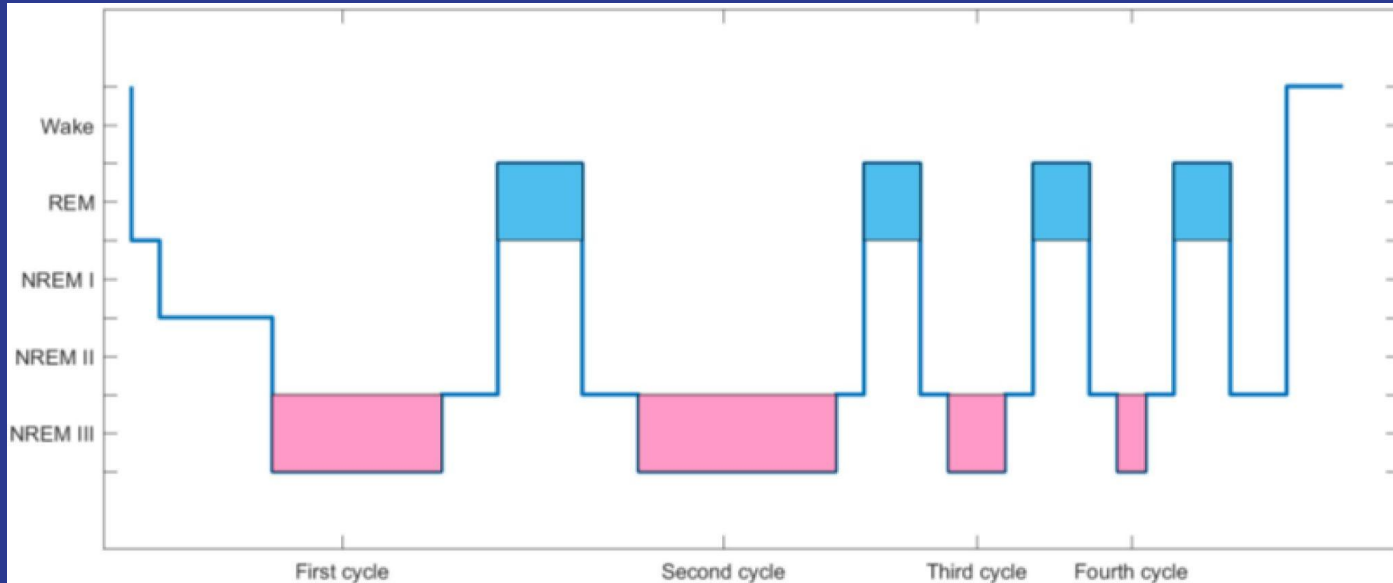# Sleep analysis through EEG

Determination of sleep patterns and quality

Sleep importance

- Muscle regeneration and tissue rebuild
- Stable and healthy emotional state maintenance
- Better concentration and productivity
- Lesser risk of cardiovascular diseases
- Many more (nowadays it is even easier to say that problems sleep deprivation causes rather than what benefits sleep provides)

Sleep structure

- 4-5 cycles of about 90-120 minutes through a night
- Each cycle - NREM (Non-Rapid Eye Movement), followed by REM (Rapid Eye Movement)
- NREM - further divided into stages 1-4 (Also the Wake stage is identified, although it does not belong to sleep stages)

Sleep structure - stages

- NREM - usually longer, as it has 4 stages in it; is responsible for recovery and muscle&mind relaxation
- As humans progress through stages 1 to 4, the sleep gets deeper, and they are harder to be awaken
- Disruption of sleep stages, i.e. waking somebody up, especially during deeper stages, is proven to largely affect emotional stability
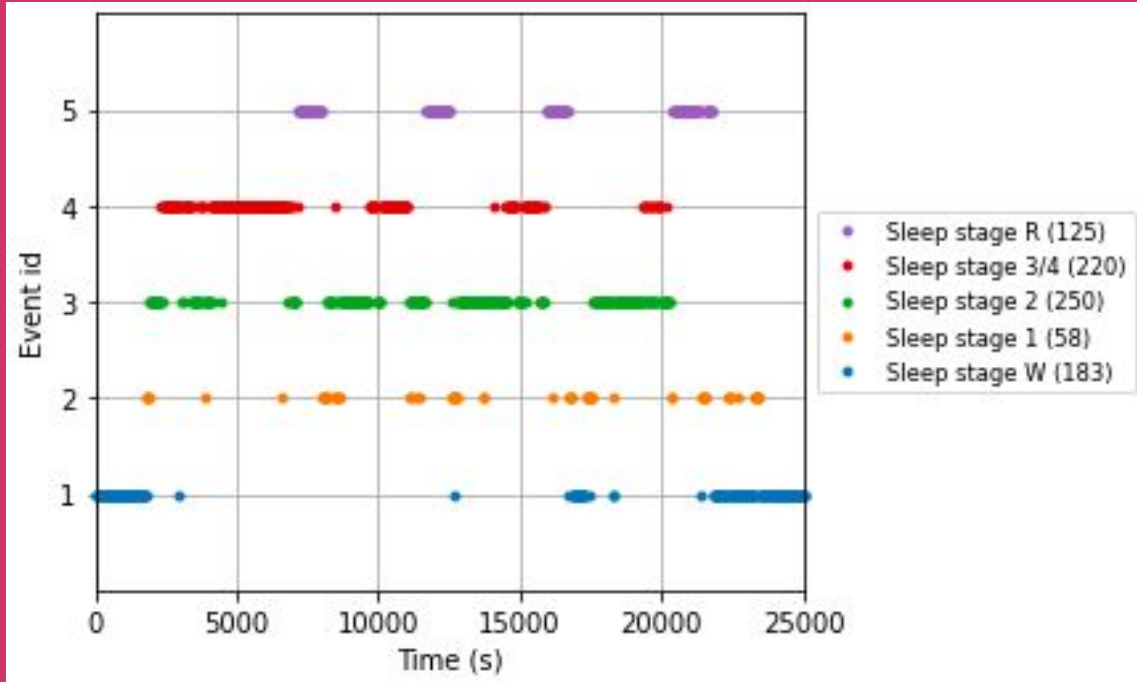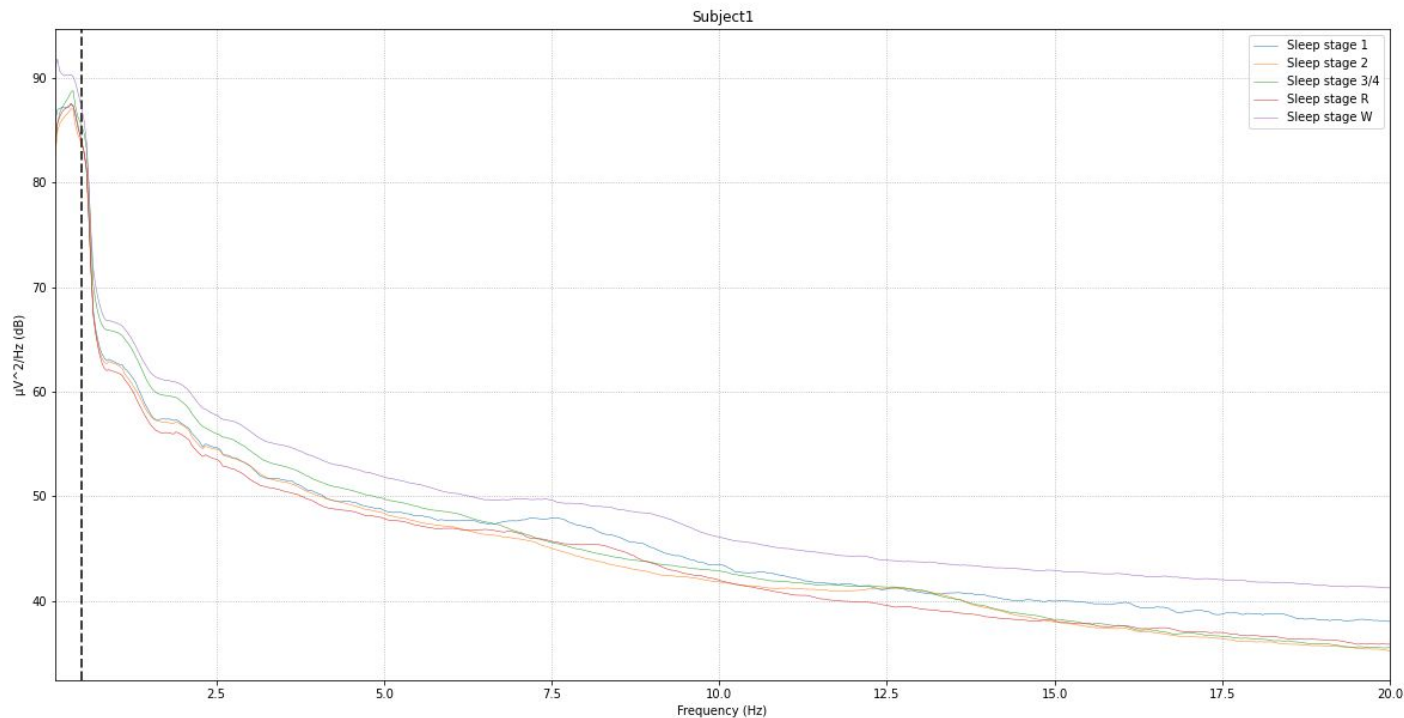
Sleep stages continued

- Earlier sleep stages are usually of higher frequency, but with smaller amplitude (comparison of stage 1 and 4 - upper graph original time-domain signal, lower - its amplitude spectrum)
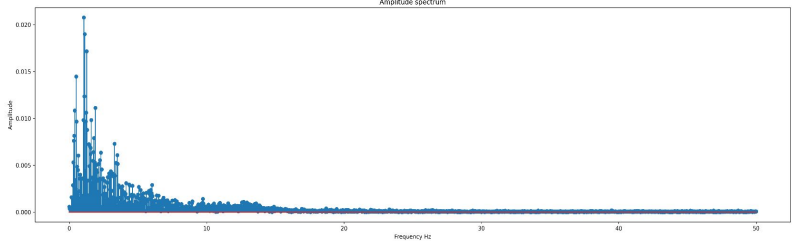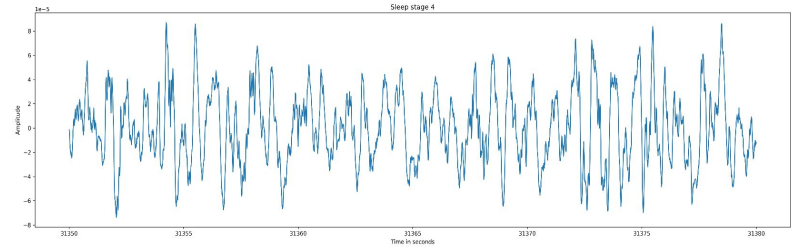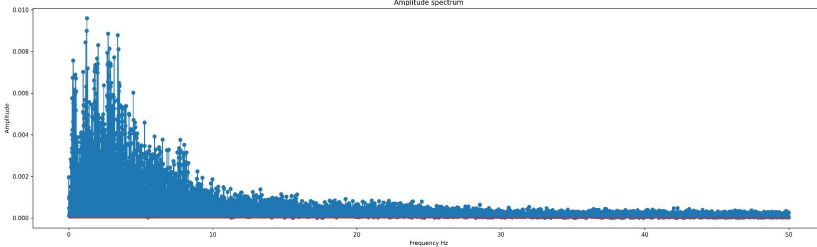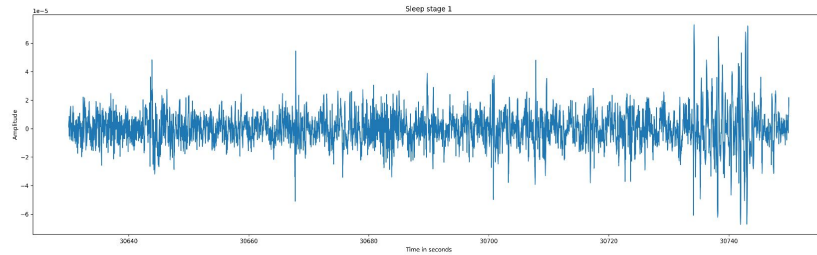
Sleep stages distribution

Energy distribution through stages

Random Forest Classifier results – 0.74 accuracy

Confusion matrix

	0	1	2	3	4
0	128	9	0	0	1
1	12	13	0	0	4
2	11	28	264	36	49
3	5	2	41	243	0
4	13	14	20	0	71

Classification report

	precision	recall	f1-score	support
Sleep stage W	0.76	0.93	0.83	138
Sleep stage 1	0.20	0.45	0.27	29
Sleep stage 2	0.81	0.68	0.74	388
Sleep stage 3/4	0.87	0.84	0.85	291
Sleep stage R	0.57	0.60	0.58	118
accuracy			0.75	964
macro avg	0.64	0.70	0.66	964
weighted avg	0.77	0.75	0.75	964

Further steps

- Use some State-Of-The-Art DL models for signal processing instead of RF classifier
- Make all classifications for one subject's EEG recordings
- Discover sleep stages specification for people with different illnesses, children, athletes, etc.
- Adding such factors as exogenous for our classification models

Thank you for attention!

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