Internship in ESA's Advanced Concepts Team
on
Neural Oscillations during Sleep in Space

Topic description

Only a few reports from the early days of human spaceflight contain sleep electroencephalography recordings (EEG). The principal investigators, at the time, found changes in the gross sleep architecture [1, 2, 3]. However, no conclusions on characteristics of sleep oscillations, such as sleep spindles or slow waves, have been drawn. The aim of this project is to use recent methods to detect and characterize the aforementioned sleep oscillations during NREM and REM sleep in space. This investigation could lead to a better understanding of sleep-wake homeostasis, sleep stability and memory consolidation during human spaceflight.

Candidate's tasks

- Pre-processing of sleep EEG data from STS-90 and STS-95 space shuttle missions [3].
- Identifying and applying appropriate detection methods for hallmark neural oscillations of sleep.
- Analysis of sleep oscillations with respect to their commonly investigated characteristics.
- Statistical analysis will be used to guide the interpretation of the results.

The ideal candidate

Mandatory:

- Strong programming skills in Python.
- Understanding of neuroscience and EEG signal processing.
- Experience with high level statistical inference.

Desirable:

- Good command of the Python MNE package for EEG analysis.
- Experience with sleep EEG analysis (e.g. sleep scoring, detection methods, effects of sleep deprivation, ...)

References

[1] A Gundel, VV Polyakov, and J Zulley. The alteration of human sleep and circadian rhythms during spaceflight. *Journal of sleep research*, 6(1):1–8, 1997.

[2] Timothy H Monk, Daniel J Buysse, Bart D Billy, Kathy S Kennedy, and Linda M Willrich. Sleep and circadian rhythms in four orbiting astronauts. *Journal of biological rhythms*, 13(3):188–201, 1998.

[3] Derk-Jan Dijk, David F Neri, James K Wyatt, Joseph M Ronda, Eymard Riel, Angela Ritz-De Cecco, Rod J Hughes, Ann R Elliott, G Kim Prisk, John B West, et al. Sleep, performance, circadian rhythms, and light-dark cycles during two space shuttle flights. *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology*, 281(5):R1647–R1664, 2001.