EEG SIGNAL QUALITY AND NOISE CHARACTERISTICS IN SPACEFLIGHT

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INTRODUCTION

Monitoring of brain activity during deep space exploration missions is crucial

- for research on mental, cognitive, psychological, and perceptual changes
- for early detection of detrimental processes
- for prevention, therapy, mental training

Constraints of EEG during spaceflight

- Proximity to electric devices and power supplies
- Limited supply and shelf-life of consumables
- Self-application and mobile recording during routine activities

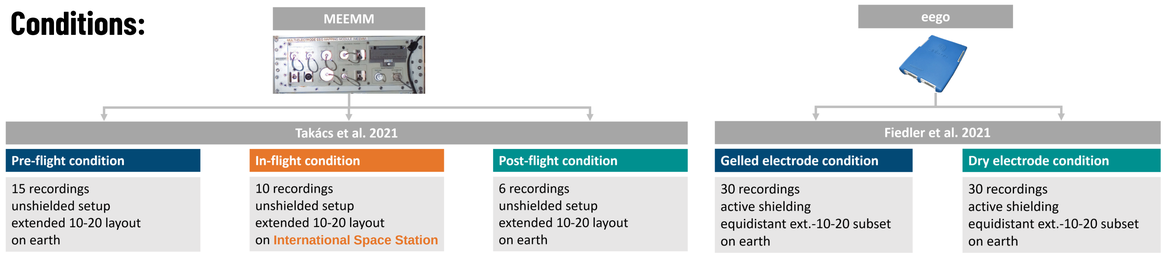
Required:

- Easy, rapid, unobtrusive monitoring of brain activity with high spatial resolution
- Dry electroencephalography (EEG) currently is the only feasible solution

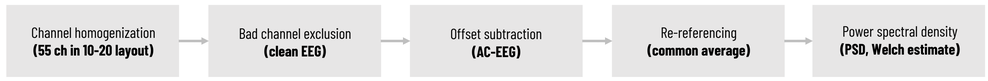
MATERIALS & METHODS

- Analysis of existing and previously published datasets
- Assessment of EEG signal quality in-flight and on earth for selected setups / devices
- Minimal data processing for objective comparison

Conditions:

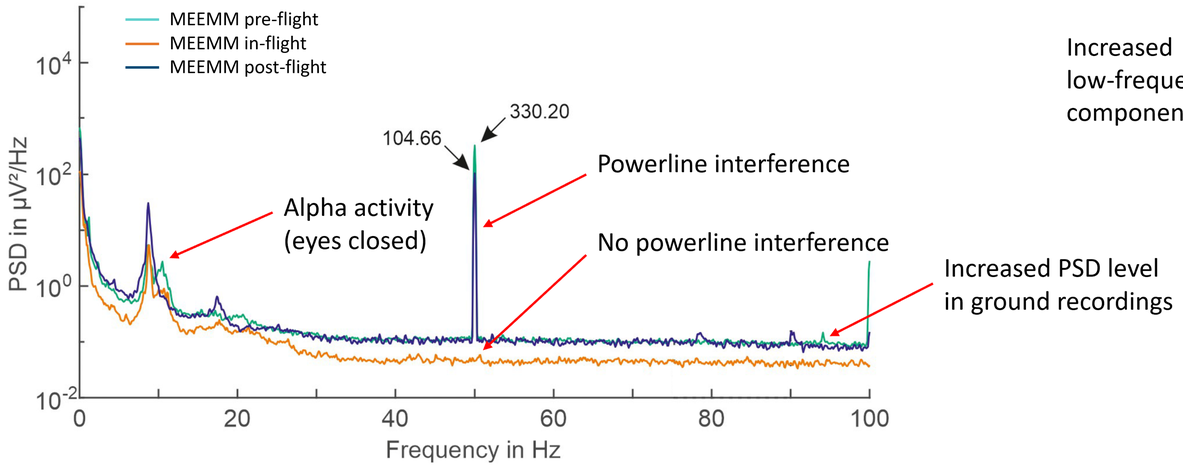


Processing:



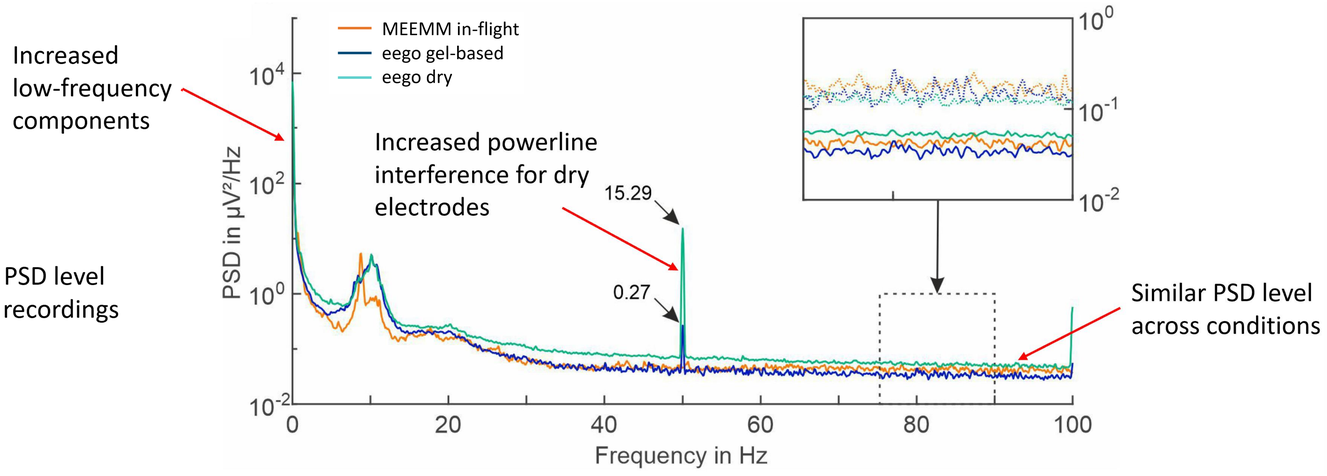
RESULTS

1. Assessment of signal quality: same system, in-flight vs. on earth



- Decrease of baseline PSD in-flight vs. on earth
- ISS systems are battery powered - No powerline interference in-flight
- MEEMM system uses unshielded cables – active shielding may further improve signal quality

2. Assessment of signal quality: unshielded vs. active shielding + gel vs. dry electrodes



- On-earth recording using active shielding results in equivalent signal quality to in-flight PSD
- Dry and gel-based signal quality equivalent, but reduced dry electrode channel reliability: 13.1 % bad channels dry vs. 3.2 % bad channels wet
- Differences in mean PSD below standard deviation across conditions

CONCLUSIONS

- Improved signal quality in space vs. on earth
- Physiological activity (alpha power) clearly pronounced in all recordings
- Active shielding may further improve signal quality in-flight
- Dry electrodes provide equivalent PSD characteristics, without needing consumables or extensive preparation
- Dry electrodes have reduced channel reliability, requiring compensation

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Reference: Fiedler, P. et al. 2023: Noise characteristics in spaceflight multichannel EEG, PLoS ONE, 18(29)

ACKNOWLEDGEMENT This work was supported in part by NASA Cooperative Agreement NINX16A069A TRISH CAT004; the German Federal Ministry of Education and Research (BMBF) grant TeleBrain (01DS19009A, JH), the Free State of Thuringia within the ThiMEDOP project (2018 IZN 0004, JH and PF) with funds of the European Union (EFRE), the Belgian Federal Science Policy Office and the European Space Agency (ESA) (AO2004, 118, GC and AMC), and the European Union's Horizon 2020 research and innovation program under a Marie Skłodowska-Curie grant (101007521, JH, PF, and FM). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

TRANSLATIONAL RESEARCH INSTITUTE FOR SPACE HEALTH

(Partially) Supported by
NASA Cooperative Agreement NINX16A069A
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