Towards an Inexpensive, Lightweight Mobile EEG

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Seed Grant: Brain & Behavior Initiative

Motivation

To Improve EEG technology for "less controlled" use

- Increased Portability
- Mobile Use (in both senses)
- Reduction of artifacts
- Ease of use for subjects
- Lower cost

Goals

Hardware Tools

- High fidelity signal capture
- Low power
- Low weight
- Audio input

Signal Processing: Compressed Sensing with high CR

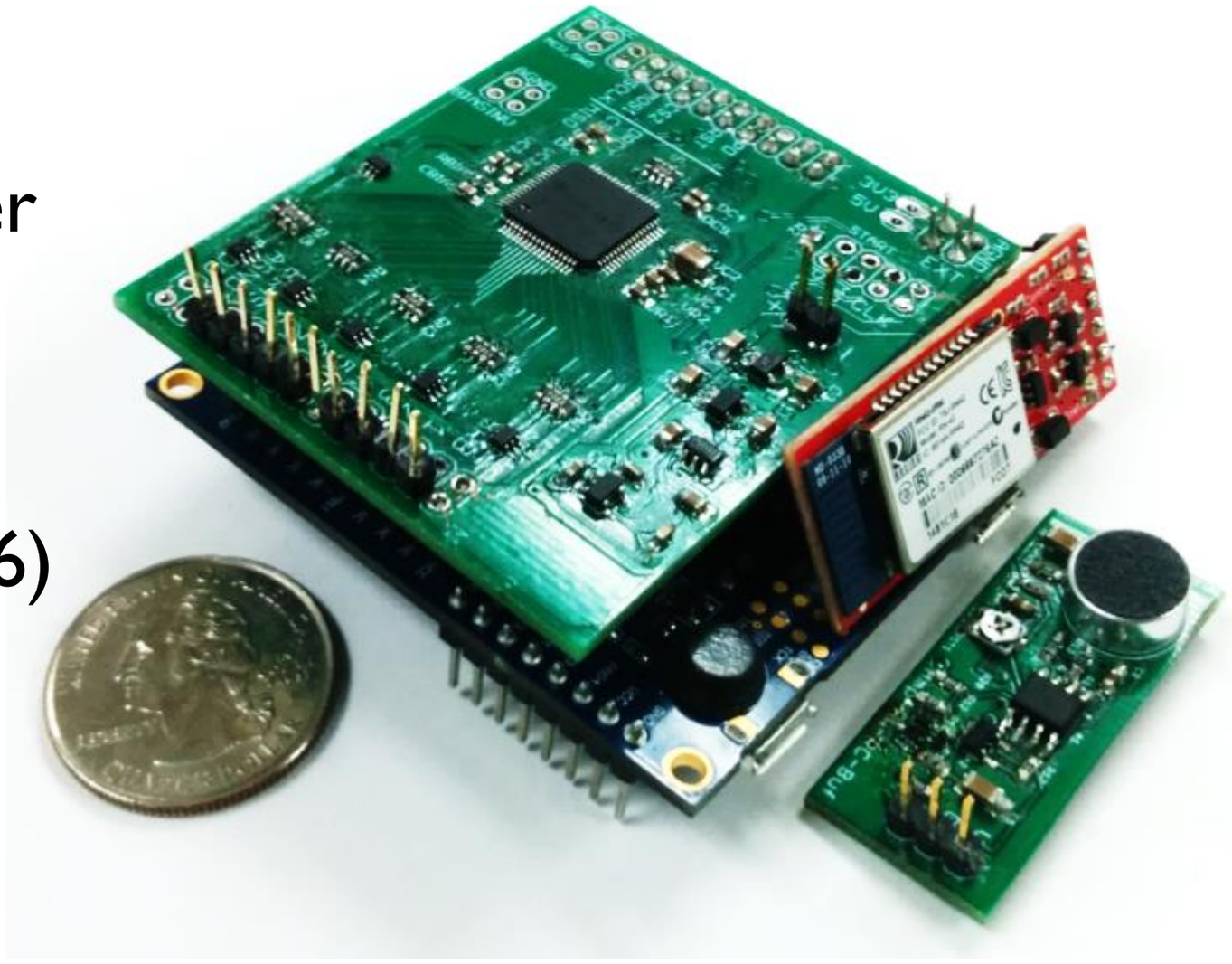
- Real-time processing
- Motion artifact suppression

Neuroscience Applications

- Kinesiology
- Dance
- Auditory

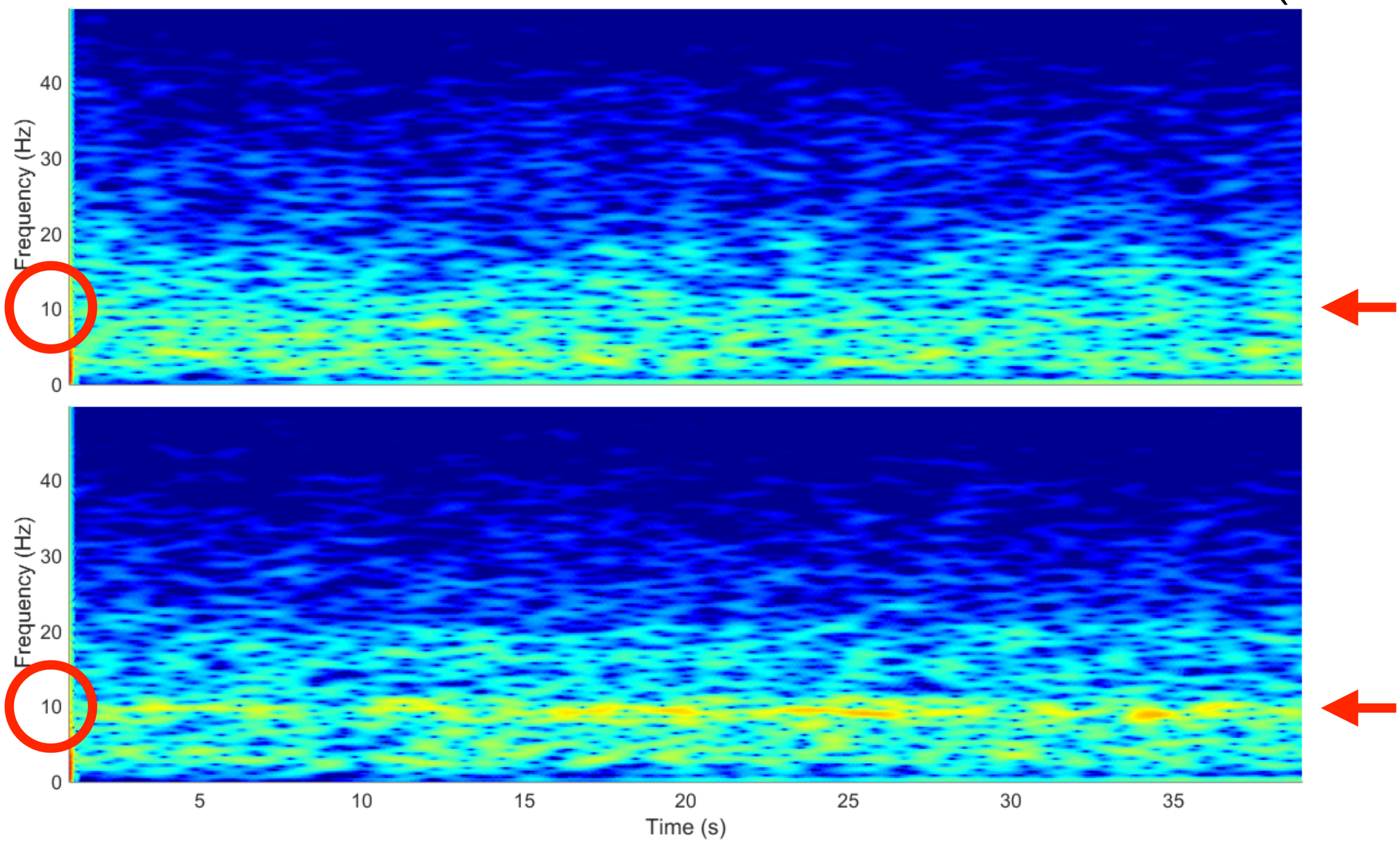
Mobile EEG System

- Biopotential Measurement Chip
  - TI ADS1299, 8-channel, 24-bit, sigma-delta ADC
  - 12x gain
- High performance microcontroller
  - Atmel SAM G55
- Bluetooth wireless transceiver
  - 230 kBaud
- Current draw: 70 mA max
- 7 EEG channels (expand to 16)
- 1 Audio channel
- 500 samples/s
- Cost ~$200

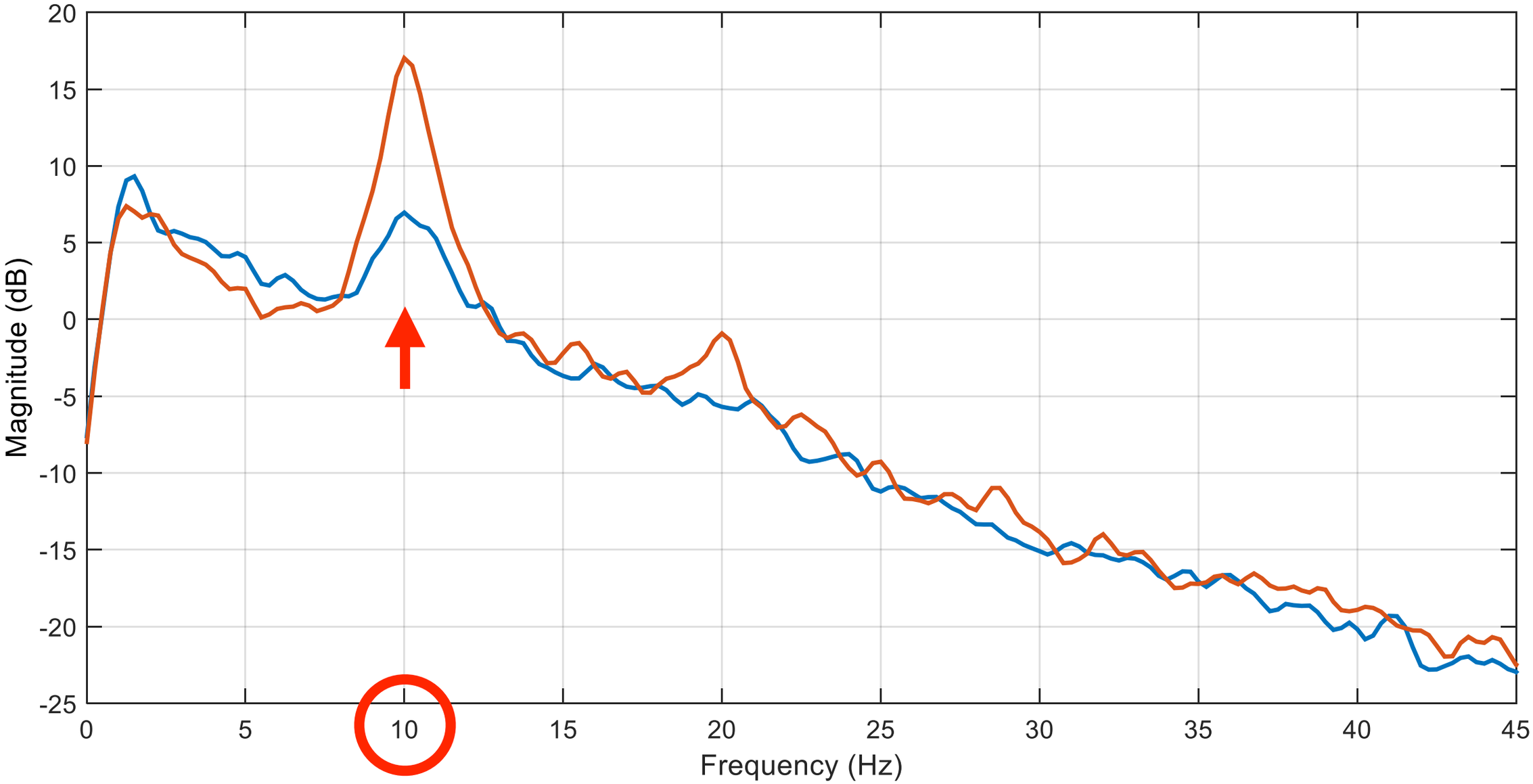


Eyes Closed vs Open

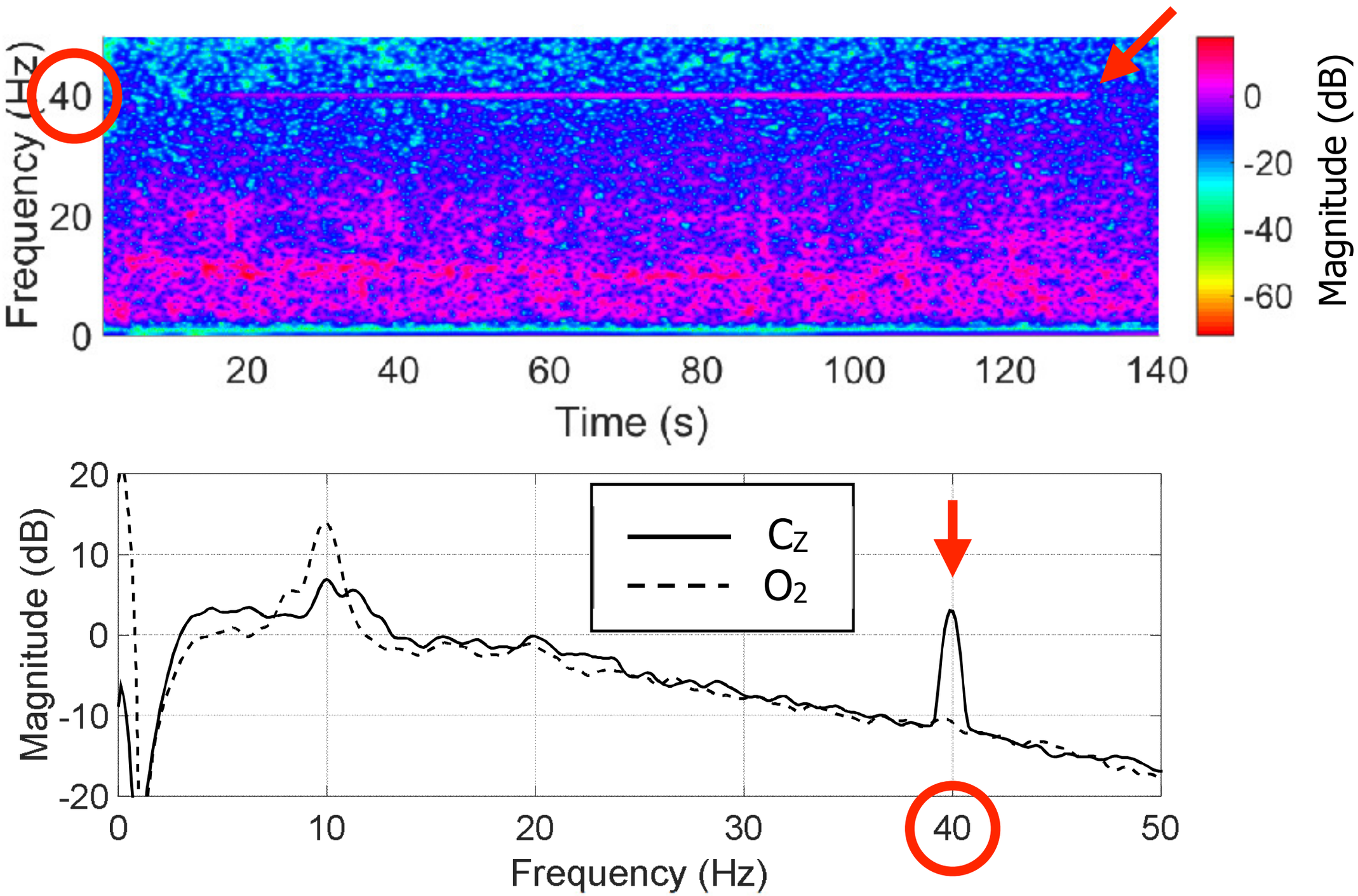
(standing)



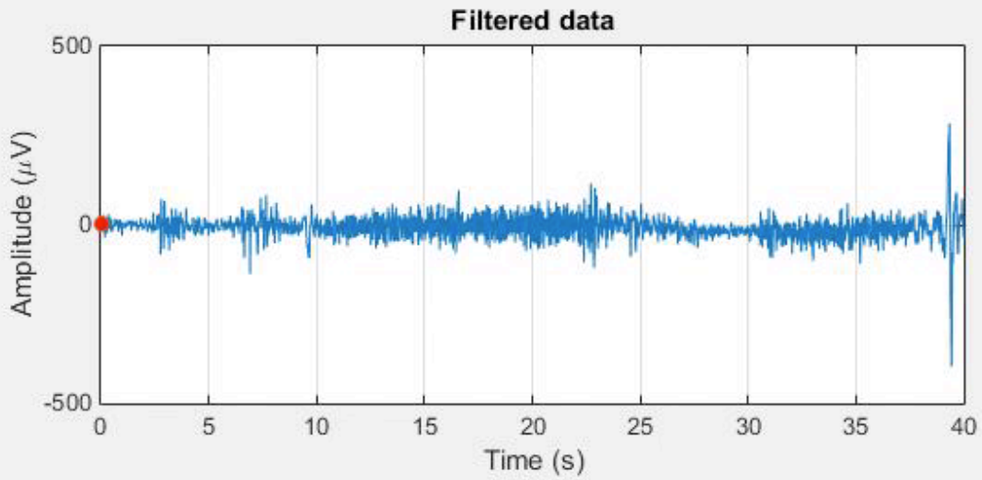
Eyes Closed vs. Open

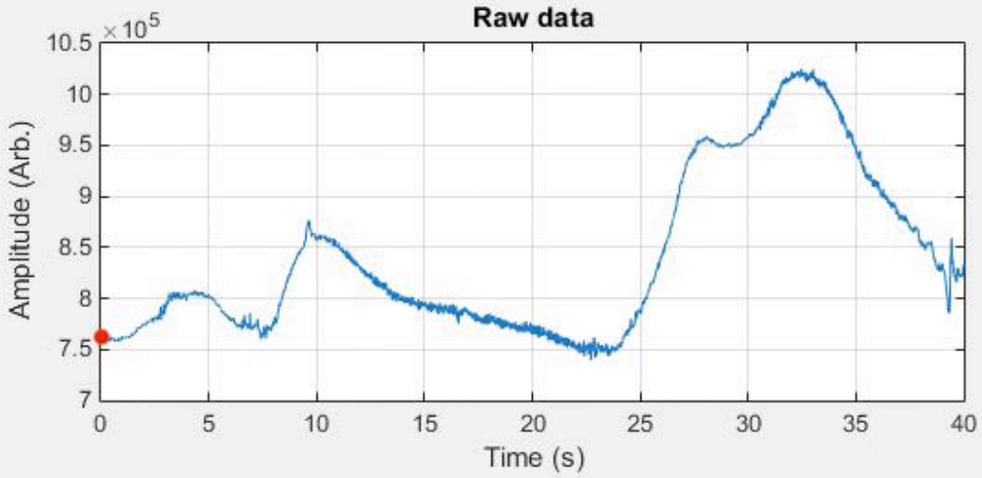


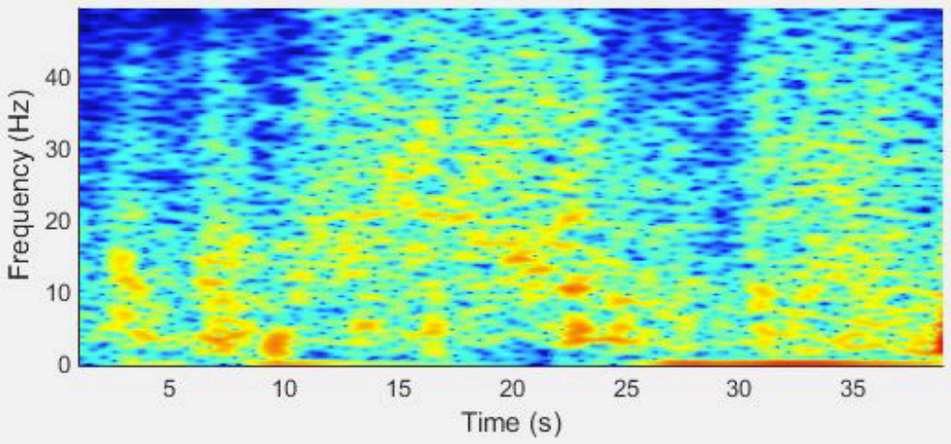
Auditory Steady State Response

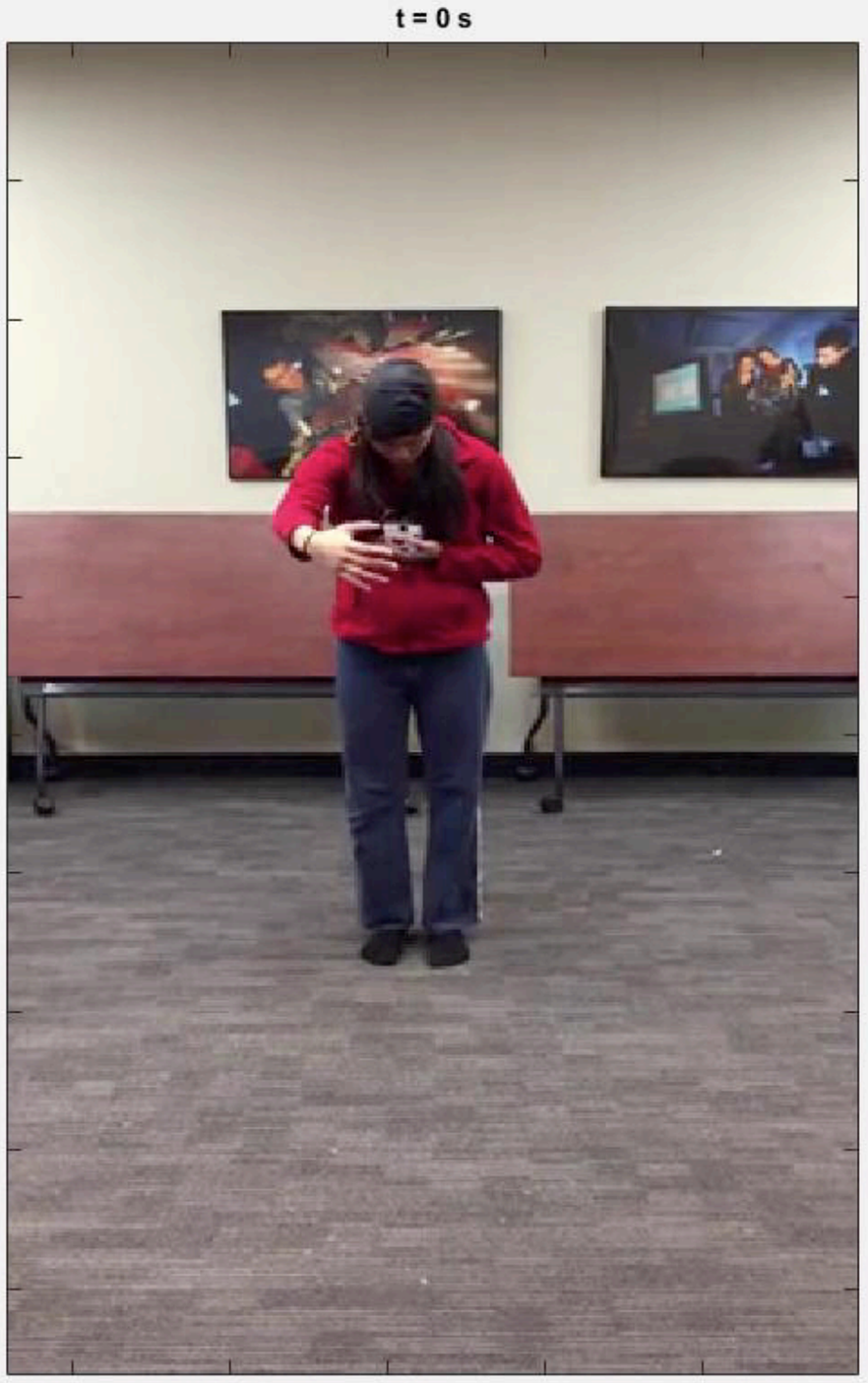


During Dance









Summary

- High fidelity EEG signal capture
- Low power
- Low weight
- Audio input

- Compressed sensing
    - Compression Ratio ~8x even before multi-channel
- Motion artifact suppression
- Real-time processing

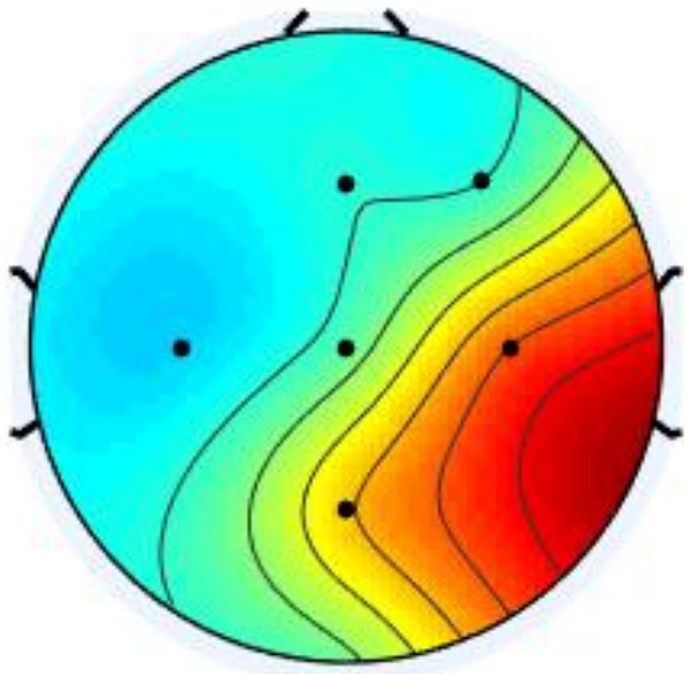
Thank You

Senevirathna, B., L. Berman, N. Bertoni, F. Pareschi, M. Mangia, R. Rovatti, G. Setti, J. Simon, and P. Abshire (2016) *A Low Cost Mobile EEG for Characterization of Cortical Auditory Responses*, 2016 IEEE International Symposium on Circuits and Systems (ISCAS).

Bertoni, N., B. Senevirathna, F. Pareschi, M. Mangia, J. Z. Simon, R. Rovatti, P. Abshire, and G. Setti (2016) *Low-power EEG monitor based on Compressed Sensing and featuring compressed domain noise rejection*, 2016 IEEE International Symposium on Circuits and Systems (ISCAS).

Topographic Map

Left Lean



Right Lean