

Imaging of Motor Activity in Freely Moving Subjects Using a Wearable NIRS Imaging System



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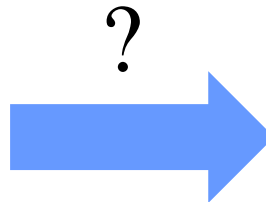
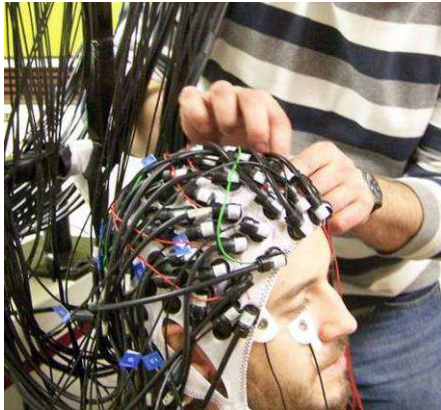
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OSA BIOMED 2012
Miami, FL, USA



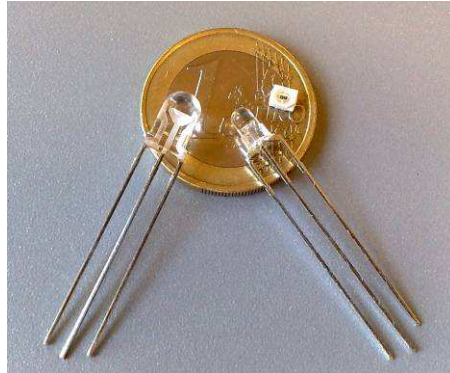
How to miniaturize NIRS? (And, why?)



- Natural environment
- Sports, physical therapy
- Children
- Bedside
- Wireless
- ...

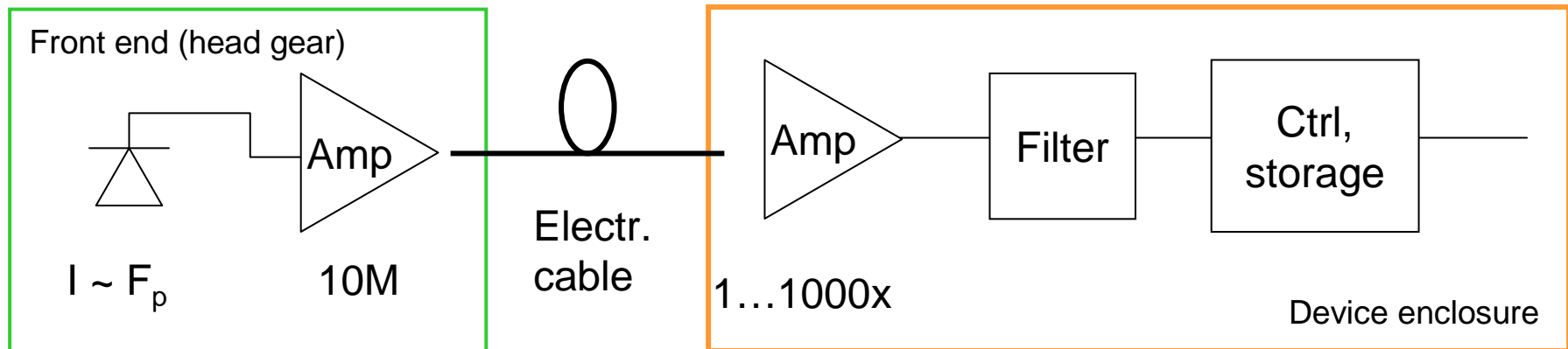
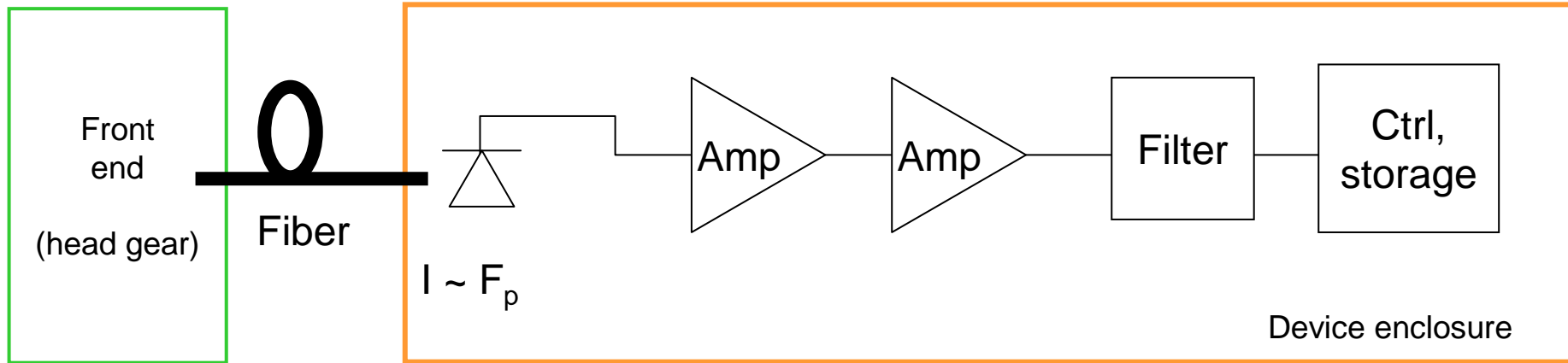


Direct Illumination



- LED
 - Wavelengths 760 nm, 850 nm
 - Radiated Power $\sim 10 \text{ mW} / \lambda$
- Pros
 - Size, cost
 - Stable operation easy
- Cons
 - $\sim 30 \text{ nm}$ spectral width
 - Diffuse
 - (Drift)

Direct Detection

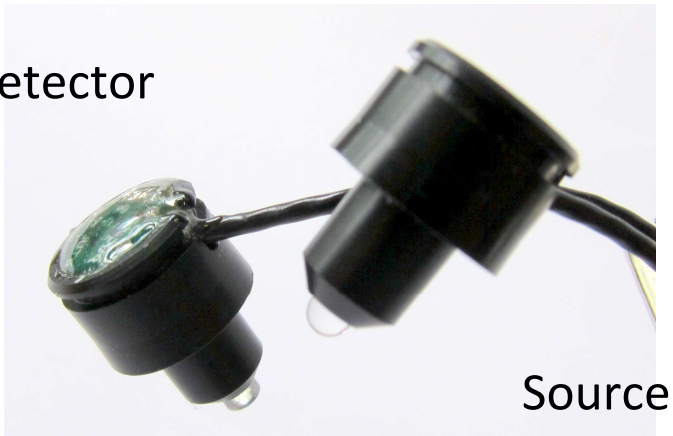


Active Sensor

LED Illumination



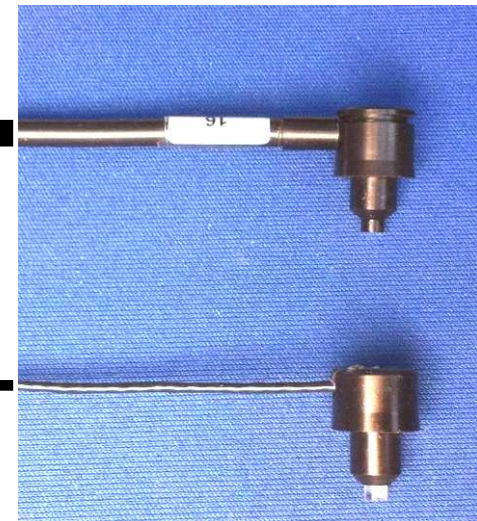
Detector



Source

● 4.0 mm

● 1.4 mm



Portable NIRS Acquisition Unit



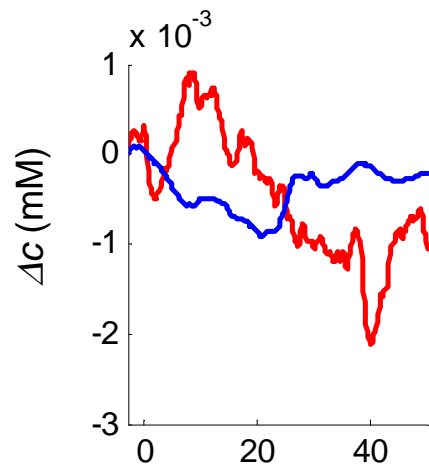
Bicycle Experiment



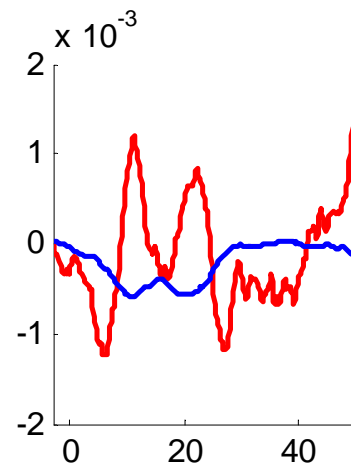
- Controlled left-hand gripping ($\sim 1..2$ Hz) during bicycle riding
- 20 sec activation / 40 sec pause / 10 trials
- N = 7 subjects

Experimental Conditions

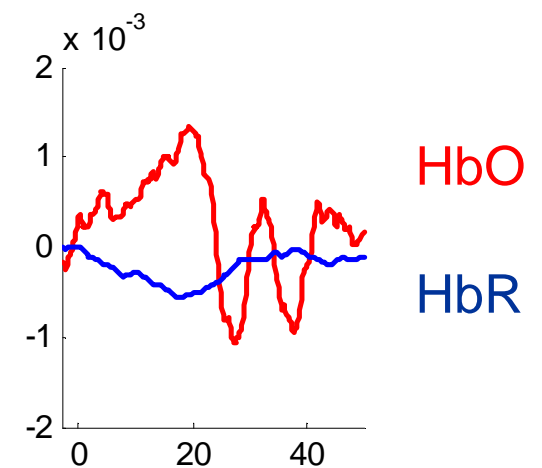
Condition 1



Condition 2



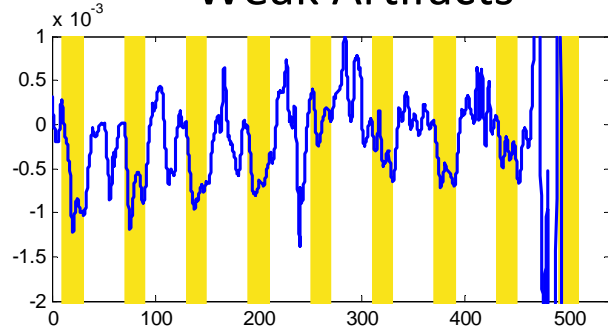
Condition 3



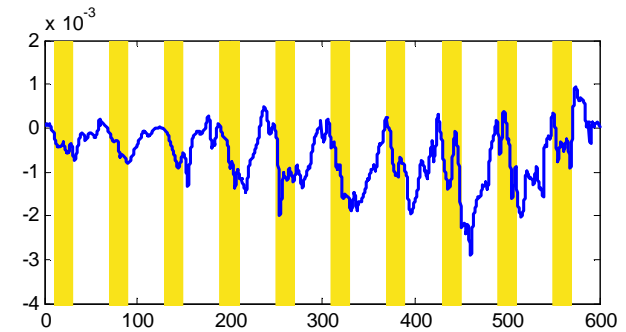
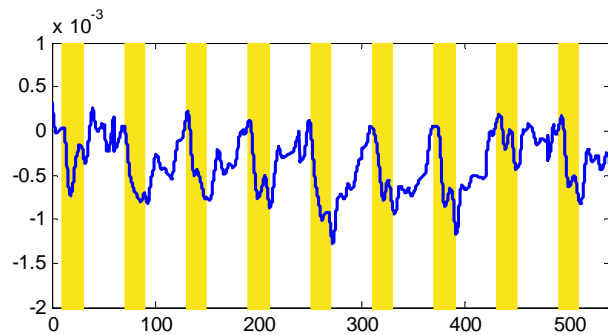
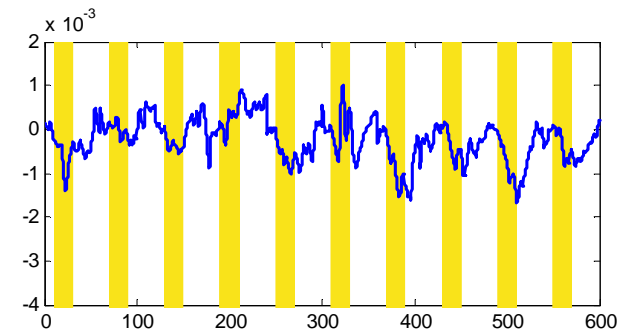
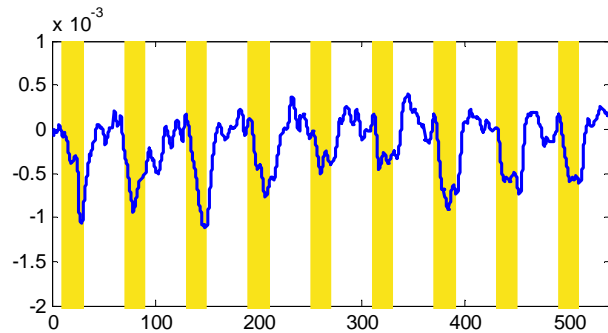
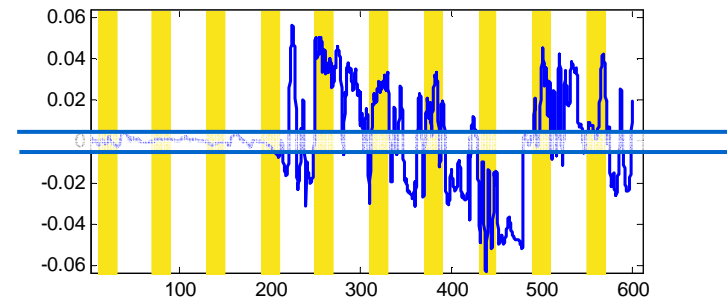
Signal Quality



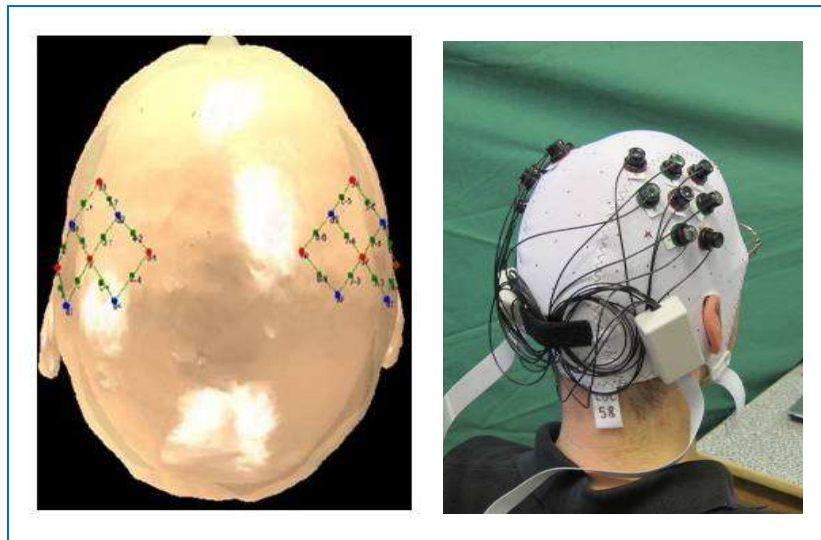
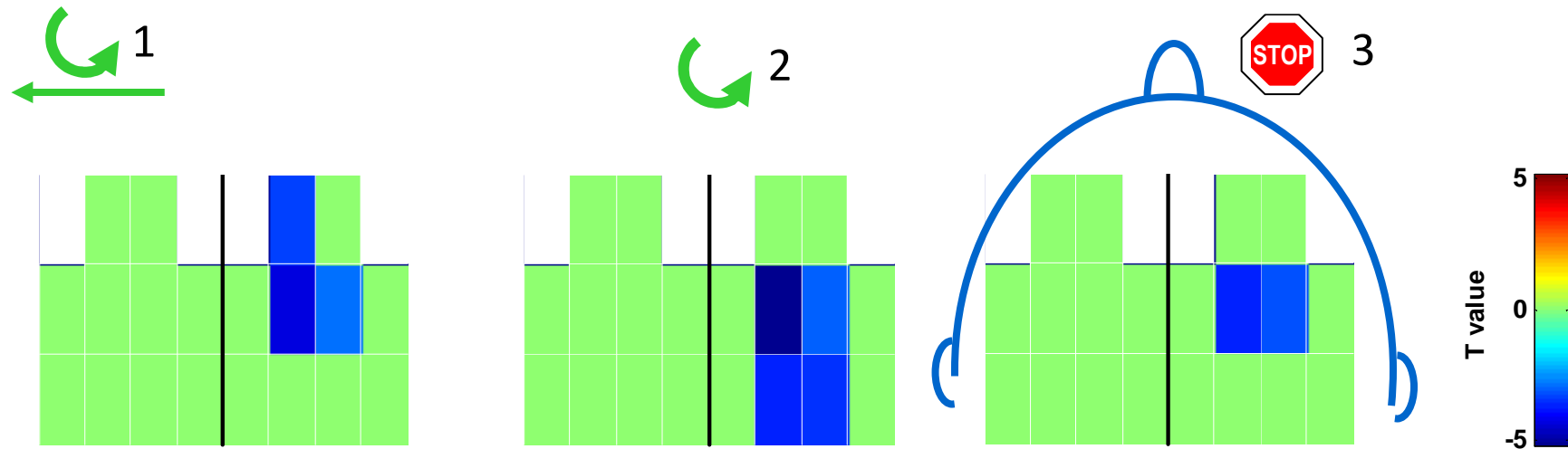
Weak Artifacts



Strong Artifacts



Spatial Mapping



Threshold @ $p = 0.0065$

(Accounts for false discovery rate)

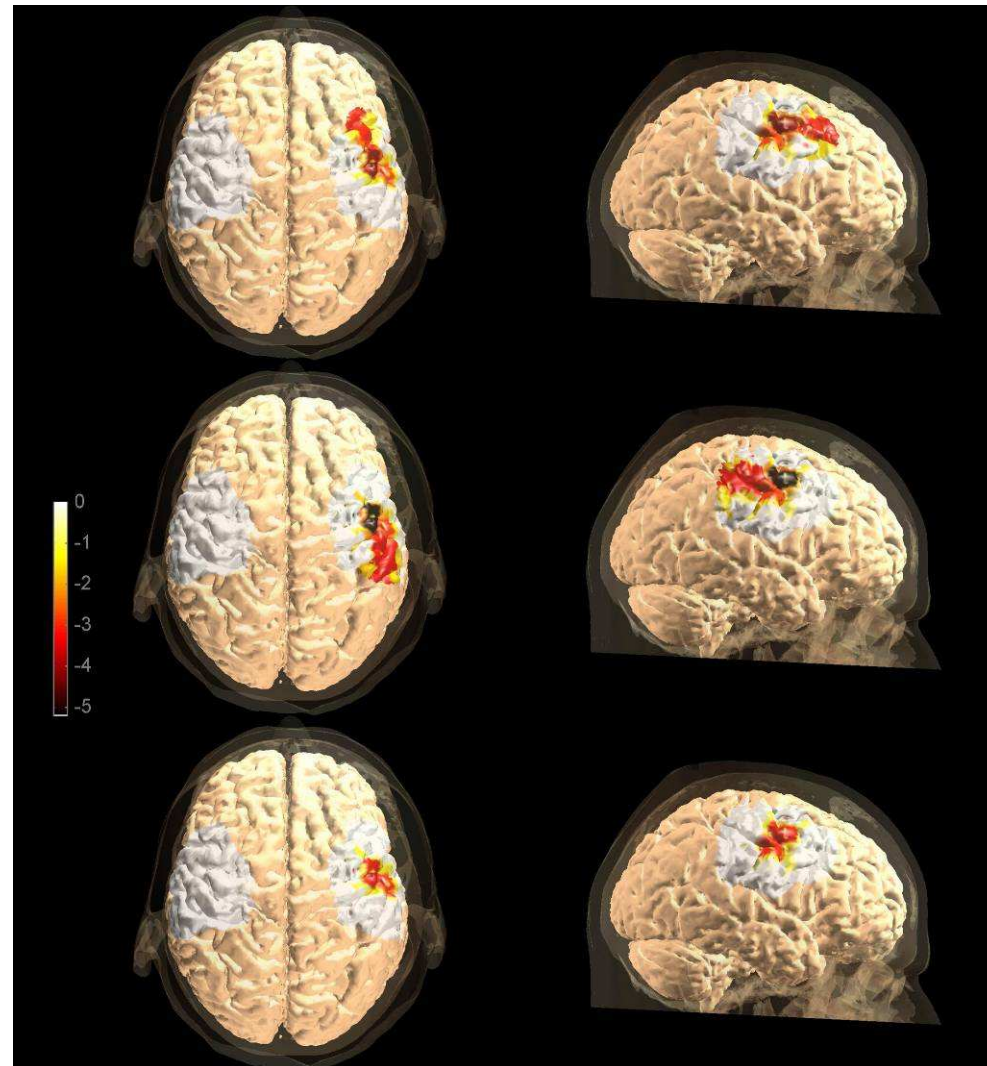
Anatomical Mapping



Cond. 1

Cond. 2

Cond. 3



Summary & Outlook

- Miniaturized active sensors
- Integrated multi-channel NIRS System into portable device (Wifi)
- Demonstrated robustness
- Demonstrated real-world untethered experiments

What next?

- More subjects
- More experiments → new kind of physiological data
- More channels
- Multimodal integration

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