The challenge of extracting cerebral activity from near-infrared spectroscopy in moving subjects.

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Résumé

Protocols dramatically lose ecological validity when subjects must stay motionless in a lying position, without being able to move their head and in a noisy environment such as with functional magnetic resonance imaging (fMRI). In addition, when the topic of interest is movement, it is fundamental to use techniques that are compatible with motion. Near-infrared spectroscopy (NIRS) has been increasingly used in this endeavor because NIRS sensors are relatively light and robust to motion artefacts. Like fMRI, NIRS relies on the detection of neurovascular coupling to infer changes in neuronal activity. However, because sensors are positioned over the scalp, the NIRS signal is strongly influenced by extracerebral hemodynamics. Because subjects execute motor actions that require muscle activity, important systemic physiological activations can also influence the intracerebral hemodynamics. In addition, although NIRS is certainly more robust to motion artefacts than other non-invasive brain recording techniques such as electro-encephalography, motion artefacts are still present and can dramatically bias the signal. In the present communication, we will show how motion artefacts, intracerebral and extracerebral hemodynamics influence the NIRS signal and illustrate these issues with our own data. Then, we will present the methods we have used to attempt to remove these influences from the signal in order to extract the task-evoked cerebral activity.

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