fNIRS and Facial Thermography to Assess Mental Workload

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Estimating Mental Workload is crucially important for the safety critical domain \cite{Marinescu2016}, and potentially valuable in broader Human-Computer Interaction. In this paper, we present our ongoing research exploring non-invasive techniques for mental workload estimation, in increasingly natural work environments. We focus on two particular techniques – 1) facial thermography and 2) fNIRS, where its portability and higher tolerance of movement artefacts make it a stronger candidate than other brain measurement techniques. Both measurements have been independently shown to correlate with workload and performance measures \cite{Marinescu2016, Maior2018}, and our current collaboration aims to compare them in more detail.

The study below was conducted in laboratory conditions and required participants to perform a custom-designed visual-motor task that imposed varying levels of demand. The task consisted of aiming at the target (red) balls using a joystick and shooting using a button on the joystick as soon as possible. Demand (the number of balloons to shoot) naturally increased for the first 6 stages, and decreased back to the original level in the last 6 stages for each of the 3 times participants played the task, hence the curves in Figure 1 following the same pattern. At the end of each stage, participants self-reported their perceived Mental Workload on a 5-point ISA scale. Participants repeated the 13-stage (45s per stage) task three times; the total duration of the study was approximately 30 minutes.

Our results provide a comparison between the physiological techniques used and their relationship with performance and the experienced workload. As a well established measure, ISA correlated strongly with performance for 11/11 participants. fNIRS correlated strongly for 7/7 (data loss), and facial thermography for only 4/11. Analysis is ongoing.

References