Muscle OPM signal modulates with force output

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Measurement of electromyographic (EMG) activity during a muscle contraction can provide insight into the healthy function of muscle tissue when compared with an external measure of force [1]. However, EMG is limited by poor spatial specificity, and it is likely that magnetomyographic (MMG) recordings (i.e. measuring the magnetic field, rather than electrical potentials, elicited by muscle activity) may offer significant advantages. MMG has been challenging in the past due to a requirement for a bespoke array of cryogenic field detectors which are expensive. However, OPMs offer an attractive and flexible platform to undertake MMG measurements

Using OPMs placed on a bicep, we investigated the relationship between change in magnetic signal during isometric contraction, and force output, at a series of different target effort levels. This was a proof of principle experiment to demonstrate that the MMG signal in a simple task is related to the behavioural output measured by a force device. Our results showed that OPMs could capture the MMG signal with high fidelity, and that the MMG demonstrated a monotonic relationship with force.

This study demonstrated the flexibility of OPMs which can capture biomagnetic signals from a range of regions, including heart, brain and muscles. Future work will aim to realise the potential of MMG for capturing highly spatially selective signals from different areas within a muscle, and also look at muscle to brain interactions.

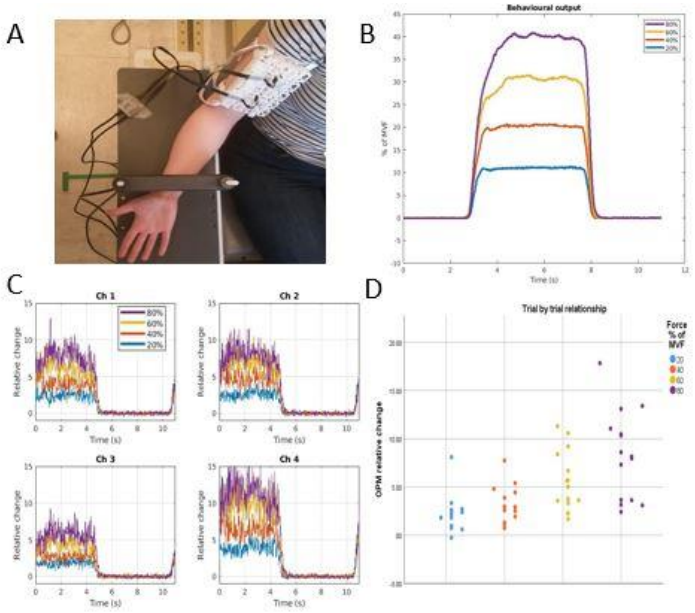

Figure 1: Measuring OPM muscle activity and force output. A) Experimental setup: 2 OPMs placed on the right bicep, with effort level measured by a newton meter placed over the wrist. Visual feedback was supplied to the participant to enable them to target different force outputs. B) Measured behavioural output at 20%, 40%, 60% and 80% of maximum voluntary force averaged over 15 trials. C) Trial averaged relative change in the MMG signal from baseline, at 4 different force levels. D) Trial-by-trial correlation between MMG signal change from baseline and force output.

References [1] T.J.Roberts & A.Gabaldon, Integrative and Comparative Biology, 48, 312-320 (2008)