**Introduction**

Regional cerebral blood flow is regulated by the "neurovascular unit" ([Gray, Anatomy, Random House, 1977]). Stroke can impair functional hyperemia despite persistent neuronal activity. Alteration of the blood oxygen level dependent (BOLD) signal has been observed post stroke ([Hamel, J. Appl. Physiol., 2006]).

- Functional hyperemia causes an increase in regional cerebral blood flow (rCBF) in relation to neural activity.
- This process is altered in cerebrovascular disease.
- Imaging functional hyperemia may help to localise and evaluate neurovascular impairment.

**Methods**

We evoke responses in the sensorimotor system and monitor motor responses during BOLD fMRI ([Rossini et al., Can Conf Med Bio Eng, 2003]). We designed an event-related visual feedback-controlled motor task to include a wide range stroke patients. The contiguity function quantifies the "connectedness" of a cluster.

- Sensorimotor system is evoked by hand gripping while motor and BOLD fMRI signals are measured.
- Single-handed grip force target is calibrated to ~25% of maximum, while both hands are monitored.
- Scanning process is noninvasive and takes ~15 mins.

**Results**

Motor task performance in right & left hands.

- Aggregate BOLD response in normal group.
- Individual case study separately identifies responding motor areas.

- Motor task performance varied, yet we obtained a 92% response rate.
- Stroke group had 58% more signals than normal—many anticorrelated.
- Stroke voxel clusters are less contiguous and less synchronised to motor signals than normal clusters.
- Normal group shows clear, focused sensorimotor responses, while the stroke group shows a less consistent dispersion of responses.

**Conclusion**

- Method produces consistent neurovascular responses in sensorimotor areas in normal group.
- Motor task was applicable to stroke patients with a wide range of motor deficits.
- Space-time characterisation identifies neurovascular impairment as a decrease in BOLD signal contiguity and correlation to the motor task.
- Future work will involve a longitudinal study to observe changes in the BOLD signal's space-time structure in recovering stroke patients.
- Monitoring regional neurovascular impairment may provide new insights for rehab programmes.

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**References:**

1. H. Grey, Anatomy, Descriptive and Surgical, Random House, 1977
2. E. Hamel, J Appl Physiol, 100, 1059-64, 2006
5. A. Gelman et al, Bayesian Data Analysis, Chapman & Hall, 2004