Closed-Loop Brain-Controlled Reaching Guided by Cortical Microstimulation

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**Background**

- Monkey seated with joystick
- Visual stimuli projected on screen
- Somatosensory stimuli presented via:
  1. Vibration of joystick handle
  2. Cortical microstimulation
- Task completion requires synthesis of vision and somatic sensation

**Task**

- Monkey holds cursor in the center
- Somatosensory cue delivered in center target
- Two peripheral targets appear after a delay: typically 2 seconds.
- Move cursor to the correct target for reward

**Implants**

- Stainless Steel microwire electrodes
- Sharp tips for penetrating pia
- 32 electrodes per array in bundles of two
- 1 mm spacing between bundles
- 40 μm diameter wires for recording and 63 μm diameter wires for stimulation
- 300 μm offset between tips (larger diameter are deeper)

**Electrodes**

- Staines Steel microwire electrodes
- Sharp tips for penetrating pia
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**Microstimulation protocol**

- 50 μA biphasic pulse pairs
- Pulse-width of 150 microseconds
- 30 Hz for one to two seconds
- Stimulation in hand S1 on electrode pairs with hand or finger receptive fields
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**Future directions**

- Visually identical but microstimulation feedback is delivered on contact

**Behavior with microstimulation**

- BMI Predictions
- BMI with microstimulation

**Acknowledgements and references**

- Nathan A. Fitzsimmons, et al. Cortical microstimulation feedback is sufficient to evoke muscle contractions of the arm and hand.