Neurostimulation Perception Obeys Strength-Duration Curves and is Primarily Driven by Pulse Amplitude

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Background

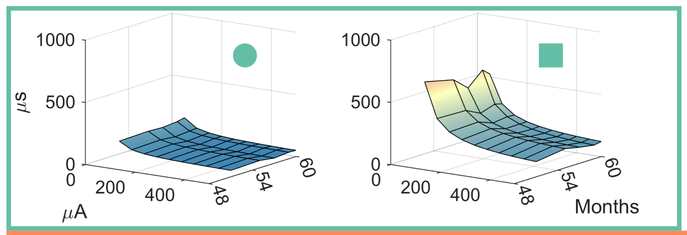
- Stimulation of peripheral nerves elicits sensations felt on amputated portions of the limb, and thus can provide sensory feedback for prosthetic limbs
- Neurostimulation confers proportionality by modulating frequency, amplitude, and duration of stimulation pulses
- The relationship between stimulation amplitude and pulse duration has not previously been characterized for extraneural stimulation

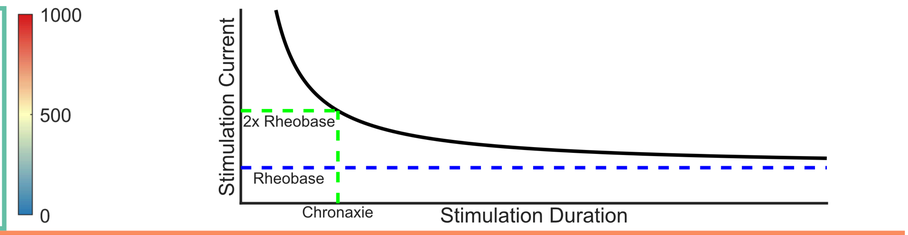
Methods

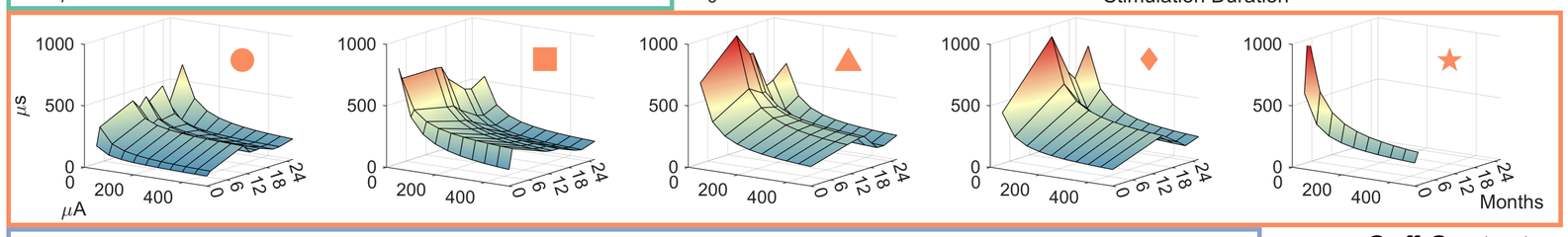
- Psychophysical protocols evaluated Detection Thresholds and Discrimination Thresholds for three participants implanted with a neuromusculoskeletal prosthesis including extraneural spiral cuff electrodes
- Strength-duration curves were modeled using Lapicque's equation to determine rheobasic current and chronaxie
- Just-noticeable differences were used to model psychometric response and sensitivity to changes in stimulation

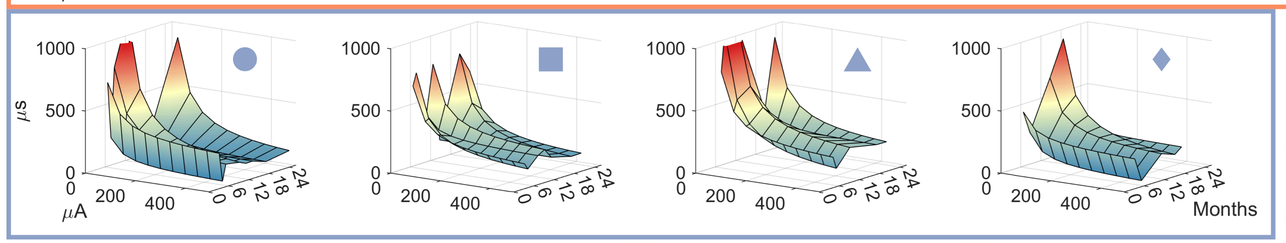
Results

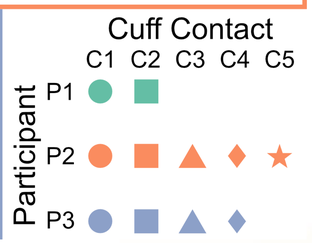
- Neurostimulation perception closely follows strength-duration curve models and is generally constant over the course of up to 24 months ($r^2 = 0.887$)
- Rheobase and chronaxie confidence intervals could be predicted by determining monotonicity ($\rho \geq 0.200$) and concavity ($\rho \leq -0.313$) of collected data
- Discrimination of peripheral nerve stimulation is more sensitive to changes in amplitude (7.7%) than to changes in pulse duration (18.3%)

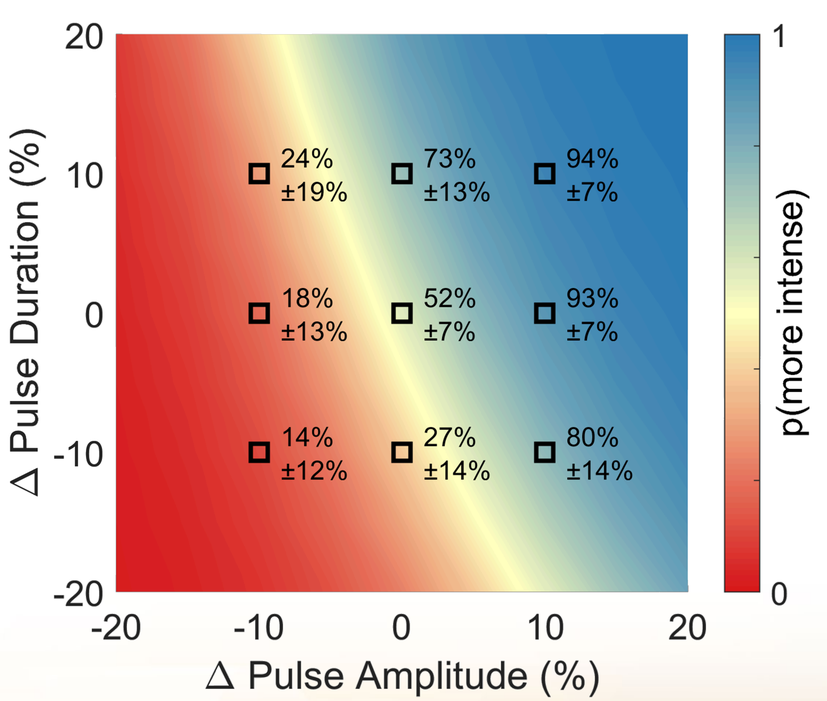












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