VLSI emulation of motor overflow in hand dystonia

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Abstract

Using VLSI (Very-Large-Scale-Integrated-circuit) emulations to verify whether clinical symptoms of dystonia can be caused by certain neuronal abnormalities.

Hypotheses:
1. Overlapping cortical representation causes motor overflow activities among fingers.
2. Tonic cortical drive to the cortex causes increased muscle activity.
3. Enlargement, de-differentiation in cortical representation (Byl & Merzenich 1997[1]) could contribute to overflow (Sanger 2000[2]).
4. Confusion on cortical representation can cause some types of dystonia.

Results: Motor overflow to an adjacent finger

Hypothesis: Abnormal sensorimotor representation leads to motor manifestation of overflow in dystonia in hand

Method: Dystonia Model

Emulated structures:

Results: Motor overflow to an adjacent finger

Hypothesis: Abnormal sensorimotor representation leads to motor manifestation of overflow in dystonia in hand

Conclusion

• Overlapping cortical representation & tonic cortical drive is sufficient to cause motor overflow symptom of dystonia
• VLSI emulation testbed allows verification of various kinds of models for clinical symptoms of neurological disorder.

Future Work

• Simulate development of abnormal motor representation by plasticity with dystonia models.
• Emulate: Could excessive cortical activities lead to ‘overflowing’ by plasticity models?
• Emulate: Could ‘overflowing’ model itself increase overall gain of sensorimotor loop?

More results

Voluntary arm swinging

A) Healthy

B) Tonic cortical drive to be performed

References


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