Decoding hand kinematics from neuronal populations in primary motor and somatosensory cortices during grasping

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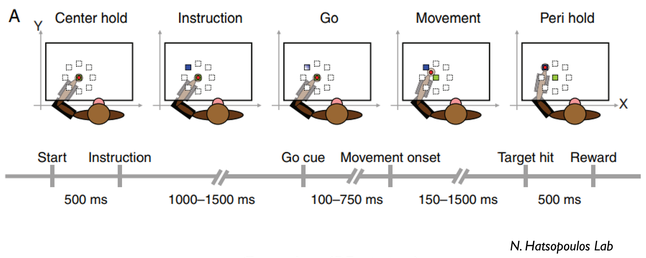
Summary

- The goal of this project is to assess the degree to which high-dimensional hand kinematics can be reconstructed from the activity of neural populations in motor (M1) and somatosensory (SC) cortices.
- As few as 20 neurons yielded robust decoding performance in all monkeys.
- We found that neuronal signals from rostral M1 yield better decoding performance than do their counterparts in caudal M1, and signals in area 3a yield better performance than do those in area 2.
- Hand postures (joint angles) are decoded significantly better than hand movements (joint angular velocities) from both M1 and SC, in contrast to what has been observed for arm kinematics during reaching, for which angular velocities are better decoded.
- Exploiting the assumption of automonous dynamics (LFADS) significantly improves decoding performance for reaching but not for grasping.

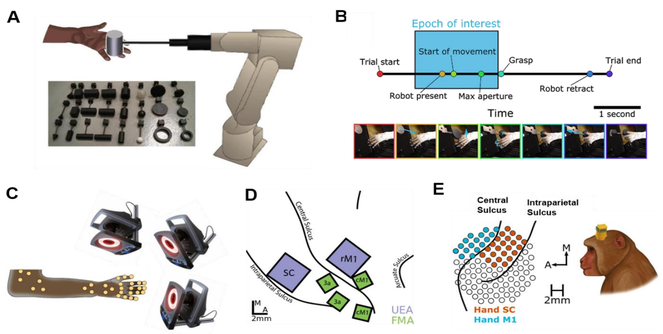
Methods

Reaching (8 states)

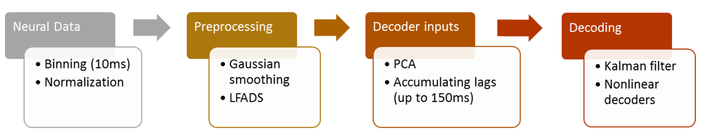


N. Hatsopoulos Lab

Grasping (35 states)



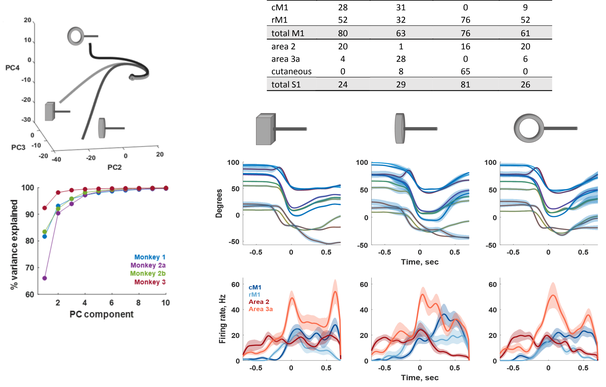
Data Analysis



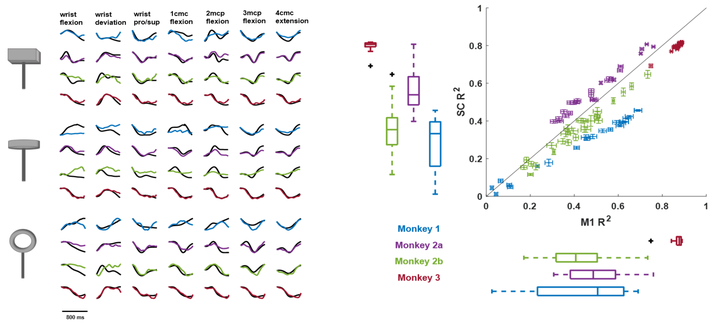
Decoding hand kinematics

Data

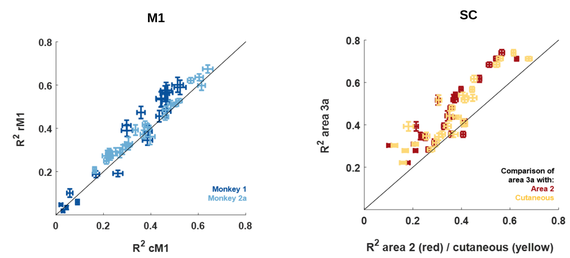
	Monkey 1	Monkey 2a	Monkey 2b	Monkey 3
cM1	28	31	0	9
rM1	52	32	76	52
total M1	80	63	76	61
area 2	20	1	16	20
area 3a	4	28	0	6
cutaneous	0	8	65	0
total S1	24	29	81	26



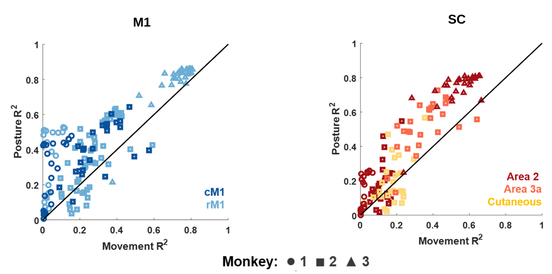
Overall decoding performance



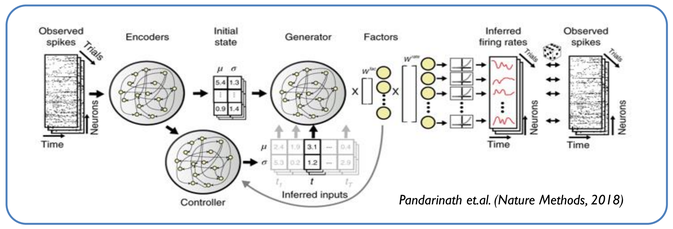
Comparison of areas

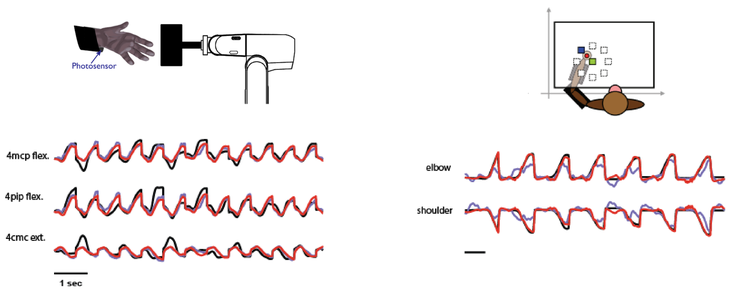


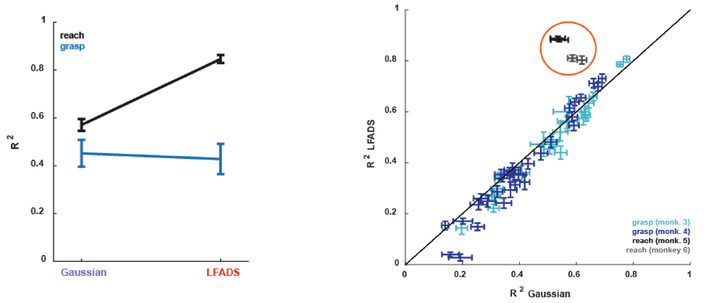
Posture and movement decoding



Decoding using dynamical systems approach







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