I-62. Quantifying representational and dynamical structure in large neural datasets

Jeffrey Seely[1] JSSEELY@GMAIL.COM
Matthew Kaufman[2] MKAUFMAN@CSHL.EDU
Adam Kohn[3] ADAM.KOHN@EINSTEIN.YU.EDU
Matthew Smith[4] MASMITH@CNBC.CMU.EDU
Anthony Movshon[5] MOVSHON@NYU.EDU
Nicholas Priebe[6] NICHOLAS@MAIL.UTEXAS.EDU
Stephen Lisberger[7] SGL@PHY.UCSF.EDU
Stephen Ryu[8] SEOULMANMD@GMAIL.COM
Krishna Shenoy[8] SHENOY@STANFORD.EDU
Larry Abbott[1]

[1]Columbia University
[2]Cold Spring Harbor Laboratory
[3]Albert Einstein College of Medicine
[4]University of Pittsburgh
[5]New York University
[6]University of Texas at Austin
[7]University of California, San Francisco
[8]Stanford University

Systems neuroscience often employs models that explain neural responses in terms of represented stimulus features or movement parameters. These models can be powerful, but may not apply equally well when neural activity is dominated by intrinsic dynamics. Here, we examine large datasets from a number of cortical areas and ask whether responses appear stimulus dominated (i.e., are most naturally described in terms of tuning functions for external parameters) or appear dominated by internal dynamics (i.e., where the future population response is a function of the past population response). We analyzed datasets (44 - 218 single and/or multi-unit isolations) from visual areas V1 and MT (recorded during the presentation of visual stimuli) and from primary motor and premotor cortex (recorded during a delayed reach task). Our analyses did not fit particular tuning or dynamical models, but instead asked whether basic features of the data tended to obey or violate expectations of representational and dynamical systems. Our datasets consist of firing rate values indexed by neuron, condition (stimulus), and time. Our analysis involves a higher-order generalization of SVD (a tensor decomposition) to expose two kinds of structure potentially present in the data. First, when the responses of different neurons reflect tuning for a set of 'represented' stimulus parameters, then structure should be best captured across neurons. Second, when the responses for different conditions reflect the evolution of fixed dynamics from a set of initial states, then structure should be best captured across conditions. We employed simulations to confirm that these expectations hold. We then applied this method to six neural datasets from four cortical areas. For datasets from V1 and MT, the dominant structure was across neurons, consistent with a representational framework. For motor and premotor cortex, the dominant structure was across conditions, consistent with a dynamical framework.

I-63. Motor coding in the supplementary motor area of humans and monkeys

Gal Chechik[1] GAL.CHECHIK@GMAIL.COM
Hadas Taubman[2] TAUBMANH@GMAIL.COM
Ariel Tankus[3] ARIELTA@GMAIL.COM
Eilon Vaadia[4] EILON.VAADIA@ELSC.HUJI.AC.IL
Itzhak Fried[5] IFRIED@MEDNET.UCLA.EDU
Rony Paz[6] RONY.PAZ@WEIZMANN.AC.IL

[1]Gonda Brain Research Center
[2]Bar Ilan University