MAR17-2016-020154

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

Linear and nonlinear manifolds for neural dynamics

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The fundamental question of how the dynamics of networks of neurons implement neural computations and information processing remains unanswered. The problem is formidable, as neural activity in any specific area not only reflects its intrinsic population dynamics, but must also represent both inputs to and outputs from that area and the computations being performed. The analysis of neural dynamics in several brain cortices has consistently revealed the existence of low dimensional neural manifolds, spanned by latent variables that capture a significant fraction of neural variability. We focus on motor cortex, and discuss a new model for neural control of movement in which "neural modes" are the generators of motor behaviors. We review existing evidence in support of neural manifolds, and present novel results on the geometric and dynamic similarities between manifolds associated with different motor tasks. We propose that this manifold-based view of motor cortex dynamics may lead to a better understanding of how the brain controls movement.