[W 76] A computational model of the anterior intraparietal area

Omid Rezai[1], Ashley Kleinhans[2], Eduardo Matallanas[3], Ben Selby[1], Bryan P. Tripp[1]

1. Centre for Theoretical Neuroscience, University of Waterloo, Waterloo, Canada
2. MIAS, CSIR, Pretoria, South Africa
3. ETSI Telecomunicación, Universidad Politécnica de Madrid, Madrid, Spain
doi: 10.12751/nncn.bc2014.0095

The monkey anterior intraparietal area (AIP) encodes visual information about three-dimensional object shape that is used to shape the hand for grasping. In robotics a similar role has been played by modules that fit point cloud data to the superquadric family of shapes and its various extensions. We developed a model of shape tuning in AIP based on cosine tuning to superquadric parameters. However, the model did not fit the data well, and we also found that it was difficult to accurately reproduce these parameters using neural networks with the appropriate inputs (modelled on the caudal intraparietal area, CIP). The latter difficulty was related to the fact that there are large discontinuities in the superquadric parameters between very similar shapes. To address these limitations we adopted an alternative shape parameterization based on an Isomap nonlinear dimension reduction. The Isomap was built using gradients and curvatures of object surface depth. This alternative parameterization was low-dimensional (like superquadrics), but data-driven (similar to an alternative clustering approach that is also sometimes used in robotics) and lacked large discontinuities. Isomaps with 16 or more dimensions reproduced the AIP data fairly well. Moreover, we found that the Isomap parameters could be approximated from CIP-like input much more accurately than the superquadric parameters. We conclude that Isomaps, or perhaps alternative dimension reductions of CIP signals, provide a promising model of AIP tuning. We have now started to integrate our model with a robot hand, to explore the efficacy of Isomap shape reductions in grasp planning. Future work will consider dynamics of spike responses and integration with related visual and motor area models.

Acknowledgements
Financial support by CrossWing Inc.; NSERC and Mitacs (Canada); DAAD-NRF (South Africa); SME and Consejo Social UPM (Spain). We thank Renaud Detry, Paul Calamai & André Nel for helpful discussions.