A computational biologically inspired model of motor control of direction

A thesis presented
by

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to
The Department of Computer Science
in partial fulfillment of the requirements
for the degree of
Master in Computer Science

Under the supervision of
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University College Dublin
Dublin, Ireland
2002

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Abstract

Sensorimotor coordination has been an active research topic for both neuroscience and artificial intelligence over the last decade. For the visual guidance of movement to be efficiently implemented in artificial systems, it is essential to understand the computational mechanisms underpinning biological motor control. This thesis explores the development of visuomotor coordination within a biologically inspired computational framework based on spike-processing neural networks.

Firstly, we address the development in a self–organizing map of neural directional selectivity. As a result of the learning process and of the input patterns used, the network develops a distributed representation of 12 directions of movement. The population code resulted is analyzed using the population vector scheme and is compared with neurobiological data on motor cortex organization.

Secondly, we propose a computational mechanism based on spike-timing dependent learning, for the transfer of directional information between a visual and a motor map. Learning of the visuomotor mapping resides in the development of connection strengths that are dependent on the similarity between the preferred directions of neurons in the two maps. The computational mechanism and the neural behaviors resulted are discussed with respect to their neurophysiological implications. We believe that biologically inspired modeling of motor control development can be highly beneficial to the understanding of brain computations underlying movement control.

Acknowledgments

I would like to thank everybody who have supported me whilst I have worked towards the completion of this thesis. Firstly, I would like to thank to my supervisor Ronan Reilly for support and guidance he has provided during my work. I would like to thank to the Enterprise Ireland for supporting financially my research during my work at University College Dublin.

I would like to thank all my colleagues who have helped me to continue my research and write this thesis: Colm Connolly, Rem Collier, Nikita Schmitt, Gina Joue. My special thanks to Nikolinka Collier and Corina Sas for their continuous support and help while I have worked for this thesis. I would also like to thank my parents for their understanding and support whenever I have needed. Finnally, I would like to thank to my friend Octavian Goga without whom I could have never been able to carry on this work.

Dedicated to my parents

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