BOOK REVIEW

Computational Maps in the Visual Cortex
by R. Miikkulainen, J. Bednar, Y. Choe, J. Sirosh 568pp,
Hardcover, € 96.95; SFR 164.00 ₤ 74.50; US\$ 125.00
ISBN:0-387-22024-0 Springer

R. M. Müri

The hardcover book of 24.2×16.3×3 cm size presents a comprehensive, unified computational theory of the visual cortex as a laterally connected self-organizing map and puts the theory in the context of past and current research in this area. A computational framework called LISSOM, or laterally interconnected synergetically self-organizing map, is a computational map of the visual cortex developed in the laboratory of the four authors over the past 10 years. The book was developed together with "Topographica", a general simulator for computational modeling of cortical maps. Topographica is intended to serve as a common software tool for the research community, and is freely available.

The book is divided into five parts with a total of 18 chapters. The first part reviews the biological background for the core constituents of LISSOM: self-organization, lateral connections, genetic versus environmentally driven, development, and temporal coding. The computational foundations for the model are reviewed.

The second part focuses on mechanisms of input-driven self-organization and presents the basic architecture of the LISSOM computational map model of the primary visual cortex.

The third part of the book demonstrates how the genetic and environmental influences may be combined with input-driven self-organization. The expansion of the LISSOM model of V1 by multi-level model includes now subcortical areas and higher visual maps. This model demonstrates a synergy of nature and nurture in developing orientation preferences, and allows one to gain insight into high-level phenomena such as infant face processing. The fourth part is dedicated to the important problem of perceptual grouping. Grouping of image elements into a coherent object is one of the most intriguing functions of the visual system. The authors introduce the PGLISSOM, i.e., the perceptual grouping LISSOM, which is an extension of the LISSOM model. Temporally correlated activity is one of the basic elements for binding and segmentation in perceptual grouping. There is a chapter about temporal coding and another one about contour integration.

In part five of the book, future directions are outlined and connections are made to related and complementary work in cortical modeling and cognitive sciences. They show that by reducing redundancy while preserving the most important features, an efficient foundation for pattern recognition is possible. They present an example application to handwritten digit recognition. Furthermore, the authors give an outlook on techniques that are developed for scaling the approach to very large maps, including possibly the entire visual cortex.

Finally, there are seven appendices giving specifications and parameters for the models and computational experiments in the book.

All chapters are clearly structured and well written. With more than 170 figures, 47 in full color, the chapters are richly illustrated. Each chapter starts with the specific biological and psychophysiological evidence and the prior modeling work. The book covers a very broad spectrum of themes in visual sciences. A strength of the book is its concise survey of anatomical, neurophysiological, and psychophysiological data necessary to understand the scope of the computer modeling of visual functions. The book is written for computational scientists and neuroscientists working in the field of the visual cortex. The book will be a valuable complement to every scientific library.

R. M. Müri (✉)
Perception and Eye Movement Laboratory,
Departments of Neurology and Clinical Research,
University of Bern, Inselspital,
3010 Bern, Switzerland
e-mail: rene.mueri@dkf.unibe.ch