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Preface

Scientific thought, as we know it today, is based upon the assumption of an objective, external world. This conviction is supported by a rationale, which calls upon mechanical laws of causal efficacy and determinism. Fundamentally, it is the correspondence between the hypotheses and their predictions through experimental research that builds the empirical success of Science. But, how to check this agreement when the observed system evolves fast in time and space and when noise perturbs the system? The research task faces complexity that transforms the experimental information into a tricky puzzle, which hides the correspondence with model predictions.

An impressive amount of notions about the fundamental mechanisms involved in the cerebral functions at subcellular, cellular and system levels emphasize the brain as a complex system characterized by multiple levels of integration with emergent properties. Complexity is observed from the sensory transduction level to the cell assembly dynamics. In order to cope with such seemingly hopeless case study one of the most challenging goal of brain science is understanding, how the nervous system codes and processes information. However, this question rests upon the difficult objective to establish an appropriate definition of information, which is both physiologically and theoretically plausible. Several attempts to crack the neural codes inspired by the reductionism have been proposed during the past decades but how robust are these codes when one considers the space-time evolution of brain waves? Can they update their expressions to enclose last experimental results or are we facing a dead-end? What is the role of the noise in the nervous system: is it a perturbation or has it a precise role in the signal transmission? This and other open problems leave us the main doubt: are our methods enough to deal with the information in the neural codes or should we develop alternative approaches?

Genomic or neurocomputing advances alone cannot answer those questions and a renewed and interdisciplinary effort has been aimed by the scientists (78) who attended the Fifth Biennial Neuronal Coding Workshop held in Aulla, Italy on 20–25 September 2003. The latest results presented at the workshop were submitted as full papers and a selection of the presentations, after peer reviewing, is published in this special issue.

This series of workshops (Prague, 1995; Versailles, 1997; Osaka, 1999; Plymouth, 2001) is intended to gather ideas for approaching the topic of Neural Coding from different viewpoints, ranging from single neurons and neural networks to animal/human behaviour in theoretical and experimental studies and by different disciplines (Lánský, 1997; Rospars, 1998; Sato et al., 2000; Borisyuk and Bugmann, 2002). The workshop held in Aulla continued the initial objective of the series by promoting the interdisciplinary discussions and the establishment of contacts among participants rather than special introductory papers. To this end a large space was reserved to the poster sessions. Abstracts of the presentations can be found in the workshop Web site <http://www.neuroheuristic.org/neural-coding-2003/>.

We would like to acknowledge the contributions of those who made this event a success, in particular the City of Aulla and the Mayor Dr. Lucio Barani, the Lunigiana Museum of Natural History and Dr. Lucia Simonini, the Neuroheuristic Research Group and Mrs.

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