
Preface

Technology is taking us to a world where myriads of heavily networked devices interact with the physical world in multiple ways, and at multiple scales, from the global Internet scale down to micro and nano devices. Many of these devices are highly mobile and autonomous, and must adapt to the surrounding environment in a totally unsupervised way.

This vision poses severe challenges to existing approaches to the design and management of ICT systems, since the size of this omni-comprehensive network, in terms of both number of constituent nodes and running services, is expected to exceed by several orders of magnitude that of existing information systems. The resulting large-scale communication system could not be handled according to conventional ICT paradigms, which are not able to accommodate the scale, heterogeneity and complexity of such scenarios. A fundamental research challenge is therefore the design of *robust decentralized computing systems* capable of operating under changing environments and noisy input, and yet exhibit the desired behavior and response time, under constraints such as energy consumption, size, and processing power. These systems should be able to adapt on the short term and evolve on the long one, and they should learn how to react to unforeseen scenarios as well as to display properties comparable to social entities.

Biological systems are able to handle many of these challenges with an elegance and efficiency still far beyond current human artifacts. Most of the desired features have been refined by nature over periods of millions of years, generating living organisms that are able to autonomously repair themselves when damaged, produce emergent behavior, survive despite drastic changes in the environment conditions and evolve over time. All these considerations generated a significant interest in the area of *bio-inspired computing*, i.e. the application of biological principles to the design of human artifacts, with the expectation of reproducing the same observed behavior.

Fully in line with this growing interests in biologically inspired computing, the first international conference on *Bio Inspired mOdelS of NEtwork, Information and Computing Systems* (BIONETICS) was successfully organized in Cavalese in December 2006. The aim was to bring together researchers and scientists from

several disciplines in computer science and engineering where bio-inspired methods are investigated. The interest in this new research approach has been confirmed by the high number of high quality submissions, and from the high number of conference attendees.

This book collects extended versions of selected outstanding papers originally submitted to BIONETICS 2006. It is structured into four parts, covering different aspects involved in the engineering of future ICT systems:

- Self-Organizing Network Environments
- System Design and Programming
- Sensor and Actor Networks
- Search and Optimization

With this book, we want to address researchers who are interested in bio-inspired computing. According to the broad spectrum addressed by the different book chapters, a variety of biological principles and their application in ICT systems are presented. Based on these information, we want to encourage researchers to initiate interdisciplinary studies especially focusing on biological disciplines.

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Models, Methods, and Tools

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