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V. Roberto (Ed.)

Intelligent Perceptual Systems

New Directions
in Computational Perception



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Preface

By *Perception* is usually meant a set of processes through which a system constructs and maintains internal representations of the environment, on the basis of sensory inputs. Perceptual processes in humans and machines, investigated by means of the computational approach, are the subject matter of this volume.

Researchers in artificial intelligence (AI), pattern recognition and psychology discuss, in a broad and cross-disciplinary perspective, aspects of vision, speech understanding, sensory-motor co-ordination and their interplay with cognitive and behavioural functionalities.

Joint research efforts involving different scientific communities are a consolidated practice in AI. In particular, in perceptual domains, the investigations of the experimental psychologists are leading to the discovery of new phenomena, the definition of levels of complexity and sources of ambiguity. Such results are extremely helpful to those researchers in artificial intelligence and pattern recognition who aim at emulating with machines the functionalities of biological systems.

All the papers in the present volume adopt the computational approach as a basic research paradigm. Connectionist models, numerical/statistical techniques, symbolic and logic-based formalisms, and hybrid representations all provide a formal background to the investigations and act as terms of a shared language, which makes easier the mutual transfer of knowledge and results.

New directions are suggested by the on-going research work, and are reflected in this volume. In particular, emphasis is placed on the automated *extraction of perceptual primitives* in analogy with visual and auditory mechanisms in biological systems; on the *integration between perceptual and cognitive functionalities* (e.g. learning, linguistic communication, planning, reasoning), which are traditionally the subject matter of several AI domains; on *sensory-motor co-ordination* and the *emergence of behavioural aspects* - resulting from the fields of active vision, advanced robotics and artificial life.

The key role of perceptual processes is stressed: they *convey meaning (semantics)* in concepts and thoughts, by creating a correspondence between them and the physical world; they *mediate the interactions and the evolution* of an intelligent system in a complex, ambiguous, unpredictable universe.

The book has been divided into four sections. The first one includes short essays reviewing some current research domains, and summarising topics covered throughout the volume. The second addresses problems of extracting and manipulating perceptual primitives. Issues regarding the integration of perceptual and cognitive functionalities are discussed in the third section, especially for what concerns communication. The last section includes practical realisations of perceptual systems, largely inspired by the ideas of active and purposive vision, in which the emergence of behavioural aspects is apparent.

I hope that the arguments reported in this volume will encourage further research work along the emerging directions, and towards a unified view of intelligent systems as complex entities integrating multiple functionalities. The goal of building intelligent perceptual systems, robust and flexible enough to operate in the real world, is still to be achieved; however, the formidable complexity of such a task is a challenge to the researchers in artificial intelligence, and remarkable progress is expected in the near future.

A part of the material reported in this book was prepared for the Second Workshop on Perception, held in Trieste, Italy, October 28-30, 1992. The workshop is an annual meeting of scientists organised by the working group on perception of the Italian Association for Artificial Intelligence (AI*IA). The Trieste meeting was co-sponsored by AI*IA and CNR, the National Research Council of Italy. The financial support of CNR under grant AI92.00485.12 is gratefully acknowledged.

I wish to thank all the researchers who contributed to the success of the meeting and the preparation of this volume.

In particular, I am grateful to Luigina Carlucci Aiello (Roma 'La Sapienza') and Oliviero Stock (IRST, Trento) - past-president and president of the AI*IA, respectively - for their continuous support of the initiatives of the working group on perception.

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Udine, September 1993

Vito Roberto

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