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Spatial Cognition II

Integrating Abstract Theories,
Empirical Studies, Formal Methods,
and Practical Applications



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Preface

Spatial cognition is concerned with the ways humans, animals, or machines think about real or abstract space and also with the ways spatial structures can be used for reasoning. Thus, space is considered both, as an *object* of cognition and as a *means* of cognition. Spatial cognition is an interdisciplinary research area involving approaches from artificial intelligence, cognitive psychology, geography, mathematics, biology, design, theoretical computer science, architecture, and philosophy. Research on spatial cognition has progressed rapidly during the past few years. The disciplines contributing to the field have moved closer together and begin to speak a common language. They have found ways of merging the research results obtained through different approaches. This allows for developing more sophisticated hybrid approaches that overcome intrinsic limitations of the individual disciplines.

Research on spatial cognition has drawn increased attention in recent years for at least three different reasons: (1) basic research dimension: there is a growing awareness of the importance of spatial cognitive abilities in biological systems, specifically with respect to perception and action, to the organization of memory, and to understanding and producing natural language; (2) computational dimension: spatial representations and spatial inference may provide suitable limitations to enhance the computational efficiency for a large and relevant class of problems; (3) application dimension: a good understanding of spatial processes is essential for a wide variety of challenging application areas including Geographic Information Systems (GIS), pedestrian and vehicle navigation aids, autonomous robots, smart graphics, medical surgery, information retrieval, virtual reality, Internet navigation, and human-computer interfaces.

This is the second volume published in the framework of the Spatial Cognition Priority Program. It augments the results presented in Freksa et al. 1998. The interdisciplinary research program (www.spatial-cognition.de) was established by the Deutsche Forschungsgemeinschaft in 1996. It consists of 16 research projects at 13 research institutions throughout Germany. Besides carrying out research in individual projects and joint research between projects, the Spatial Cognition Priority Program organizes ‘topical colloquia’, partly with international participation. A colloquium on *Types of spatial knowledge* was held in Göttingen in May 1997; a colloquium on *Spatial cognition and soft computing* was held in Hamburg in June 1997; a colloquium on *Qualitative and metric approaches to spatial inference and motion analysis* was held in Berlin in June 1997; a colloquium on *Space and action* was held in Ohlstadt in December 1997; a colloquium on *Route and survey knowledge* was held in Bremen in February 1998; a colloquium on the *Representation of motion* was held in Munich in October 1998; a colloquium on *Spatial inference* was held in Freiburg in February 1999; a colloquium on *Systems of reference for spatial knowledge* was held in Hamburg in April 1999; a colloquium on *Spatial cognition in real and virtual environments* was held in Tübingen in April 1999; and a colloquium on *Maps*

and diagrammatic representations of the environment was held in Hamburg in August 1999.

The volume contains 28 articles and is structured into five sections: The section *Maps and diagrams* consists to a large extent of contributions to the international colloquium on *Maps and diagrammatic representations of the environment*. The work presented in the section *Motion and spatial reference* was discussed at the colloquium on the *Representation of motion* or at the colloquium on *Systems of reference for spatial knowledge*. The section *Spatial relations and spatial inference* draws largely from contributions to the colloquium on *Spatial inference*. Most of the work published in the section *Navigation in real and virtual systems* was first presented at the international colloquium on *Spatial cognition in real and virtual environments*. Some of the work in the section *Spatial memory* had been discussed at the colloquium on *Route and survey knowledge*. All contributions underwent a thorough reviewing procedure. The articles reflect the increased cooperation among the researchers in the area of spatial cognition.

We thank all authors for their careful work and for observing our tight deadlines and formatting conventions. We thank the reviewers of the contributions for their insightful and thorough comments and suggestions for improvement. We thank Thora Tenbrink, Karin Colsman, and Thitsady Kamphavong for their superb editorial support. We thank Alfred Hofmann, Antje Endemann and Anna Kramer of Springer-Verlag for the pleasant cooperation. We gratefully acknowledge the guidance by Andreas Engelke and the support of the Deutsche Forschungsgemeinschaft. We thank the reviewers of the DFG spatial cognition priority program for their valuable advice.

April 2000

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Table of Contents

Maps and Diagrams

Cognitive Zoom: From Object to Path and Back Again	1
<i>Carol Strohecker</i>	
Monitoring Change: Characteristics of Dynamic Geo-spatial Phenomena for Visual Exploration	16
<i>Connie Blok</i>	
The Use of Maps, Images and "Gestures" for Navigation	31
<i>Stephen C. Hirtle</i>	
Schematizing Maps: Simplification of Geographic Shape by Discrete Curve Evolution	41
<i>Thomas Barkowsky, Longin Jan Latecki and Kai-Florian Richter</i>	
Schematic Maps as Wayfinding Aids	54
<i>Hernan Casakin, Thomas Barkowsky, Alexander Klippel and Christian Freksa</i>	
Some Ways that Maps and Diagrams Communicate	72
<i>Barbara Tversky</i>	
Spatial Communication with Maps: Defining the Correctness of Maps Using a Multi-Agent Simulation	80
<i>Andrew U. Frank</i>	
Schematic Maps for Robot Navigation	100
<i>Christian Freksa, Reinhard Moratz and Thomas Barkowsky</i>	

Motion and Spatial Reference

From Motion Observation to Qualitative Motion Representation	115
<i>Alexandra Musto, Klaus Stein, Andreas Eisenkolb, Thomas Röfer, Wilfried Brauer and Kerstin Schill</i>	
Lexical Specifications of Paths	127
<i>Carola Eschenbach, Ladina Tschander, Christopher Habel and Lars Kulik</i>	
Visual Processing and Representation of Spatio-temporal Patterns	145
<i>Andreas Eisenkolb, Kerstin Schill, Florian Röhrbein, Volker Baier, Alexandra Musto and Wilfried Brauer</i>	
Orienting and Reorienting in Egocentric Mental Models	157
<i>Robin Hörnig, Klaus Eyferth and Holger Gärtner</i>	

Investigating Spatial Reference Systems through Distortions in Visual Memory	169
<i>Steffen Werner and Thomas Schmidt</i>	

Spatial Relations and Spatial Inference

Towards Cognitive Adequacy of Topological Spatial Relations	184
<i>Jochen Renz, Reinhold Rauh and Markus Knauff</i>	
Interactive Layout Generation with a Diagrammatic Constraint Language .	198
<i>Christoph Schlieder and Cornelius Hagen</i>	
Inference and Visualization of Spatial Relations	212
<i>Sylvia Wiebrock, Lars Wittenburg, Ute Schmid and Fritz Wysotzki</i>	
A Topological Calculus for Cartographic Entities	225
<i>Amar Isli, Lledó Museros Cabedo, Thomas Barkowsky and Reinhard Moratz</i>	
The Influence of Linear Shapes on Solving Interval-Based Configuration Problems	239
<i>Reinhold Rauh and Lars Kulik</i>	

Navigation in Real and Virtual Spaces

Transfer of Spatial Knowledge from Virtual to Real Environments	253
<i>Patrick Péruch, Loïc Belingard and Catherine Thinus-Blanc</i>	
Coarse Qualitative Descriptions in Robot Navigation	265
<i>Rolf Müller, Thomas Röfer, Axel Lankenau, Alexandra Musto, Klaus Stein and Andreas Eisenkolb</i>	
Oblique Angled Intersections and Barriers: Navigating through a Virtual Maze	277
<i>Gabriele Janzen, Theo Herrmann, Steffi Katz and Karin Schweizer</i>	
Modelling Navigational Knowledge by Route Graphs	295
<i>Steffen Werner, Bernd Krieg-Brückner and Theo Herrmann</i>	
Using Realistic Virtual Environments in the Study of Spatial Encoding ...	317
<i>Chris Christou and Heinrich H.Bülthoff</i>	
Navigating Overlapping Virtual Worlds: Arriving in One Place and Finding that You're Somewhere Else	333
<i>Roy A. Ruddle</i>	

Spatial Memory

Influences of Context on Memory for Routes	348
<i>Sabine Schumacher, Karl Friedrich Wender and Rainer Rothkegel</i>	
Preparing a Cup of Tea and Writing a Letter: Do Script-Based Actions Influence the Representation of a Real Environment?	363
<i>Monika Wagener, Silvia Mecklenbräuker, Werner Wippich, Jörg E. Saathoff and André Melzer</i>	
Action Related Determinants of Spatial Coding in Perception and Memory	387
<i>Bernhard Hommel and Lothar Knuf</i>	
Investigation of Age and Sex Effects in Spatial Cognitions as Assessed in a Locomotor Maze and in a 2-D Computer Maze	399
<i>Bernd Leplow, Doris Höll, Lingju Zeng and Maximilian Mehdorn</i>	
Author Index	419