## Contents

Preface / ix

Spatial Aggregation: Language and Applications / 3
Christopher Bailey-Kellogg and Feng Zhao, The Ohio State
University; Kenneth Yip, Massachusetts Institute of
Technology

A Compositional Modeling Language / 12
Daniel Bobrow, Xerox Corporation Palo Alto Research
Center; Brian Falkenhainer, Xerox Wilson Center; Adam
Farquhar, Richard Fikes, and Yumi Iwasaki, Stanford
University; Kenneth Forbus, Northwestern University;
Thomas Gruber, Colloquy Systems Inc.; Benjamin Kuipers,
University of Texas at Austin

Temporal Constraints on Trajectories in Qualitative Simulation / 22

Giorgio Brajnik, Università di Udine, Italy and Daniel J. Clancy, University of Texas at Austin

The Need for Qualitative Reasoning in Automated Modeling: A Case Study / 32

Antonio C. Capelo, Liliana Ironi, and Stefania Tentoni, Istituto di Analisi Numerica del C.N.R., Italy

Qualitative Reasoning for Automated Traffic Surveillance / 40

Jonathan H. Fernyhough, University of Leeds, United Kingdom

Qualitative Phasor Analysis / 43

Juan Flores and Art Farley, University of Oregon

Self-Explanatory Simulators for Middle-School Science Education: A Progress Report / 52 Kenneth D. Forbus, Northwestern University

A Qualitative Reasoning Approach to Chemical Process Design / 57

Ioa S. Gavrila, Bert Bredeweg, and Piet Iedema, University of Amsterdam, The Netherlands

Adaptive Modeling / 67
Ashok K. Goel, Georgia Institute of Technology

Transition-Based Qualitative Simulation / 74

John M. Gooday and Anthony G. Cohn, University of Leeds, United Kingdom

Transformation of Qualitative Dynamic Models – Application in Hydro-Ecology / 83 Ulrich Heller and Peter Struss, Technical University of Munich, Germany

Reasoning about Structure of Interval Systems: An Approach by Sign Directed-Graph / 93 Yoshiteru Ishida and Atusi Nogi, Nara Institute of Science and Technology, Japan

Qualitative Reasoning in Tutoring Interactions / 103

Kees de Koning and Bert Bredeweg, University of

Amsterdam, The Netherlands

A Hierarchy of Qualitative Representations for Space / 113

Benjamin Kuipers, University of Texas at Austin

A Qualitative Model of Physical Fields / 121

Monika Lundell, Swiss Federal Institute of Technology,
Switzerland

Diagnosis of Dynamic Systems Does Not Necessarily Require Simulation / 127 Andreas Malik and Peter Struss, Technical University of Munich, Germany

Comprehending Complex Behavior Graphs through Abstraction / 137

Richard S. Mallory, Bruce W. Porter, and Benjamin J. Kuipers, The University of Texas at Austin Qualitative Reasoning about Electrical Circuits Using Series-Parallel-Star Trees / 147

Jakob Mauss, DAIMLER-BENZ AG and Bernd Neumann, Labor für Künstliche Intelligenz (LKI), Germany

Context-Sensitive and Expectation-Guided Temporal Abstraction of High-Frequency Data / 154

Silvia Miksch, Austrian Research Institute for Artificial Intelligence (OFAI); Werner Horn, Austrian Research Institute for Artificial Intelligence (OFAI) and University of Vienna; Christian Popow, University of Vienna; Franz Paky, Hospital of Mödling, Austria

Analyzing Discontinuities in Physical System Models / 164
Pieter J. Mosterman and Gautam Biswas, Vanderbilt
University

Backward Qualitative Simulation of Structural Model for Strategy Planning / 174

Takenao Ohkawa, Shinya Hata, and Norihisa Komoda, Osaka University, Japan

Inference of Local Rainfall Using Qualitative Reasoning / 181

Satoru Oishi and Shuichi Ikebuchi, Kyoto University, Japan

Using Qualitative Representations in Controlling Engineering Problem Solving / 190 Yusuf Pisan, Northwestern University

Interpreting Simulation with Functional Labels / 198 Chris Price and David Pugh, University of Wales, United Kingdom

Model-Based Automatic Generation of Sequence Control Programs from Design Information / 206

T. Sakao, Y. Umeda, and T. Tomiyama, The University of Tokyo; Y. Shimomura, Mita Industrial Co., Ltd., Japan

Qualitative Models in Ecology and their Use in Intelligent Tutoring Systems / 216

Paulo S.B.A. Salles, Robert I. Muetzelfeldt, and Helen Pain, University of Edinburgh, United Kingdom

Development of Self-Maintenance Photocopiers / 225 Y. Shimomura, K. Ogawa, and S. Tanigawa, Mita Industrial Co., Ltd.; Y. Umeda and T. Tomiyama, The University of Tokyo, Japan A Customized Logic Paradigm for Reasoning about Models / 235

Reinhard Stolle and Elizabeth Bradley, University of Colorado at Boulder

Constraint Logic Programming – A Framework for Qualitative Reasoning / 245 László Teleki, Universität Bonn, Germany

Formation of Qualitative Knowledge Obtained from Quantitative Simulation of Mechanisms / 253 Vladimir Vissikirsky, Institute of Cybernetics, Ukraine

Scale-Based Reasoning on Possible Law Equations / 255 Takashi Washio, Mitsubishi Research Institute, Inc. and Hiroshi Motoda, Osaka University, Japan

Automated Decomposition of Model-Based Learning Problems / 265

Brian C. Williams and Bill Millar, NASA Ames Research Center

A Model-Based Approach to Reactive Self-Configuring Systems / 274

Brian C. Williams and P. Pandurang Nayak, NASA Ames Research Center

Practical Application of Stochastic Qualitative Reasoning to Fault Detection of Building Air Conditioning Systems / 283

Masaki Yumoto, Takenao Ohkawa, and Norihisa Komoda, Osaka University; Fusachika Miyasaka, Yamatake Honeywell Corporation, Japan

Using Qualitative Correlations as Evidence of Uncertain Reasoning / 292

Qi Zhao, University of Alberta, Canada and Toyoaki Nishida, Nara Institute of Science and Technology, Japan

Observation Filtering: From Qualitative Simulation to Qualitative Observer / 299

Zhifeng Zhuang and Paul M. Frank, University of Duisburg, Germany

Index / 307