Preface

Bisimilarity is a fundamental concept in the theory of concurrency; it was proposed originally by R. Milner as a tool for the investigation of concurrent processes in the 1980s. The concept has originally been relational, the work by Aczel and others has shown that bisimilarity can be formulated as the existence of a span of morphisms, in this way making it accessible to methods from the theory of coalgebras. In fact, the impact of the notion of bisimilar systems in coalgebra can arguably be compared to the importance of congruences in classical algebra.

The groups of E. G. Omodeo at Trieste and of E.-E. Doberkat at Dortmund share an interest in the various facets of bisimulations. During their long and successful cooperation, these groups had the privilege of being funded in a three year interval by the Vigoni program, which expresses as a goal to further the cooperative research between Italian and German groups. The project Teoria ed applicazioni delle bisimulazioni / Bisimulationen: Theorie und Anwendungen was funded by the Vigoni project during the years 2007—2009, one of its scientific highlights was the workshop Theory and Applications of Bisimulations which took place on July 3, 2009 in Gorizia. The present collection reflects the work being presented in Gorizia. Some papers found here are updates of the talks given at the workshop, some papers are closely related to the workshop's theme.

Alberto Casagrande's contribution "Hybrid Automata and Bisimulations" surveys hybrid automata and bisimulation relations. Both notions are formally introduced, and the model checking problem over hybrid automata is briefly discussed. It is shown how in some cases bisimulations can be used to quotient infinite state systems to finite ones so that the model checking over hybrid automata is reduced to model checking over finite models. Finally, some classes of hybrid automata which admit finite bisimulation quotients are reviewed. The paper "A Tableau System for a Fragment of Hyperset Theory" by *Domenico Cantone, Massimo Felici and Marianna Nicolosi Asmundo* proposes a decision procedure for a fragment of the hyperset theory, `HMLSS`, which takes inspiration from a tableau saturation strategy for the fragment `MLSS` of well-founded set theory. The procedure alternates deduction and model checking steps, driving the correct application of otherwise very liberal rules, thus significantly speeding up the process of discovering a satisfying assignment of a given `HMLSS`-formula or proving that no such assignment exists. *Ernst-Erich Doberkat* presents in his contribution "A Note on the Coalgebraic Interpretation of Game Logic" a coalgebraic interpretation of game logic, making the results of coalgebraic logic available for this context. Some interesting properties of a coalgebraic interpretation are studied, showing among others that Aczel's Theorem on the characterization of bisimilar models through spans of morphisms is valid in this context. Congruences as those equivalences on

the state space which preserve the structure of the model are investigated as well. The Note "Stating infinity in Set/Hyperset Theory" by *Eugenio G. Omodeo, Alberto Policriti and Alexandru I. Tomescu* deals with the Infinity Axiom. It can be expressed in a logically simple form — even if the Axiom of Foundation is not assumed — by means of a formula involving only restricted universal quantifiers. Moreover, with Aczel's Anti-Foundation Axiom superseding von Neumann's Axiom of Foundation, a similar formula has recently emerged, which enjoys the additional property that it is satisfied only by (infinite) ill-founded sets. New short proofs of both results are presented in this paper. The contribution "Bisimilarity, hypersets, and stable partitioning: a survey" by *Eugenio G. Omodeo* puts bisimulation into the algorithmic context of finding efficient partition refinement methods and argues that the coarsest stable partitioning problem and the determination of bisimilarity are two faces of the same coin. The paper contends that the set-theoretic view not only offers a clear conceptual background, but is leading to new insights on the algorithmic complexity issues. *Giacomo Lenzi* gives in "Recent results on the modal μ-calculus: a survey" an overview of the modal μ-calculus with special emphasis on recent results. Finally, *Christoph Schubert* discusses in his contribution "Topo-bisimulations are coalgebraic" a topological interpretation of the modal logic **S4** by reformulating it as a coalgebra for the filter functor, concluding that the topological semantics is subsumed in coalgebraic semantics. Moreover, the relational notion of topo-bisimulation can be characterized via spans of open and continuous maps of topological spaces or via spans of coalgebras morphisms.

We hope to have convinced the reader that bisimulations are an area which offers many interesting questions in many important areas of mathematics and theoretical computer science. We want to thank all authors who did contribute to the Gorizia workshop and to the present special issue, as well as to the organization committee of that workshop: Luca Bortolussi, Alberto Casagrande, Giovanna D'Agostino, and Christoph Schubert. We are most grateful to the referees who did their work without complaints on time and very constructively. We should not forget to thank our funding agencies, the *Deutscher Akademischer Austauschdienst* and *Ateneo Italo-Tedesco* for supporting us.

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