

Mohammad Reza Mousavi
Anna Philippou (Eds.)

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Formal Techniques for Distributed Objects, Components, and Systems

42nd IFIP WG 6.1 International Conference, FORTE 2022
Held as Part of the 17th International Federated Conference
on Distributed Computing Techniques, DisCoTec 2022
Lucca, Italy, June 13–17, 2022, Proceedings



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Foreword

The 17th International Federated Conference on Distributed Computing Techniques (DisCoTec 2022) took place in Lucca from June 13 to June 17, 2022. It was organised by the IMT School for Advanced Studies Lucca. The DisCoTec series is one of the major events sponsored by the International Federation for Information Processing (IFIP), the European Association for Programming Languages and Systems (EAPLS), and the Microservices Community. DisCoTec 2022 comprised three conferences:

- COORDINATION, the IFIP WG 6.1 24th International Conference on Coordination Models and Languages
- DAIS, the IFIP WG 6.1 22nd International Conference on Distributed Applications and Interoperable Systems
- FORTE, the IFIP WG 6.1 42nd International Conference on Formal Techniques for Distributed Objects, Components and Systems

Together, these conferences covered a broad spectrum of distributed computing subjects, ranging from theoretical foundations and formal description techniques to systems research issues. As is customary, the event also included several plenary sessions in addition to the individual sessions of each conference, which gathered attendants from the three conferences. These included joint invited speaker sessions and a joint session for the best papers from the three conferences.

The DisCoTec 2022 invited speakers were:

- Muffy Calder, University of Glasgow, UK
- Maarten van Steen, University of Twente, The Netherlands
- Luca Viganò, King's College London, UK

Associated with the federated event, five satellite events took place:

- BlockTEE 2022: Workshop on Blockchain Technologies and Trusted Execution Environments
- CoMinDs 2022: Workshop on Collaborative Mining for Distributed Systems
- FOCODILE 2022: Workshop on the Foundations of Consensus and Distributed Ledgers
- ICE 2022: Workshop on Interaction and Concurrency Experience
- REMV 2022: Workshop on Robotics, Electronics and Machine Vision

Moreover, we also had a number of short tutorials on hot topics:

- An Introduction to Spatial Logics and Spatial Model Checking by Vincenzo Ciancia
- A Gentle Adventure Mechanising Message Passing Concurrency Systems by David Castro-Perez, Francisco Ferreira, Lorenzo Gheri, and Martin Vassor

- Smart Contracts in Bitcoin and BitML by Massimo Bartoletti and Roberto Zunino
- The Δ Q Systems Development Paradigm by Neil Davies, Seyed Hossein Haeri, Peter Thompson, and Peter Van Roy
- ChorChain: A Model-driven Approach for Trusted Execution of Multi-party Business Processes on Blockchain by Alessandro Marcelletti

Of course, all of this could not be done without the precious work of the Program Committees of the three main conferences and the five workshops, and of the Steering Committee and Advisory Boards. Many thanks to all of them, they are too many to mention. However, I would like to thank personally the Program Committee Chairs of the main conferences, namely Maurice ter Beek and Marjan Sirjani (for Coordination), David Eyers and Spyros Voulgaris (for DAIS), and Mohammad Mousavi and Anna Philippou (for FORTE). They have managed to select an excellent set of research papers.

The organization of DisCoTec 2022 was only possible thanks to the dedicated work of the Organizing Committee, including Marinella Petrocchi, Simone Soderi, Francesco Tiezzi (Workshops and Tutorials Chair) and Giorgio Audrito (Publicity Chair). But a special thanks has to go to Letterio Galletta, the Chair of the Local Organizing Committee, who, in many cases, because of my absence, acted also as General Chair. Finally, I would like to thank IFIP WG 6.1, EAPLS, and the Microservices Community for sponsoring this event, Springer's Lecture Notes in Computer Science team for their support and sponsorship, EasyChair for providing the reviewing framework, and the IMT School for providing the support and the infrastructure to host the event.

June 2022

Rocco De Nicola

Preface

This volume contains the papers presented at the 42nd IFIP WG 6.1 International Conference on Formal Techniques for Distributed Objects, Components, and Systems (FORTE 2022), held as one of three main conferences of the 17th International Federated Conference on Distributed Computing Techniques (DisCoTec 2022) during June 13–17, 2022. The conference was organized by the IMT School for Advanced Studies Lucca.

FORTE is a well-established forum for fundamental research on theory, models, tools, and applications for distributed systems, with special interest in

- Component- and model-based design
- Cyber-physical systems, autonomous systems, and AI-enabled systems design and trustworthiness
- Object technology, modularity, software adaptation
- Self-stabilization and self-healing/organizing
- Software quality, reliability, availability, and safety
- Security, privacy, and trust in distributed and/or communicating systems
- Service-oriented, ubiquitous, and cloud computing systems
- Verification, validation, formal analysis, and testing of the above.

The Program Committee received a total of 28 submissions, written by authors from 19 different countries. Of these, 12 papers were selected for inclusion in the scientific program. Each submission was reviewed by at least three Program Committee members with the help of 18 external reviewers in selected cases. The selection of accepted submissions was based on electronic discussions via the EasyChair conference management system.

As program chairs of FORTE 2022, we actively contributed to the selection of the keynote speakers for DisCoTec 2022:

- Muffy Calder, University of Glasgow, UK
- Maarten van Steen, University of Twente, The Netherlands
- Luca Viganò, King’s College London, UK

We are most grateful to Muffy Calder for accepting our invitation to be the FORTE-related keynote speaker. This volume contains the abstract of her talk entitled “30+ years of FORTE research: a personal perspective”.

We wish to thank all the authors of submitted papers, all the members of the Program Committee for their thorough evaluations of the submissions, and the external reviewers who assisted the evaluation process. We would also like to express our appreciation to the Steering Committee of FORTE for their advice and suggestions. Last but not least, we thank the DisCoTec General Chair, Rocco De Nicola, and his organization team for

their hard, effective work in providing an excellent environment for FORTE 2022 and all other conferences and workshops.

June 2022

Mohammad Reza Mousavi
Anna Philippou

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30+ Years of FORTE Research: A Personal Perspective (Abstract of Invited Talk)

Muffy Calder 

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I attended the first FORTE conference in Scotland in 1988, and have published in several FORTE conferences since then. Over the past 34 years the field has changed, and so has my own research. Using six example applications, from 1989 to 2020, I reflect on how my own research in fundamental research on theory, models, tools for distributed systems has evolved, and where we might focus research in the future.

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