

# DAGSTUHL SEMINAR

## EXPRESSIVENESS IN CONCURRENCY

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# Contents

# 1 Preface

One of the main research objectives of computer science is the development of formal methods for the design and implementation of programming languages. This research area has witnessed a proliferation of concepts, models and methods. However, the problem of the relative expressive power of the various programming concepts has rarely been addressed systematically.

A systematic study and a formal comparison is even more needed in the case of formalisms for programming or specifying parallel and distributed systems. This study is indispensable for classifying the different programming languages and for providing a formal basis for design principles and implementation techniques of concurrent and/or distributed programming languages.

The main aim of the seminar, organized within the program of the HCM-network EXPRESS, was a better understanding of the interconnections and relations between programming concepts, constructs, models and logics for concurrent specification and implementation languages. The final objective of the project is the definition of a general framework for the comparison of the formal methods for specification and verification developed within the various programming paradigms, in particular with a focus on process algebras. The seminar gave the possibility to compare results of the project with related approaches.

The different talks and the lively discussion offered the occasion for comparing specification and verification methods, developed various programming paradigms, and threw light on:

- the primitives for communication (synchronous vs asynchronous) and nondeterministic choice (internal vs external);
- the different stress on causal and temporal dependencies offered by the various semantic models (process algebras, Petri nets, modal logics, rewrite systems),
- the relative merits of the different approaches to concurrent systems semantics (algebraic, axiomatic, operational, denotational).

The program of the seminar was intense and stimulating; it comprised 30 talks, the abstracts of which are recorded in this report in alphabetical order.

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## Acknowledgements

Many thanks to Arend Rensink and to the Dagstuhl team for their help in the preparation of the seminar. On behalf of all the participants, the organizers would also like to thank the staff of Schloß Dagstuhl for providing an excellent environment.

## 2 Workshop Programme

### Monday 16

*Morning Session - Chair: Ursula Goltz*

- 9.00 Luca Aceto: A Menagerie of Non-finitely based Semantic over BPA\*
- 9.40 Joachim Parrow: Trios in Concert
- 10.30 COFFEE BREAK
- 10.50 Maciej Koutny: Two Semantics for the Box Algebra
- 11.30 Walter Vogler: Efficiency of Asynchronous Systems and Expressivity of Read Arcs in Petri Nets
- 12.15 LUNCH BREAK

*Afternoon Session - Chair: Frits Vaandrager*

- 14.00 David Janin: On the Expressive Completeness of the Modal Mu-Calculus wrt. Monadic Second Order Logic
- 14.40 Alexander Rabinovich: On Translations of Temporal Logic of Actions into Monadic Second Order Logic
- 15.20 COFFEE and CAKE BREAK
- 16.10 Rom Langerak: Causal Ambiguity and Partial Orders
- 16.50 Julia Padberg: Rule-Based Refinement of Petri Nets

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### Tuesday 17

*Morning Session - Chair: Rocco De Nicola*

- 9.00 Ilaria Castellani: On Bisimulations for the Asynchronous  $\beta$ -calculus
- 9.40 Uwe Nestmann: Choice Encodings
- 10.30 COFFEE BREAK
- 10.50 Michele Boreale: On the Expressiveness of Internal Mobility in Name Passing Calculi
- 11.30 Catuscia Palamidessi: Comparing the Expressive Power of the Synchronous and the Asynchronous  $\beta$ -calculus
- 12.15 LUNCH BREAK

*Afternoon Session - Chair: Walter Vogler*

- 14.00 Michael Siegel: A Proof System for Stabilizing Systems
- 14.40 Arend Rensink: Action Refinement as an Implementation Relation
- 15.20 COFFEE and CAKE BREAK
- 16.10 Mads Dam: Modelling security and authentication protocols as higher order processes

## Wednesday 18

*Morning Session - Chair: Rob van Glabbeek*

- 9.00 Mogens Nielsen: Behavioural Equivalence for Infinite Systems - Partially Decidable!
  - 9.40 Anna Labella: Models of Nondeterministic Regular Expressions
  - 10.30 COFFEE BREAK
  - 10.50 Eike Best: CCP, NETS and COMPOSETS
  - 11.30 Eric Badouel: Splitting of Actions, Higher-Dimensional Automata, and Net Synthesis
  - 12.15 LUNCH BREAK
- EXCURSION
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## Thursday 19

*Morning Session - Chair: Ed Brinksma*

- 9.00 Jan Willem Klop: Rewriting in Concurrency
- 9.40 Rocco De Nicola: Testing Processes via Basic Observables
- 10.30 COFFEE BREAK
- 10.50 Frits Vaandrager: Minimizable Timed Automata
- 11.30 Ursula Goltz: Causal Testing and Action Dependencies
- 12.15 LUNCH BREAK

*Afternoon Session - Chair: Jan Willem Klop*

- 14.00 Rob van Glabbeek: On the Expressiveness of ACP
  - 14.40 Gianna Reggio: Labelled Transition Logic and Rewriting Logic
  - 15.20 COFFEE and CAKE BREAK
  - 16.10 Alban Ponse: Grid Protocols based on Synchronous Communication
  - 16.50 EXPRESS Meeting
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**Friday 20**

*Morning Session - Chair: Mogens Nielsen*

9.00 Ed Brinksma: The Use of Contexts in Formal Design

9.40 Michaela Huhn: Action Refinement and Property Inheritance in Systems of Sequential Agents

10.10 COFFEE BREAK

10.30 Wojciech Penczek: Partial Order Temporal Logics

11.10 Peter Niebert: Branching Time Properties and Partial Order Reductions

12.15 LUNCH

END