Curriculum Vitæ et Studiorum

Matteo Pradella

May 2011

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1 General Information and Education

- I was born in Sondrio (Italy) on May 31, 1971.
- I got my high school degree (Italian "Diploma di Maturità Scientifica") at Liceo Scientifico "Carlo Donegani", Sondrio in August, 1990.
- I graduated in Computer Engineering (Italian "Laurea in Ingegneria Informatica") at Politecnico di Milano in June, 1996. Thesis: *Finite Approximations of Temporal Logic Models*, advisor: Prof. Dino Mandrioli.
- I received my Ph.D. degree in Computer Science from Politecnico di Milano in January, 2001. Thesis: *Methods and Tools for the Design and Analysis of Distributed Supervision and Control Systems*, advisor: Prof. Dino Mandrioli.
  Chorafas Foundation prize for best Ph.D. thesis (May 1, 2001).

2 Main Activities

June, 1996 - May, 1997 I worked on the TRIO temporal logic semantic tools, in a joint project between Politecnico and Enel, the Italian Energy Agency.

June, 1997 - April, 1998 Military service.

May, 1998 - January, 2001 Ph.D. student in Computer Science: Main topic was Formal Methods for Distributed Supervision and Control Systems. Particularly, I worked on a methodology (TRIO/CORBA) for moving from temporal logic specifications to high level CORBA-based architecture. My advisor was Prof. Dino Mandrioli.

During my Ph.D. I worked on the two following minor themes:

- An Associative Description Model for Programming Languages, with Prof. Stefano Crespi Reghizzi;
- Formal Definitions of Practical Agents in the E-Commerce, with Prof. Marco Colombetti.

July, '00 - December, '00 Visiting student, Naval Research Laboratory, Washington, DC.

I worked with the Software Engineering group (code 5546) under the supervision of Constance Heitmeyer. The main topic was about decidability of analysis of potential transitions in system described using SCR (Software Cost reduction). These potential transitions are usually obtained as dead-ends of semiautomated proofs of properties.

May, '01 - December, '01 Post-doctorate grant at Politecnico di Milano. The main topic was methods and tools for specification, validation and verification of complex and safety-critical systems. The grant was financed by the Italian Ministry of Education, University, and Research (MIUR).

August, '01 - October, '01 &

August, '02 - September, '02 Again with Naval Research Laboratory (code 5546), Washington, DC, as visiting researcher.

The main topic of these visits was about analysis of security policy for operating systems. More specifically, we worked on Security-Enhanced (SE) Linux, by NSA. We described the system (and the policy itself) by using TAME (Timed Automata Modeling Environment, by NRL), and we wrote an automated policy extraction and translation tool.

December, '01 - February, '11 Tenured researcher at CNR (the Italian National Research Council), *Istituto di Elettronica e di Ingegneria dell'Informazione e delle Telecomunicazioni (IEIIT)* (Electronics, Information Technology and Telecommunications), section of Milano.

March, '11 - Now Associate professor at Dipartimento di Elettronica e Informazione (DEI), Politecnico di Milano.

3 Research interests

My research activity is mainly in two different areas: formal methods, and formal languages.

3.1 Formal methods

I work on formal models and methods for critical and distributed systems with the *SW engineering group* (DEEP-SE) at DEI, Politecnico di Milano. My main research topics are integrated tools for the specification and validation of critical systems; model checking techniques; bounded model and satisfiability checking; SAT-based verification techniques in general. Since my Laurea degree I worked on the TRIO real-time logic language: e.g. its industrial application, for distributed and critical systems (TRIO-CORBA), higher order extensions and usage for describing architectures of complex systems (ArchiTRIO).

Here is a brief summary of my most important contributions in this area (chronologically presented):

- **TRIO on finite time domains** My first experience with the TRIO language, an object oriented metric linear temporal logic for critical systems, was both theoretical and practical. The practical activity was on the design and implementation of part of the TRIO semantics tools (History checker, Test case generator). The more theoretical activity was about improvements of the TRIO semantics on finite temporal domain (to obtain decidability, and therefore possibility to implement efficient tools). Results of this latter activity were presented at FTRTFT'98.

- **TRIO-CORBA** During my PhD I worked on the ESPRIT European project OpenDREAMS-II. The main aim of the project was to establish and perform a complete framework and methodology for designing and implementing distributed Supervision and Control Systems, based on the CORBA middleware platform. I contributed to the definition of the TRIO-CORBA formal language, and its related methodology for moving from formal specification to high level architecture of the distributed system. Main publications for this activity are the TOSEM paper of 2003, and the ICSE conference paper of 2000. In 2001, I got the Chorafas Foundation prize for this work.

- **Industrial formal methods** One of the first and foremost aim for researchers in formal methods is industrial application of the proposed techniques. This is in general a sore spot of the field, thanks to the difficulty of these of approaches, their cost, and often the lack of good, easily applicable, and performing verification tools. During my career I had the luck of participating in a couple of industrial-driven experiences, one with Metropolitane Milanesi SpA (Milano's Subway Company), and one with Ferrovie Statali SpA (the Italian railways company). I coauthored some

publications on these experiences; the foremost ones were presented at the conferences ISAS'99, SMC'02, and FORMS'03.

- **Security of Operating Systems** While at the Naval Research Laboratory in Washington, DC, I worked on a DARPA funded research on secure operating systems. Our work focused on the automated extraction of a formal model of the security policy of SE-Linux (a security-oriented variant of the popular Linux OS, originally designed by NSA), and its formal verification. I defined the basic formal model of the kernel calls, and wrote a tool for the extraction of the relevant parts of the policy (called CALCA). This research was presented at DISCEX-III in 2003, and at Policy'03.

- **Model checking TRIO with Spin** In an attempt to obtain more performing "push-button" tools for the TRIO language, we started working with one of the then most efficient model checking tools, i.e. Spin. The main aim was to obtain an effective tool to model-check specification mainly written in TRIO, i.e. using a descriptive, logical notation, instead of more typical operational automata-based ones. The approach we proposed is based on mapping TRIO descriptions to alternating automata with counters, and then implementing the automata directly in Promela, Spin's language. Byproducts of this research are the Trio2Promela tool, and the papers presented at FME'03, ATVA'03, FSEN'07, and ICSE'07.

- **ArchiTRIO** After the fruitful OpenDREAMS experience, we decided to re-think and extend the TRIO-CORBA language, widening its scope well beyond CORBA-based systems. So, we started working on the ArchiTRIO language, a TRIO variant suitable for defining high level system architecture, also compatible with the *de facto* industrial standard UML 2. A major step in this work was moving away from our classical first order underlying logical language, to define an higher order extension of it, called HOT (Higher Order TRIO). This activity was presented at SDL'05 and FORTE'05.

- **Zot and SAT-based verification** In recent years, the availability of efficient and often open-source SAT (Boolean satisfiability) solving tools spurred their application also in the field of formal verification. The simple yet flexible essence of the SAT problem makes it a convenient base for the expression of different other problems, e.g. (Bounded) Model Checking. I am the initiator of this recent activity, with Zot, a simple Bounded Satisfiability Checker, born to be compatible with the TRIO language, but also easily extensible to support different notations. This experience has already obtained a number of promising results (presented at ESEC/FSE 2007, FM 2008, ICTAC 2008, ASE 2008, ICFEM 2008, FM 2009, SEFM 2009). In 2007, I got a Formal Methods Europe "Small Project" grant for Zot.

- **Verification and automatic composition of Service-based Systems** This recent activity combines my experiences in both bounded model checking and in tile-based system analysis, as it applies both techniques (or variant thereof) to the problem of automatic composition of services in service-oriented architectures. This activity was (and is going to be) presented at ICSOC 2009, ICECCS 2010, and ICSE/SEAMS 2010.

3.2 Formal Languages

I work with the *Formal languages and compiler group* at DEI, Politecnico di Milano. My main research interests are: associative descriptions of programming languages; picture languages and 2D grammars and formalisms (Tiling Grammars and Systems, Wang Tiles, Kolam Grammars); parsing and recognition algorithms for 2D.

Here is a terse summary of my most important contributions in this area:

- **Associative Language Descriptions (ALD)** During my PhD, as a minor research activity I started working on the Associative Language Description (ALD) model, initially proposed by Crespi Reghizzi and Braitenberg, then refined and studied by Cherubini, Crespi Reghizzi, and San Pietro. This model combines two historically prominent approaches of formal linguistics: the structural Chomskian method and the associative (or distributional) method. From the former ALD takes the tree structure of CF rules, from the latter the notion of local testability and context association. Aim of my work was demonstrating the applicability of the ALD approach to programming languages, by defining a practical designing methodology, and the complete grammar of Pascal. This activity was presented in Computer Languages (2001), and at DCAGRS'99.

- **2D Tile Grammars** Together with Crespi Reghizzi, I defined in 2003 the Tile Grammar (TG) model, to combine the tiling systems model, considered an analogous of regular languages in two dimensions, with a grammar-based approach. The main strength of our approach resides in its generality: we were able to relate and compare quite different 2D grammatical formalisms, and to define polynomial time parsing algorithms for important subclasses of TG (such as Kolam Context-free grammars, and Regional Grammars). Recently, I started working on the problem of determinism for tiling systems, and introduced a new model called Wang Automata. We presented the model, the algorithms, and some theoretical properties in Theoretical Computer Science (2005, 2006), Information Processing Letters (2008), and at the conferences DLT'03, MFCS'08, MFCS'09, SOFSEM'10. In 2008, I got a RTSL (curiosity-driven research) grant from CNR for this activity.

- **SAT-based recognition of tiling systems** The tile model is an interesting and recently proposed approach for defining self-assembling systems. Tiling systems (TS) and variants are for instance used to design

complex self-assembling molecular objects and nano-structures; and have been proposed also to define self-healing distributed software architectures. As a computational model, it is well known that tile-based systems can be used to solve NP-hard problems. Our idea was to encode the parsing problem for TS into SAT and then use off-the-shelf SAT-solvers to recognize, or complete, or also generate pictures. Thanks to these results, tiling systems-described objects can be implemented, and automatically analyzed on mundane computing hardware with reasonable efficiency. The main publication on this activity is in Pattern Recognition, 2008.

- **Context-oriented languages and paradigms** This very recent activity is not really formal, but involves programming languages. We introduced a first proposal to *ContextErlang*, a context-oriented variant of the distributed, fault-tolerant, and concurrency-oriented language Erlang. Our idea is to study linguistic constructs to enable adaptable and evolving distributed applications, in the scope of the ERC project SMScom. This activity has been presented at ICSE/SEAMS 2010, and COP 2010.

3.3 Tools

Software tools are natural byproducts of my research efforts. During my career I worked on or helped designing various tools and environments (e.g. the TRIO semantics tools, the TRIDENT environment, Trio2Promela, CALCA).

I designed, developed and am currently maintaining the following GPL-licensed tools.

Zot (since 2006) is an open and easily extendable *bounded model/satisfiability checker*. It was born as a satisfiability checker, as its original language is the TRIO metric temporal logic. Zot now supports operational, descriptive, or hybrid models. Its plug-in based architecture permits both mono- and bi-infinite discrete temporal domains (i.e. infinite both towards the past and the future), and also supports dense-time-based formalisms through discretization (at present variants of MTL logic and timed automata (TA)). Zot is written in Common Lisp.

Sat-Ts (since 2006) is a SAT-based parser and completer for Tiling Systems. Sat-Ts exploits off-the-shelf SAT-solvers to recognize pictures described through tiling systems, to complete partial pictures, and to generate them. Sat-Ts is written in Scheme.

Mazpa (since 2006) is a parsing tool for some classes of 2D grammars. At presents, it supports Context-Free Kolam grammars in the Chomsky-like normal form originally introduced by O. Matz, and Regional tile grammars. Both modules implement polynomial time 2D extensions of the classical Cocke-Kasami-Younger bottom-up parsing algorithm. Mazpa is written in Scheme.

4 Publications

International journals

1. S. Crespi Reghizzi, M. Pradella, P. San Pietro, Associative Definition of Programming Languages, Computer Languages, Vol 26/2-4, pp 105-123, 2001

2. A. Coen-Porisini, M. Pradella, M. Rossi, D. Mandrioli, A Formal Approach for Designing CORBA based Applications, ACM Transactions on Software Engineering and Methodology (TOSEM), vol. 12, n. 2, April 2003

3. S. Crespi Reghizzi, M. Pradella, Tile Rewriting Grammars and Picture Languages, Theoretical Computer Science, Vol 340/2 pp 257-272, 2005

4. A. Cherubini, S. Crespi Reghizzi, M. Pradella, P. San Pietro, Picture languages: Tiling Systems versus Tile Rewriting Grammars, Theoretical Computer Science, Vol 356/1-2 pp 90-103, 2006

5. C. A. Furia, A. Morzenti, M. Pradella, M. Rossi, Comments on "An Interval Logic for Real-Time System Specication", IEEE Transactions on Software Engineering, Vol 32/6, pp 424-427, 2006

6. M. Pradella, S. Crespi Reghizzi, A SAT-based parser and completer for pictures specified by tiling, Pattern Recognition, Vol 41, pp 555-566, 2008 doi: 10.1016/j.patcog.2007.06.018

7. S. Crespi Reghizzi, M. Pradella, A CKY parser for picture grammars, Information Processing Letters, Vol 105/6, pp 213-217, 2008 doi: 10.1016/j.ipl.2007.09.002

8. C. A. Furia, M. Pradella, M. Rossi, Comments on Temporal Logics for Real-Time System Specification, Computing Surveys, Vol 41(2), February 2009

9. V. Lonati, M. Pradella. Deterministic recognizability of picture languages with Wang automata, Discrete Mathematics & Theoretical Computer Science, vol. 12:4, pp 73-94, 2010.

10. V. Lonati, M. Pradella. Strategies to scan pictures with automata based on Wang tiles, RAIRO - Theoretical Informatics and Applications, vol. 45, pp 163-180, 2011.

International peer-reviewed conferences and workshops

1. A. Coen-Porisini, M. Pradella, P. San Pietro, A finite domain semantics for testing temporal logic specifications, *FTRTFT'98 Symposium Proceedings* (Eds. A.P. Ravn and H. Rischel), Lecture Notes on Computer Science (LNCS), vol. 1486, pp 41-54, Springer Verlag, September 1998

2. A. Morzenti, M. Pradella, M. Rossi, S. Russo, A. Sergio, A Case Study in Object-oriented modeling and Design of Distributed Multimedia Applications, *Proc. of 2nd Symposium on Software Engineering for Parallel and Distributed Systems (PDSE'99)*, Los Angeles (USA), Maggio 1999, IEEE Computer Society Press, pp 217 - 223

3. A. Casazza, D. Comini, A. Morzenti, M. Pradella, P. San Pietro, F. Scheriber, Specification and Test Case Generation for the Safety Kernel of the Naples Subway, *Proc. of 5th International Conference on Information Systems Analysis and Syntesis (ISAS'99)*, 31 July-4 August 1999, Vol. 1, pp 533-540

4. S. Crespi Reghizzi, M. Pradella, P. San Pietro, Conciseness of Associative Language Descriptions, *Proc. of International Workshop on Descritional Complexity of Automata, Grammars and Related Structures (DCAGRS'99)*, J. Dassow and D. Wotschke (eds.), 20-23 July 1999, pp. 99-108

5. A. Coen-Porisini, M. Pradella, M. Rossi, An Evolutionary Approach to the Design of Supervision and Control Systems, *Proc. of International Workshop on Principles of Software Evolution (IWPSE'99)*, 16-17 July 1999, pp. 37-42

6. M. Pradella, M. Colombetti, A Formal Description of a Practical Agent for E-Commerce, *Proc. of 3rd International Workshop on Agent Mediated Electronic Commerce (AMEC)*, Barcelona, 4 June 2000

7. A. Coen-Porisini, M. Pradella, M. Rossi, D. Mandrioli, A Formal Approach for Designing CORBA based Applications, *Proc. of the 22-nd International Conference on Software Engineering (ICSE 2000)*, Limerick (IR), 4-11 June 2000, pp 188-197

8. U. Foschi, M. Giuliani, A. Morzenti, M. Pradella, P. San Pietro, Software procurement and methods for specification and validation in the railway transportation industry, IEEE International Conference on System, Man and Cybernetics (SMC 2002), Hammamet, Tunisia, 6-9 October 2002

9. M. Archer, E. Leonard, M. Pradella, Modeling Security-Enchanced Linux Policy Specifications for Analysis, Research Summaries for DISCEX III, 3rd DARPA Information Survivability Conference and Exposition, Washington, DC, 22-24 April 2003.

10. U. Foschi, M. Giuliani, A. Morzenti, M. Pradella, P. San Pietro, The Role of Formal Methods in Software Procurement for the Railway Transportation Industry, Symposium on Formal Methods for Railway Operation and Control Systems (FORMS 2003), Budapest, Hungary, 15-16 May 2003

11. S. Crespi Reghizzi, M. Pradella, Tile Rewriting Grammars, 7th International Conference on Developments in Language Theory (DLT 2003), LNCS 2710, Szeged, Hungary, 7-11 July 2003

12. A. Morzenti, M. Pradella, P. San Pietro, P. Spoletini, Model-checking TRIO specifications in SPIN, FM 2003: 12th International FME Symposium, LNCS 2805, Pisa, Italy, 8-14 September 2003

13. M. Archer, E. Leonard, M. Pradella, Analyzing Security-Enhanced Linux Policy Specifications, IEEE 4th International Workshop on Policies for Distributed Systems and Network (Policy 2003), Lake Como, Italy, 4-6 June 2003

14. M. Pradella, P. San Pietro, P. Spoletini, A. Morzenti, Practical Model Checking of LTL with Past, 1st Int. Workshop on Automated Technology for Verification and Analysis (ATVA 2003), National Taiwan University, December 10-13 2003

15. M. Pradella, M. Rossi, D. Mandrioli, A UML-compatible formal language for system architecture description, SDL 2005: 12th International SDL Forum, LNCS 3530, June 20-24, 2005

16. M. Pradella, M. Rossi, D. Mandrioli, ArchiTRIO: a UML-compatible language for architectural description and its formal semantics, FORTE 2005: 25th IFIP WG 6.1 International Conference on Formal Techniques for Networked and Distributed Systems, LNCS 3731, National Taiwan University, October 2-5, 2005

17. P. Colombo, M. Pradella, M. Rossi, G. Sassaroli, A UML 2-compatible language and tool for formal modeling real-time system architectures, SAC 2006: 21st Annual ACM Symposium on Applied Computing, Dijon, April 23-27, 2006

18. D. Bianculli, P. Spoletini, A. Morzenti, M. Pradella, P. San Pietro, Model checking temporal metric specifications with Trio2Promela, IPM International Symposium on Fundamentals of Software Engineering (FSEN 2007), volume 4767 of Lecture Notes in Computer Science, pp. 388-395, 2007

19. D. Bianculli, A. Morzenti, M. Pradella, P. San Pietro, P. Spoletini, Trio2-Promela: a model checker for temporal metric specifications, 29th Int. Conference on Software Engineering (ICSE 2007), Research Demonstrations Track, pp. 61-62, 2007

20. M. Pradella, A. Morzenti, P. San Pietro, The Symmetry of the Past and of the Future: Bi-infinite Time in the Verification of Temporal Properties, 6th joint meeting of the European Software Engineering Conference and the ACM SIGSOFT Symposium on the Foundations of Software Engineering (ESEC/FSE 2007), Dubrovnik, Croatia, September 3-7, 2007

21. C. A. Furia, M. Pradella, M. Rossi, Automated Verification of Dense-Time MTL Specifications via Discrete-Time Approximation, FM'08: 15th International Symposium on Formal Methods, volume 5014 of Lecture Notes in Computer Science, pp. 132-147. Springer-Verlag, May 2008.

22. M. Pradella, A. Morzenti, P. San Pietro, Benchmarking Model- and Satisfiability-Checking on bi-infinite time, 5th International Colloquium on Theoretical Aspects of Computing (ICTAC 2008), volume 5160 of Lecture Notes in Computer Science, pp. 290-304. Springer-Verlag, 2008

23. A. Cherubini, S. Crespi Reghizzi, M. Pradella, Regional languages and tiling: a unifying approach to picture grammars, 33nd International Symposium on Mathematical Foundations of Computer Science (MFCS 2008), volume 5162 of Lecture Notes in Computer Science, pp. 253-264. Springer-Verlag, 2008

24. M. Pradella, A. Morzenti, P. San Pietro, Refining Real-Time System Specifications through Bounded Model- and Satisfiability-Checking, 23rd IEEE/ACM International Conference on Automated Software Engineering (ASE 2008), September 2008, pp. 119-127

25. Carlo A. Furia, Matteo Pradella, and Matteo Rossi. Practical Automated Partial Verification of Multi-Paradigm Real-Time Models, 10th International Conference on Formal Engineering Methods (ICFEM 2008), LNCS 5256, pp. 298-317, 2008

26. V. Lonati, M. Pradella, Snake-Deterministic Tiling Systems, MFCS 2009, LNCS 5734, pp 549-560, 2009

27. A. Cherubini, M. Pradella, Picture Languages: From Wang Tiles to 2D Grammars, CAI 2009, LNCS 5725, pp 13-46, 2009

28. M. Pradella, A. Morzenti, P. San Pietro, A Metric Encoding for Bounded Model Checking, Proc. of 16th International Symposium on Formal Methods (FM 2009), LNCS 5850, pp. 741-756, 2009.

29. M. Bersani, C. A. Furia, M. Pradella, M. Rossi, Integrated Modeling and Verification of Real-Time Systems through Multiple Paradigms, Proc. of 7th IEEE International Conference on Software Engineering and Formal Methods (SEFM 2009), pp. 13-22, 2009.

30. L. Cavallaro, E. Di Nitto, M. Pradella, An Automatic Approach to Enable Replacement of Conversational Services, Proc. of 7th International Conference on Service Oriented Computing (ICSOC - ServiceWave 2009), LNCS 5900, pp. 159-174, 2009.

31. V. Lonati, M. Pradella, Picture recognizability with automata based on Wang tiles, Proc. of 36th International Conference on Current Trends in Theory and Practice of Computer Science (SOFSEM 2010), LNCS 5901, pp. 576-587, 2010.

32. L. Cavallaro, E. Di Nitto, C. A. Furia, M. Pradella, A Tile-based Approach for Self-assembling Service Compositions, Proc. of 15th IEEE International Conference on Engineering of Complex Computer Systems St. Anne's College, University of Oxford, 22-26 March 2010.

33. M. Bersani, A. Frigeri, A. Morzenti, M. Pradella, M. Rossi, P. San Pietro, Bounded Reachability for Temporal Logic over Constraint Systems, Proc. of 17th International Symposium on Temporal Representation and Reasoning (TIME), 2010.

34. M. Bersani, L. Cavallaro, A. Frigeri, M. Pradella, M. Rossi, SMT-based Verification of LTL Specifications with Integer Constraints and its Application to Runtime Checking of Service Substitutability , Proc. of 8th IEEE International Conference on Software Engineering and Formal Methods (SEFM), 2010.

35. L. Cavallaro, E. Di Nitto, P. Pelliccione, M. Pradella, M. Tivoli, Synthesizing adapters for conversational web-services from their WSDL interface, Proc. of ICSE 2010 SEAMS Workshop on Software Engineering for Adaptive and Self-Managing Systems, 2010

36. C. Ghezzi, M. Pradella, G. Salvaneschi, Programming Language Support to Context-Aware Adaptation - A Case-Study with Erlang, Proc. of ICSE 2010 SEAMS Workshop on Software Engineering for Adaptive and Self-Managing Systems, 2010

37. C. Ghezzi, M. Pradella, G. Salvaneschi, Context Oriented Programming in Highly Concurrent Systems, Proc. of 2nd International Workshop on Context-oriented Programming (COP) at ECOOP, 2010.

38. C. Ghezzi, M. Pradella, G. Salvaneschi, An evaluation of the adaptation capabilities in programming languages, 6th International Symposium on Software Engineering for Adaptive and Self-Managing Systems (SEAMS), May 23-24, 2011.

39. V. Lonati, D. Mandrioli, M. Pradella, Precedence Automata and Languages, The 6th International Computer Science Symposium in Russia (CSR), LNCS 6651, pp. 291304, June 14-18, 2011.

40. V. Lonati, M. Pradella, Towards more expressive 2D deterministic automata, 6th International Conference on Implementation and Application of Automata (CIAA), LNCS 6807, pp. 225-237, July 13-16, 2011.

In books

1. M. Pradella, M. Colombetti, A Formal Description of a Practical Agent for E-Commerce, Editori F. Dignum e U. Cortés, Agent Mediated Electronic Commerce III, *Lecture Notes on Artificial Intelligence (LNAI)*, vol. 2003, Springer-Verlag, 2001 (*extended versions of the work presented at AMEC 2000*).

Other workshops and technical reports

1. A. Casazza, D. Comini, A. Morzenti, M. Pradella, P. San Pietro, F. Scheriber, Specification and Test Case Generation for the Safety Kernel of the Naples Subway, *FMERail Workshop 3*, St. Poelten - Austria, 24-26 February 1999.

2. A. Cherubini, S. Crespi Reghizzi, M. Pradella, P. San Pietro, Associative Language Descriptions versus Context-Free models, *British Colloquium for Theoretical Computer Science (BCTCS 2001)*, Glasgow, Scotland, 9-12/4/2001.

3. S. Crespi Reghizzi, M. Pradella, On parsing some classes of 2D languages (Abstract), ESF Workshop "Advances on Two-dimensional language theory", Salerno, Italy, May 3-5, 2006

4. V. Lonati, M. Pradella, Deterministic recognizability of picture languages by Wang automata, Proc. of 11th Italian Conference on Theoretical Computer Science (ICTCS 2009).

5. M. Pradella, S. Crespi Reghizzi, SAT-TS: a SAT-based tool to recognize and complete pictures specified by tiling (Extended abstract), DLT 2007, Workshop on Tilings and Self-Assembly, Turku, Finland, TUCS General Publication N. 45, Part III, pp. 33-35, June 2007

6. M. Pradella, Associative Language Descriptions: a portable compendium, *R. T. n. 99-26*, Politecnico di Milano, Dip. Elettronica e Informazione, 1999

7. M. Pradella, A Formal Description of a Practical Agent for E-Commerce, *R. T. n. 2000-7*, Politecnico di Milano, Dip. Elettronica e Informazione, 2000

8. M. Archer, E. Leonard, M. Pradella, Towards a methodology and tool for the analysis of Security-Enhanced Linux security policies, Technical Report NRL/MR/5540-02-8629, NRL, Washington, DC, 2002

9. M. Pradella, Finite-Domain Temporal Logic in ACL2: a semantics-based approach, Rapporto Interno n. 2002.53, Dipartimento di Elettronica e Informazione, Politecnico di Milano, 2002

10. M. Archer, E. Leonard, M. Pradella, Analyzing Security-Enhanced Linux Policy Specifications, Technical Report NRL/MR/5540–03-8659, NRL, Washington, DC, March 27, 2003

11. C. A. Furia, D. Mandrioli, A. Morzenti, M. Pradella, M. Rossi, P. San Pietro, Higher Order TRIO, Internal Report 2004.28, Dipartimento di Elettronica ed Informazione, Politecnico di Milano, September 2004

12. C. A. Furia, M. Pradella, M. Rossi. Dense-Time MTL Verification Through Sampling. Rapporto Interno 2007.37, Dipartimento di Elettronica e Informazione, Politecnico di Milano, 2007

13. C. A. Furia, M. Pradella, M. Rossi. Practical Automated Partial Verification of Multi-Paradigm Real-Time Models. arXiv:0804.4383, April 2008.

14. M. Pradella, A. Morzenti, P. San Pietro, A Metric Encoding for Bounded Model Checking (extended version). arXiv:0907.3085, July 2009

15. M. Pradella, A. Cherubini, S. Crespi Reghizzi, A unifying approach to picture grammars. arXiv:0910.2829, October 2009.

16. M. Pradella, A User's Guide to Zot, arXiv:0912.5014, December 2009.

17. V. Lonati, D. Mandrioli, M. Pradella, Precedence Automata and Languages, arXiv:0912.5014, December 2010.

5 Research projects and grants

I participated in several research projects:

1998 ESPRIT project "OpenDREAMS-II": the aim of the project was studying and developing advanced distributed supervision and control systems, based on the CORBA middleware.

1999 Joint project between Metropolitane Milanesi SpA (Milano's Subway Company) and Politecnico. Aim of the project is the specification, validation, and verification of topographic interface of Naple's subway.

1999 MURST (the Italian Ministry of Education and Research) Project MOSAICO "Metodologie e strumenti di progetto di sistemi ad alte prestazioni per applicazioni distribuite" (Methods and tools for designing high performance distributed systems), national coordinator Prof. Luciano Lenzini.

2001 Joint project between Ferrovie Statali SpA (the Italian railways company) and Politecnico. Aim of the project is the analysis and comparison of the two formal methods and tools *StateMate* and *SDL*.

2001 PRIN (Research Projects of National Relevance) project "Linguaggi Formali e Automi: teoria ed applicazioni" (Formal languages and automata: theory and applications), national coordinator Prof. Antonio Restivo.

2002 Joint project between Rete Ferroviaria Italiana S.p.A (the Italian railways company) and Politecnico, to define the technical specifications "Software cycle for safety-critical signaling systems".

2002 Naval Research Laboratory project "Analyzing Security Policies for SE Linux" `http://chacs.nrl.navy.mil/projects/selinux/`

2002 SP4 project: "Architetture e software ad alta qualità di servizio per global computing su cooperative Wide Area Networks" (High quality and dependable software architectures for global computing on cooperative wide area networks), national coordinator Prof. Ugo Montanari

2003 PRIN project "Linguaggi Formali e Automi: Metodi, Modelli e Applicazioni" (Formal languages and automata: methods, models and applications), national coordinator Prof. Antonio Restivo.

2005 PRIN project "Automi e Linguaggi Formali: aspetti matematici e applicativi" (Automata and formal languages: mathematical aspects and applications), national coordinator Prof. Antonio Restivo.

2007 My *bounded satisfiability checker* Zot received a *Formal Methods Europe (FME) Small Project* grant (5K EUR).

2008 My RSTL reseach proposal (Curiosity-driven research) "Grammatiche 2D per la descrizione di immagini" (2D grammars for picture descriptions), code 760, received a CNR grant in 2008 (33K EUR).

2008 PRIN project "D-ASAP", national coordinator Prof. Carlo Ghezzi.

2008 ERC Advanced Investigator Grant "SMScom", principal investigator Prof. Carlo Ghezzi.

6 Teaching activity

My teaching activity is mainly at Politecnico di Milano, where I taught Teoretical Computer Science for computer engineering students from 2003 to 2010. Now the course is part of Principles and Algorithms of Computer Science.

In 2002 I participated in defining the Algorithms and Data Structures course for mathematical engineering students. This course adopts the classical text *Introduction to Algorithms* by Cormen, Leiserson, Rivest, and Stein, while using Python as a multi-paradigm (procedural, object-oriented, functional and concurrent) target language. I taught the course from 2002 to 2008.

- Teaching assistant of Foundations of Computer Science II. Prof. Giuseppe Pozzi, Politecnico di Milano - Como, 1998-1999, and 1999-2000.

- Teaching assistant of Formal Languages. Prof. Stefano Crespi Reghizzi, Università della Svizzera Italiana - Lugano, 1999-2000, and 2000-2001.

- Teaching assistant of Foundations of Computer Science II. Prof. Angelo Morzenti, Politecnico di Milano, 2000-2001.

- Teaching assistant of Foundations of Software Engineering II. Prof. Angelo Morzenti, Politecnico di Milano, 2000-2001.

- Course on Foundations of Computer Science, Politecnico di Milano, IV faculty, 2001-2002.

- Teaching assistant of Foundations of Computer Science III. Prof. Angelo Morzenti, Politecnico di Milano, 2001-2002, and 2002-2003.

- Course on Algorithms and Data Structures, Politecnico di Milano, II faculty, 2002-2003, 2003-2004, 2005-2006, 2006-2007, 2007-2008.

- Course "The Python Programming Language", for CESI Ricerca SpA (a research company in the electricity and energy field controlled by ENEA, the Italian National Agency for New Technologies, Energy and the Environment), 16 hours, May 2008.

- Couse on Teoretical Computer Science, Politecnico di Milano, V faculty, 2003-2004, 2004-2005, 2005-2006, 2006-2007, 2007-2008, 2008-2009, 2009-2010.

- PhD course on Functional Programming: principles and applications (together with Matteo Rossi), 2010.

Present teaching activity:

- Course on Principles and Algorithms of Computer Science (half course about Teoretical Computer Science), Politecnico di Milano, V faculty, 2010-2011.

- Online course on Principles and Algorithms of Computer Science (half course about Teoretical Computer Science), Politecnico di Milano - Como, V faculty, 2010-2011.

Individual student guidance at Politecnico di Milano

Laurea (undergraduate) thesis advisor of candidates:

- A. Longo (2005-06)
- F. Mutti (2005-06)
- E. Parrinello (2006-07)
- P. Lischetti (2006-07)
- D. Rizzo (2007-2008)
- S. Riboni (2007-2008)

Laurea (graduate/old programme) thesis co-advisor of candidates:

- M. G. Rossi (1997-98)
- L. Lopomo (2001-2002)
- C. Casoli (2001-2002)
- D. Casiraghi (2007-2008)

Co-advisor of PhD candidate Luca Cavallaro (2010).

7 Professional activity

- Program committee member of the *29th IEEE-TCS, ACM-SIGSOFT International Conference on Software Engineering* (ICSE 2007) - Research Demonstrations Track.
- Review activities for international journals:
  - *IEEE Transaction on Software Engineering (TSE): 2001, 2002*
  - *ACM Transactions on Software Engineering and Methodology (TOSEM): 2002, 2003, 2004, 2006*
  - *Journal RAIRO - Theoretical Informatics and Applications: 2006*

- *Theoretical Computer Science: 2006, 2009*
- *Science of Computer Programming: 2009*
- *Journal of Automata, Languages and Combinatorics: 2010*
- *Formal Aspects of Computing: 2010*

• Review activities for international conferences:

- *ECOOP'99 - 13th European Conference on Object-Oriented Programming*
- *SEPN 2000 - Workshop on Software Engineering and Petri Nets*
- *CC 2003 - 12th International Conference on Compiler Construction*
- *FM 2003 - 12th International FME Symposium*
- *TCS 2004 - 3rd IFIP International Conference on Theoretical Computer Science*
- *ICSE 2005 - 27th International Conference on Software Engineering*
- *FM 2005 - Formal Methods 2005*
- *CIAA 2005 - 10th International Conference on Implementation and Application of Automata*
- *AICA 2005 - Congresso dell'Associazione Italiana per L'Informatica ed il Calcolo Automatico*
- *AutoMathA conference 2007 (Automata: from Mathematics to Applications)*
- *LATA 2008 - 2nd International Conference on Language and Automata Theory and Applications*
- *DLT 2008 - 12th International Conference on Developments in Language Theory*
- *DLT 2009 - 13th International Conference on Developments in Language Theory*
- *FM 2009 - Formal Methods 2009*
- *FASE 2010 Fundamental Approaches to Software Engineering*
- *COP 2011 3rd Workshop on Context-Oriented Programming*
- *DLT 2011 - 15th International Conference on Developments in Language Theory*
- *CAI 2011: 4th International Conference on Algebraic Informatics*