



Federico Mari

Assistant Professor

Education

- 2010 **Ph.D. Computer Science**, *Sapienza Università di Roma*, Prof. Enrico Tronci.
- 2006 **Master Degree Computer Science**, *Sapienza Università di Roma, SCL*.

Appointments

- 2015–now **Assistant Professor**, *Computer Science Department*, Sapienza Università di Roma. Ricercatore a Tempo Determinato, Tipologia A.
- 2010–2014 **Postdoctoral Researcher**, *CS Dept*, Sapienza.
- 2008 **Visiting Ph.D. Student**, University of Texas at Austin with Prof. L. Alvisi.
- 2008–now **Member of the Model Checking Lab (MCLab) group**, *directed by Prof. E. Tronci, CS Dept, Sapienza*.

The MCLab group (mclab.di.uniroma1.it) focuses on designing algorithms and developing tools for the automatic verification (model checking) of safety- and mission-critical systems. The group is involved in many on-going collaborations with international scientists from several countries and it is active and efficient in accessing to funding opportunities, also as principal investigator.

Teaching Activities

- 2012/13–now **Professor**, *Basi di dati*, Bachelor, CS Dept, Sapienza.
- 2009/10 **Professor**, *Basi di dati*, Associazione Centro Elis (Roma).
Tecnico superiore per lo sviluppo del software IFTS (Istruzione Formazione Tecnico Superiore)
- 2015/16–now **Member of the Doctoral School Committee**, *CS Dept, Sapienza*.
- 2016/17–now **Teaching Assistant**, *Formal Methods in Software Development*, Master, CS Dept, Sapienza, course held in English.
- 2009/10–2014/15 **Teaching Assistant**, *Metodi formali per il software*, Master, CS Dept, Sapienza.
- 2008/09 **Teaching Assistant**, *Fondamenti di programmazione*, Bachelor, CS Dept, Sapienza.
- 2007/08 **Teaching Assistant**, *Laboratorio di programmazione*, Bachelor, CS Dept, Sapienza.
- 2014/15–now **Students supervisor**, *Bachelor, Master, and Ph.D. student level*.

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Awards and Honours

- 2011/03 **Award from “Fondazione Anna Maria Catalano”.**
“Fondazione Anna Maria Catalano” <http://www.fondazionecatalano.it> is a non-profit organisation for sustaining environment and renewable energy. This € 2,000 award has been granted to F. Mari for his research activities related to formal methods and tools for automatic synthesis of control software from formal specifications of the closed loop system [29].
- ICSEA 2011 **Best paper award, for [28].**

Funding Information

Grants

- 2007 **Algorithms and Tools for SAT-based Bounded Model Checking of Hybrid Systems**, *granted by Dipartimento di Matematica “Ennio de Giorgi” dell’Università del Salento, Lecce, € 2,000.*

- Principal investigator

Other

- 2013 **PAEON - Model Driven Computation of Treatments for Infertility Related Endocrinological Diseases**, *EC Seventh Framework Programme FP7-ICT-2011-9, € 2,453,997 (€ 626,382 to partner Sapienza), paeon.di.uniroma1.it.*

- Scientific responsible of the research task (RTD) “T5.1 - Dissemination Plan, Project Web Site, Communication Channels” (del “WP5 - Dissemination & Exploitation”), due from partner Sapienza University of Rome, headed by E. Tronci
- Active participation to the writing of this project proposal

- 2012 **SmartHG - Energy Demand Aware Open Services for Smart Grid Intelligent Automation**, *EC Seventh Framework Programme FP7-ICT-2011-8, € 3,299,998 (€ 597,378 to partner Sapienza), smarthg.di.uniroma1.it.*

- Responsible of the management task (MGT) “T1.2 - Project Monitoring” (of “WP1 - Project Management”), due from partner Sapienza University of Rome, headed by E. Tronci
- Scientific responsible of the research task (RTD) “T3.4 - Design and Development of home Energy Bill Reduction (EBR) service” (of “WP3 - Design of Home Intelligent Automation Services”); this task T3.4 was initially due from Spanish partner IMDEA Energía but scientific responsibility has been moved during the project lifetime to partner Sapienza University of Rome, headed by E. Tronci
- Active participation to the writing of this project proposal

- 2009 **ULISSE - USOCs KnowLedge Integration and Dissemination for Space Science Experimentation**, *EC Seventh Framework Programme FP7-SPACE-2007-1, € 4,858,223 (€ 155,460 to partner Sapienza).*

- Scientific responsible of the research task (RTD) “T2420 - Automatic plan validation and verification” on satellite operational procedures V&V (of work package “WP2400 - Planning and validation”), due from partner Sapienza University of Rome, headed by E. Tronci

- 2010 **ESA-ITI-AO6067 - Verifying Satellite Operational Procedures**, *European Space Agency (ESA) Innovation Triangle Initiative (ITI). ITI Type B, € 150,000 (€ 45,000 to partner Sapienza).*

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2008 **SSFRT - System and Software Functional Requirements Technique**, *European Space Agency (ESA) ITT AO5459*, € 200,000 (€ 15,000 to partner Sapienza).

Current Research Interests

Formal methods (model checking) applied to hybrid systems

- Control In [1, 4, 18, 19, 21, 22, 23, 24, 25, 29] we presented novel algorithms and tools
Software (software **QKS**) that, given a discrete time linear hybrid system model P for a plant,
Synthesis a desirable controllable region and a goal region, returns a correct-by-construction
control software K for P , along with a suitable representation for the set of states
on which K is guaranteed to work. The output control software K is guaranteed to
drive the specified closed loop system towards the desired goal.
- System Level In [10, 14, 20] we presented novel algorithms and tools (software **SyLVer**) for the
Verification formal verification of system level requirements of hybrid systems. Our approach ex-
ploits simulators (SIMSAT, Simulink) as black-box models, in order to automatically
generate all possible simulation testing scenarios.

Scientific Community Service

Speaker at Peer Reviewed Conferences

- 2012 **EMSOFT**, Paper [22] at Tampere, Finland, October 7-12, 2012.
2009 **SSS**, Paper [31] at Lyon, France, November 3-6, 2009.
2007 **HSCC**, Paper [35] at Pisa, Italy, April 3-5, 2007.

Organizing Committees

- 2013 **ETAPS**, Member of the Organizing Committee.
Conference page: <http://www.etaps.org/index.php/2013/organizers>

Journals and Conferences Refereeing

- 2016–now **TC**, *Transactions on Computers*, journal, IEEE.
2015–now **SIMPAT**, *Simulation Modelling Practice and Theory*, journal, Elsevier.
2016–now **IPDPS**, *Int. Parallel & Distributed Processing Symposium*, conference, IEEE.
2014–now **FORTE**, *Forum for fundamental research on theory, models, tools, and applications for distributed systems*, conference, Springer LNCS.

Invited Talks

- 2012 **Sintesi Logica: Invited Talk**, V. Alimuzhin, F. Mari, I. Melatti, I. Salvo, E. Tronci. *A Parallel Approach to Automatic Synthesis of Control Software*. Ottava Giornata Nazionale di Sintesi Logica, Milano, 4 luglio 2012.

Technology Transfer

Free Software

2017 **SyLVer**, *System Level formal Verifier*.

SyLVer [2, 3] is a program realising system level formal verification of safety properties for cyber-physical systems. SyLVer uses an assume-guarantee approach, assuming the system is available as a black-box through a simulator (MATLAB Simulink block diagram).

- Docker image with executable available at <http://mclab.di.uniroma1.it/site/index.php/software/49-sylver>
- SyLVer as a service (SyLVaaS) is also available at <http://mclab.di.uniroma1.it/site/index.php/software/44-sylvaas>

2017 **QKS**, *Quantified Controller Synthesis for discrete time linear hybrid systems*.

QKS is a software for the automatic generation of control software (as C code) for discrete time **linear** hybrid systems starting from formal specifications of the closed loop system.

- QKS executable available at BitBucket public repository <https://bitbucket.org/mclab/qks>; this software implements sequential[4, 29, 24, 23, 24, 25] and parallel[19] methods, on-the-fly algorithm[18], and method to obtain succinct software[22].

Open-source Software

2017 **QKS linearizer**, *QKS for discrete time non-linear hybrid systems*.

QKS linearizer is an open-source software for the linearization of discrete time non-linear hybrid systems. The linearizer, used in cascade with QKS, allows automatic generation of control software (as C code) for discrete time **non-linear** hybrid systems starting from formal specifications of the closed loop system.

- QKS linearizer[1, 21] available as open-source software at BitBucket public repository <https://bitbucket.org/mclab/linearizer-benchmark> (also with a comparison of QKS with state-of-the-art synthesis tool PESSOA on the inverted pendulum example).

2017 **NashMV**, *Verifying (Coalition) Nash Equilibria in MAD Distributed Systems*.

NashMV [31, 34] is a software for checking whether a given protocol is a Nash equilibrium in a Multiple Administrative Domain (MAD) system, that is checking if all participants are rationally stimulated to follow the protocol.

- NashMV is available as open-source software at BitBucket public repository <https://bitbucket.org/mclab/nashmv>.

Publications

○ F. Mari has **41** publications:

- **7 journal papers**, among which IEEE Transactions on Automatic Control (TAC) and ACM Transactions On Software Engineering And Methodology (TOSEM).
- **28 conference papers**, among which Computer Aided Verification (CAV) and Formal Methods in Computer Aided Design (FMCAD).
- **6 technical reports** at CoRR.

Journal Articles

- [1] V. Alimguzhin, F. Mari, I. Melatti, I. Salvo, and E. Tronci. Linearising discrete time hybrid systems. *IEEE Transactions On Automatic Control*, 63(4):To appear, 2018.
- [2] T. Mancini, F. Mari, A. Massini, I. Melatti, and E. Tronci. Anytime system level verification via parallel random exhaustive hardware in the loop simulation. *Microprocessors and Microsystems*, 41:12–28, 2016.

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- [3] T. Mancini, F. Mari, A. Massini, I. Melatti, and E. Tronci. Sylvaas: System level formal verification as a service. *Fundamenta Informaticae*, 149(1-2):101–132, 2016.
- [4] F. Mari, I. Melatti, I. Salvo, and E. Tronci. Model based synthesis of control software from system level formal specifications. *ACM Transactions On Software Engineering And Methodology*, 23(1):Article 6, 2014.
- [5] F. Mari, I. Melatti, E. Tronci, and A. Finzi. A multi-hop advertising discovery and delivering protocol for multi administrative domain manet. *Mobile Information Systems*, 3(9):261–280, 2013.
- [6] F. Mari, I. Melatti, I. Salvo, and E. Tronci. Linear constraints and guarded predicates as a modeling language for discrete time hybrid systems. *International Journal on Advances in Software*, vol. 6, nr 1&2:155–169, 2013.
- [7] F. Mari, I. Melatti, I. Salvo, and E. Tronci. Synthesizing control software from boolean relations. *International Journal on Advances in Software*, vol. 5, nr 3&4:212–223, 2012.

Conference Papers

- [8] V. Alimguzhin, F. Mari, I. Melatti, E. Tronci, E. Ebeid, S.A. Mikkelsen, R.H. Jacobsen, J.K. Gruber, B. Hayes, F. Huerta, and M. Prodanovic. A glimpse of smarthg project test-bed and communication infrastructure. In *Digital System Design (DSD), 2015 Euromicro Conference on*, pages 225–232, 2015.
- [9] R. Ehrig, T. Dierkes, S. Schaefer, S. Roebnitz, E. Tronci, T. Mancini, I. Salvo, V. Alimguzhin, F. Mari, I. Melatti, A. Massini, B. Leeners, T.H.C. Krueger, M. Egli, and F. Ille. An integrative approach for model driven computation of treatments in reproductive medicine. In *Proceedings of the 15th International Symposium on Mathematical and Computational Biology (BIOMAT 2015), Rorkee, India*, 2015.
- [10] T. Mancini, F. Mari, A. Massini, I. Melatti, and E. Tronci. Sylvaas: System level formal verification as a service. In *Proceedings of the 23rd Euromicro International Conference on Parallel, Distributed and Network-based Processing (PDP 2015), special session on Formal Approaches to Parallel and Distributed Systems (4PAD)*, 2015.
- [11] T. Mancini, F. Mari, A. Massini, I. Melatti, and E. Tronci. Simulator semantics for system level formal verification. In *Proceedings Sixth International Symposium on Games, Automata, Logics and Formal Verification (GandALF 2015)*, 2015.
- [12] T. Mancini, F. Mari, I. Melatti, I. Salvo, E. Tronci, J.K. Gruber, B. Hayes, M. Prodanovic, and L. Elmegaard. User flexibility aware price policy synthesis for smart grids. In *Digital System Design (DSD), 2015 Euromicro Conference on*, pages 478–485, 2015.
- [13] T. Mancini, F. Mari, A. Massini, I. Melatti, and E. Tronci. System level formal verification via distributed multi-core hardware in the loop simulation. In *Proc. of the 22nd Euromicro International Conference on Parallel, Distributed and Network-Based Processing*. IEEE Computer Society, 2014.

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- [14] T. Mancini, F. Mari, A. Massini, I. Melatti, and E. Tronci. Anytime system level verification via random exhaustive hardware in the loop simulation. In *In Proceedings of 17th EuroMicro Conference on Digital System Design (DSD 2014)*, 2014.
- [15] E. Tronci, T. Mancini, F. Mari, I. Melatti, R. H. Jacobsen, E. Ebeid, S. A. Mikkelsen, M. Prodanovic, J. K. Gruber, and B. Hayes. Smarthg: Energy demand aware open services for smart grid intelligent automation. In *Proceedings of the Work in Progress Session of SEAA/DSD 2014*, 2014.
- [16] E. Tronci, T. Mancini, I. Salvo, F. Mari, I. Melatti, A. Massini, S. Sinisi, F. Davì, T. Dierkes, R. Ehrig, S. Röblitz, B. Leeners, T. Krüger, M. Egli, and F. Ille. Patient-specific models from inter-patient biological models and clinical records. In *Formal Methods in Computer-Aided Design (FMCAD)*, 2014.
- [17] E. Tronci, T. Mancini, F. Mari, I. Melatti, I. Salvo, M. Prodanovic, J. K. Gruber, B. Hayes, and L. Elmegaard. Demand-aware price policy synthesis and verification services for smart grids. In *Proceedings of Smart Grid Communications (Smart-GridComm), 2014 IEEE International Conference On*, 2014.
- [18] V. Alimguzhin, F. Mari, I. Melatti, I. Salvo, and E. Tronci. On-the-fly control software synthesis. In *Proc. of International SPIN Symposium on Model Checking of Software (SPIN 2013)*, volume 7976 of *Lecture Notes in Computer Science*, pages 61–80. Springer - Verlag, 2013.
- [19] V. Alimguzhin, F. Mari, I. Melatti, I. Salvo, and E. Tronci. A map-reduce parallel approach to automatic synthesis of control software. In *Proc. of International SPIN Symposium on Model Checking of Software (SPIN 2013)*, volume 7976 of *Lecture Notes in Computer Science*, pages 43–60. Springer - Verlag, 2013.
- [20] T. Mancini, F. Mari, A. Massini, I. Melatti, F. Merli, and E. Tronci. System level formal verification via model checking driven simulation. In *Proceedings of the 25th International Conference on Computer Aided Verification. July 13-19, 2013, Saint Petersburg, Russia*, volume 8044 of *Lecture Notes in Computer Science*, pages 296–312. Springer - Verlag, 2013.
- [21] V. Alimguzhin, F. Mari, I. Melatti, I. Salvo, and E. Tronci. Automatic control software synthesis for quantized discrete time hybrid systems. In *Proceedings of the 51th IEEE Conference on Decision and Control, CDC 2012, December 10-13, 2012, Maui, HI, USA*, pages 6120–6125. IEEE, 2012.
- [22] V. Alimguzhin, F. Mari, I. Melatti, I. Salvo, and E. Tronci. On model based synthesis of embedded control software. In Ahmed Jerraya, Luca P. Carloni, Florence Maraninchi, and John Regehr, editors, *Proceedings of the 12th International Conference on Embedded Software, EMSOFT 2012, part of the Eighth Embedded Systems Week, ESWeek 2012, Tampere, Finland, October 7-12, 2012*, pages 227–236. ACM, 2012.
- [23] F. Mari, I. Melatti, I. Salvo, and E. Tronci. Linear constraints as a modeling language for discrete time hybrid systems. In *Proceedings of ICSEA 2012, The Seventh International Conference on Software Engineering Advances*, pages 664–671. ThinkMind, 2012.

- [24] F. Mari, I. Melatti, I. Salvo, and E. Tronci. *Theoretical Aspects of Computing – ICTAC 2012*, volume 7521 of *Lecture Notes in Computer Science*, chapter Undecidability of Quantized State Feedback Control for Discrete Time Linear Hybrid Systems, pages 243–258. Springer Berlin Heidelberg, 2012.
- [25] F. Mari, I. Melatti, I. Salvo, and E. Tronci. Control software visualization. In *Proceedings of INFOCOMP 2012, The Second International Conference on Advanced Communications and Computation*, pages 15–20. ThinkMind, 2012.
- [26] G. Verzino, F. Cavaliere, F. Mari, I. Melatti, G. Minei, I. Salvo, Y. Yushtein, and E. Tronci. Model checking driven simulation of sat procedures. In *Proc. of 12th International Conference on Space Operations (SpaceOps 2012)*, 2012.
- [27] F. Cavaliere, F. Mari, I. Melatti, G. Minei, I. Salvo, E. Tronci, G. Verzino, and Y. Yushtein. Model checking satellite operational procedures. In *DATA Systems In Aerospace (DASIA), Org. EuroSpace, Canadian Space Agency, CNES, ESA, EUMETSAT. San Anton, Malta, EuroSpace.*, 2011.
- [28] F. Mari, I. Melatti, I. Salvo, and E. Tronci. From boolean relations to control software. In *Proceedings of ICSEA 2011, The Sixth International Conference on Software Engineering Advances*, pages 528–533. ThinkMind, 2011.
- [29] F. Mari, I. Melatti, I. Salvo, and E. Tronci. Synthesis of quantized feedback control software for discrete time linear hybrid systems. In T. Touili, B. Cook, and P. Jackson, editors, *Computer Aided Verification*, volume 6174 of *Lecture Notes in Computer Science*, pages 180–195. Springer Berlin / Heidelberg, 2010.
- [30] A. Bobbio, E. Ciancamerla, S. Di Blasi, A. Iacomini, F. Mari, I. Melatti, M. Minichino, A. Scarlatti, E. Tronci, R. Terruggia, and E. Zendri. Risk analysis via heterogeneous models of scada interconnecting power grids and telco networks. In *Proceedings of Fourth International Conference on Risks and Security of Internet and Systems (CRiSIS)*, pages 90–97, 2009.
- [31] F. Mari, I. Melatti, I. Salvo, E. Tronci, L. Alvisi, A. Clement, and H. Li. Model checking coalition nash equilibria in mad distributed systems. In R. Guerraoui and F. Petit, editors, *Stabilization, Safety, and Security of Distributed Systems, 11th International Symposium, SSS 2009, Lyon, France, November 3-6, 2009. Proceedings*, volume 5873 of *Lecture Notes in Computer Science*, pages 531–546. Springer, 2009.
- [32] S. Mazzini, S. Puri, F. Mari, I. Melatti, and E. Tronci. Formal verification at system level. In *In: DATA Systems In Aerospace (DASIA), Org. EuroSpace, Canadian Space Agency, CNES, ESA, EUMETSAT. Istanbul, Turkey, EuroSpace*, 2009.
- [33] F. Chierichetti, S. Lattanzi, F. Mari, and A. Panconesi. On placing skips optimally in expectation. In M. Najork, A.Z. Broder, and S. Chakrabarti, editors, *Web Search and Web Data Mining (WSDM 2008)*, pages 15–24. Acm, 2008.
- [34] F. Mari, I. Melatti, I. Salvo, E. Tronci, L. Alvisi, A. Clement, and H. Li. Model checking nash equilibria in mad distributed systems. In A. Cimatti and R. Jones,

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editors, *FMCAD '08: Proceedings of the 2008 International Conference on Formal Methods in Computer-Aided Design*, pages 1–8, Piscataway, NJ, USA, 2008. IEEE Press.

- [35] F. Mari and E. Tronci. Cegar based bounded model checking of discrete time hybrid systems. In A. Bemporad, A. Bicchi, and G.C. Buttazzo, editors, *Hybrid Systems: Computation and Control (HSCC 2007)*, volume 4416 of *Lecture Notes in Computer Science*, pages 399–412. Springer, 2007.

Technical Reports (CoRR)

- [36] F. Mari, I. Melatti, I. Salvo, and E. Tronci. Model based synthesis of control software from system level formal specifications. Technical report, 2013.
- [37] V. Alimguzhin, F. Mari, I. Melatti, I. Salvo, and E. Tronci. A map-reduce parallel approach to automatic synthesis of control software. Technical report, 2012.
- [38] V. Alimguzhin, F. Mari, I. Melatti, I. Salvo, and E. Tronci. On model based synthesis of embedded control software. Technical report, 2012.
- [39] V. Alimguzhin, F. Mari, I. Melatti, I. Salvo, and E. Tronci. Automatic control software synthesis for quantized discrete time hybrid systems. Technical report, 2012.
- [40] F. Mari, I. Melatti, I. Salvo, and E. Tronci. From boolean functional equations to control software. Technical report, 2011.
- [41] F. Mari, I. Melatti, I. Salvo, and E. Tronci. Quantized feedback control software synthesis from system level formal specifications for buck dc/dc converters. Technical report, 2011.

Dissertations

- [42] F. Mari. Ph.D. thesis. verification and synthesis for discrete time linear hybrid systems, 2010.
- [43] F. Mari. Master thesis. automatic hybrid systems verification via satisfiability, 2006.