

Laura Titolo

National Institute of Aerospace

Personal Information

name Laura Titolo
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Short Bio

I am a Research Scientist at the National Institute of Aerospace (NIA) and member of the NASA Langley Formal Methods Team from September 2017. From September 2015 to September 2017 I was a postdoctoral researcher at NIA.

From September 2014 to August 2015 I was a post-doctoral researcher in the Mobile Networks and Software Reliability (MORSE) team at the University of Málaga (Spain).

I received my Ph.D. in Computer Science from the University of Udine (Cycle XXVI) on May, 12 2014. My thesis title was "An Abstract Interpretation Framework for Diagnosis and Verification of Timed Concurrent Constraint Languages" and it was written under the supervision of Marco Comini and Alicia Villanueva. I was a member of the F.Li.T (Formal Light-Weight Tools) group at the Department of Mathematics and Computer Science of the University of Udine (Italy) and I have also collaborated with the ELP (Extensions of Logic Programming) group at the Department of Information Systems and Computation of the Technical University of Valencia (Spain).

I received my Bachelor degree (Laurea Triennale) and Master degree (Laurea Specialistica) in Computer Science from the University of Udine, in July 2008 and October 2010, respectively, both with full marks and honors (110/110 cum laude). I was one of the few selected students of the Scuola Superiore of the University of Udine, an higher learning school of studies within the University of Udine with advanced courses in addition to those held at the (standard) university. The Scuola Superiore scholarship fully supported my whole University studies. I received my degree from the Scuola Superiore of the University of Udine in June 2011 with full marks and honors (110/110 cum laude).

My research interests include:

- Formal Methods
- Automatic Debugging, Verification and Analysis of Concurrent, Reactive and Hybrid systems
- Automatic Analysis of Floating-Point Programs
- Semantics of Declarative Languages
- Abstract Interpretation
- Temporal Logics
- Application of Formal Methods Techniques to the Analysis of Safety Critical Avionic Software

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Academic Positions

- September 2017-now **Research Scientist II**, *National Institute of Aerospace, USA*.
Main activities:
- Conducted research on formal methods for safety-critical systems as member of the NASA Langley Formal Methods (NFM) Group
 - Participation in the coordination of the program of international research visitors
 - Participation in the planning and deployment of the research activities of the NIA Formal Methods team
 - Participation in the evaluation of the research of others as member of several committees for computer science conferences and journals.
- September 2015- **PostDoctoral Research Scholar**, *National Institute of Aerospace, USA*.
Research Topics:
- September 2017
- Static Analysis of Floating-Point Programs
 - Application of Formal Methods Techniques to the Analysis of Safety Critical Avionic Software
 - Abstract Interpretation and Semantics of Declarative Languages
 - Runtime Verification
- September 2014-August 2015 **PostDoctoral Researcher**, *University of Málaga, Spain*.
Research Topics: Semantics of Declarative Languages, Abstract Interpretation, Model Checking, Automatic Debugging, Verification and Analysis of Hybrid, Reactive and Concurrent Systems, Cyber-Physical Systems, Temporal Logics
- January 2011-May 2014 **Ph.D. Student**, *University of Udine, Italy*.
Research Topics: Semantics of Declarative Languages, Abstract Interpretation, Analysis of Reactive and Concurrent Systems, Constraint Programming, Temporal Logics
- January 2010-March 2010 **Researcher**, *Technical University of Valencia, Spain*.
Research Topics: Semantics of Declarative Languages, Abstract Interpretation, Constraint Programming

Education

- May 2014 **Ph.D. in Computer Science**, *University of Udine, Italy*.
Thesis Title: “An Abstract Interpretation Framework for Diagnosis and Verification of Timed Concurrent Constraint Languages”. Supervisors: Prof. Marco Comini and Prof. Alicia Villanueva.
- June 2011 **Diploma Scuola Superiore dell’Università degli Studi di Udine (Excellence University Institute, Scientific track)**, *Scuola Superiore, University of Udine, Italy, 110/110 cum laude*.
- October 2010 **Master Degree in Computer Science**, *University of Udine, Italy, 110/110 cum laude*.
Thesis Title: “Una semantica bottom-up goal-independent per Timed Concurrent Constraint Programming” (“A bottom-up goal-independent semantics for Timed Concurrent Constraint Programming”). Supervisors: Prof. Marco Comini and Prof. Alicia Villanueva.
- July 2008 **Bachelor Degree in Computer Science**, *University of Udine, Italy, 110/110 cum laude*.
Thesis Title: “Semantica Algebrica di CLP(FD)” (“Algebraic Semantics for CLP(FD)”) Supervisor: Prof. Marco Comini.

Publications

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Journal Publications

- María del Mar Gallardo, Leticia Lavado, Laura Panizo, Laura Titolo: *A Constraint-based Language to Model Intelligent Environments*, Journal of Reliable Intelligent Environments, Volume 3, Issue 1, pp 55-79, Springer, 2017, DOI: 10.1007/s40860-017-0040-3
- Marco Comini, María del Mar Gallardo, Laura Titolo, Alicia Villanueva: *A program analysis framework for tccp based on abstract interpretation*, Formal Aspects of Computing, Volume 29, Issue 3, pp 531-557, Springer, 2017, DOI: 10.1007/s00165-016-0409-8
- Marco Comini, Laura Titolo, Alicia Villanueva: *Abstract Diagnosis for tccp using a Linear Temporal Logic*, Theory and Practice of Logic Programming (TPLP) Volume 14, Issue 4-5, Special Issue of the 30th International Conference on Logic Programming, pages 787-801, Cambridge University Press, 2014
- Laura Titolo: *An Abstract Interpretation Framework for Verification of Timed Concurrent Constraint Languages*, on-line supplement of the journal Theory and Practice of Logic Programming (TPLP), Volume 13, Issue 4-5, Cambridge University Press, 2013
- Marco Comini, Laura Titolo, Alicia Villanueva: *Abstract Diagnosis for Timed Concurrent Constraint programs*, Theory and Practice of Logic Programming (TPLP) Volume 11 Issue 4-5, Special Issue of the 28th International Conference on Logic Programming, pages 487-502, Cambridge University Press, 2011

Peer-reviewed Conferences

- Laura Titolo, Mariano Moscato, Cesar A. Muñoz, Aaron Dutle, Francois Bobot: *A Formally Verified Floating-Point Implementation of the Compact Position Reporting Algorithm*, submitted to the 22nd International Symposium on Formal Methods (FM 2018)
- Laura Titolo, Marco A. Feliú, Mariano Moscato, Cesar A. Muñoz: *An Abstract Interpretation Framework for the Round-Off Error Analysis of Floating-Point Programs*, 19th International Conference on Verification, Model Checking, and Abstract Interpretation (VMCAI 2018), Lecture Notes in Computer Science, Vol. 10747, pp. 516-537, 2018, DOI: 10.1007/978-3-319-73721-8_24
- Mariano Moscato, Laura Titolo, Aaron Dutle, Cesar A. Muñoz: *Automatic Estimation of Verified Floating-Point Round-Off Errors via Static Analysis*, 36th International Conference on Computer Safety, Reliability, and Security (SAFE-COMP 2017), Lecture Notes in Computer Science, Vol. 10488, pp. 213-229, 2017 DOI: 10.1007/978-3-319-66266-4_14
- Aaron Dutle, Mariano Moscato, Laura Titolo, Cesar A. Muñoz: *A Formal Analysis of the Compact Position Reporting Algorithm*, Proceedings of the 9th Working Conference on Verified Software: Theories, Tools, and Experiments (VSTTE 2017), Lecture Notes in Computer Science, Vol. 10712, pp. 19-34, 2017, DOI: 10.1007/978-3-319-72308-2_2

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- Marco Comini, María del Mar Gallardo, Laura Titolo, Alicia Villanueva: *Abstract analysis of universal properties for tccp*, 25th International Symposium on Logic-Based Program Synthesis and Transformation (LOPSTR 2015), Selected Revised Papers, Lecture Notes in Theoretical Computer Science, Vol. 9527, pp. 163–178 DOI: 10.1007/978-3-319-27436-2_10
- María del Mar Gallardo, Laura Panizo, Laura Titolo: *A discretized operational semantics for the implementation of hy-tccp*, Proceedings of the XV Conference on Programming and Languages (PROLE 2015)
- María del Mar Gallardo, Laura Panizo, Laura Titolo: *A discretized operational semantics for the implementation of hy-tccp*, Proceedings of the XXIII Conference on Concurrency and Distributed Systems (JCS D 2015)
- Damián Adalid, María del Mar Gallardo, Laura Titolo: *Modeling Hybrid Systems in the Concurrent Constraint Paradigm*, Selected paper from the XV Conference on Programming and Languages (PROLE 2014), Electronic Proceedings in Theoretical Computer Science (EPTCS), Vol. 173, pages 1-15
- Damián Adalid, María del Mar Gallardo, Laura Titolo: *Modeling Hybrid Systems in Hy-tccp*, Proceedings of the 3rd International Workshop on Formal Techniques for Safety-Critical Systems (FTSCS 2014)
- Marco Comini, Laura Titolo, Alicia Villanueva: *Abstract Diagnosis for tccp using a Linear Temporal Logic (Abstract)*, Proceedings of the XV Conference on Programming and Languages (PROLE 2014)), Cadiz, Spain
- Marco Comini, Laura Titolo, Alicia Villanueva: *Towards an Effective Decision Procedure for LTL formulas with Constraints*, Proceedings of the 23rd Workshop on Logic-based methods in Programming Environments (WLPE 2013)
- Marco Comini, Laura Titolo, Alicia Villanueva: *Abstract Diagnosis for Timed Concurrent Constraint programs (Abstract)*, Proceedings of the XII Conference on Programming and Languages (PROLE 2011)

Technical Reports

- Marco Comini, Laura Titolo, Alicia Villanueva: *A Compact Goal-Independent Bottom-Up Fixpoint Modeling of the Behavior of TCCP*, Technical Report

Project Participation

September 2015	NIA's Research Cooperative Agreement No. NNL09AA00A with NASA Langley Research Center
September 2014	"CHECKIT: New Extensions of Formal Methods in Modelling, Verification, Synthesis and Optimization of Embedded and Mobile Communication Systems: Application on Certification of LTE Protocols" (P11-TIC-7659), University of Málaga (Spain)
May 2011-May 2013	"SweetLogics" project (TIN 2010-21062-C02), financed by the Spanish ministry of science and innovation, Technical University of Valencia (Spain)
January 2010-March 2010	"TechnoLogics" project (TIN 2007-68093-C02), financed by the Spanish ministry of science and innovation, Technical University of Valencia (Spain)

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Research Stays

- March 2017 Invited researcher, French Alternative Energies and Atomic Energy Commission (CEA), Paris, France
- June 2014 Invited researcher, Universidad del País Vasco, San Sebastian, Spain
- June 2011 Invited researcher, University of Siena, Italy
- May-December 2012 Visiting Ph.D. student, Technical University of Valencia (Spain)
- February-May 2011 Visiting Ph.D. student, Technical University of Valencia (Spain)
- September 2009-March 2010 Exchange Student (Erasmus Programme), Technical University of Valencia (Spain)

Conference Committees

- Program Committee Member of the First International Workshop on Trusted Numerical Computations Workshop (TNC 2018), Krakow, Poland
- Program Committee Member of the 11th International Workshop on Numerical Software Verification (NSV 2018), hosted by the Federated Logic Conference, Oxford, UK
- Program Committee Member of the 10th NASA Formal Methods Symposium (NFM 2018), Newport News, USA
- Program Committee Member of the 30th Italian Conference on Computational Logic (CILC 2015), Genova, Italy
- Organization Committee Member of the 23th Spanish Workshop on Concurrency and Distributed Systems, Málaga, Spain

Referee Activity

- Reviewer for the Journal of Automated Reasoning (Springer)
- Reviewer for the Journal of Logical and Algebraic Methods in Programming (ELSEVIER)
- Reviewer for the ACM Transactions on Computational Logic (TOCL) Journal
- Reviewer for the 8th International Conference on Interactive Theorem Proving (ITP 2017)
- Reviewer for the 6th Workshop on Automated Formal Methods (AFM 2017) (FSCD 2016)
- Reviewer for the 1st International Conference on Formal Structures for Computation and Deduction (FSCD 2016)
- Reviewer for the 24th International Symposium on Logic-Based Program Synthesis and Transformation (LOPSTR 2014)
- Reviewer for the 30th International Conference on Logic Programming (ICLP 2014)

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- Reviewer for the 7th International Conference on Tests and Proofs (TAP 2013)
- Reviewer for the 16th International Workshop on Formal Methods for Industrial Critical Systems (FMICS 2011)
- Reviewer for the 15th International Workshop on Formal Methods for Industrial Critical Systems (FMICS 2010)

Seminars and Talks

Invited Talks

- September 2017 *Static Analysis of the Round-Off Error of Floating-Point Programs*. seminar at the Technical University of Valencia, Spain
- August 2017 *An Abstract Interpretation Framework for the Round-Off Error Analysis of Floating-Point Programs*. Dagstuhl Seminar 17352, "Analysis and Synthesis of Floating-point Programs"
- March 2017 *A Static Analysis Framework for the Estimation of Verified Floating-Point Round-Off Errors*. French Alternative Energies and Atomic Energy Commission (CEA), Paris, France
- June 2014 *Abstract Diagnosis for tccp using a Linear Temporal Logic*. University of the Basque Country, San Sebastian, Spain
- January 2014 *An Abstract Interpretation Framework for Verification of Timed Concurrent Constraint Languages*. IMDEA Software Institute, Madrid, Spain
- June 2011 *Abstract Diagnosis for Timed Concurrent Constraint programs*. Dipartimento di Scienze Matematiche e Informatiche, Univesità degli Studi di Siena, Italy

Conference Talks

- January 2018 *An Abstract Interpretation Framework for the Round-Off Error Analysis of Floating-Point Programs*. 19th International Conference on Verification, Model Checking, and Abstract Interpretation (VMCAI 2018), Los Angeles, USA
- September 2017 *Automatic Estimation of Verified Floating-Point Round-Off Errors via Static Analysis*. 36th International Conference on Computer Safety, Reliability, and Security (SAFECOMP 2017), Trento, Italy
- July 2015 *Abstract analysis of universal properties for tccp*. 25th International Symposium on Logic-Based Program Synthesis and Transformation (LOPSTR 2015), Siena, Italy
- November 2014 *Modelling Hybrid Systems in Hy-tccp*. Third International Workshop on Formal Techniques for Safety-Critical Systems (FTSCS 2014), Luxembourg
- July 2014 *Abstract Diagnosis for tccp using a Linear Temporal Logic*. 30th International Conference on Logic Programming (ICLP 2014), Vienna, Austria
- August 2013 *Towards an Effective Decision Procedure for LTL formulas with Constraints*. 23rd Workshop on Logic-based methods in Programming Environments (WLPE 2012), Istanbul, Turkey
- August 2013 *An Abstract Interpretation Framework for Verification of Timed Concurrent Constraint Languages*. 9th ICLP Doctoral Consortium, Istanbul, Turkey

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July 2011 *Abstract Diagnosis for Timed Concurrent Constraint programs*. 27th International Conference on Logic Programming (ICLP 2011), Lexington, Kentucky, USA

Other Talks

March 2017 *A Static Analysis Framework for the Estimation of Verified Floating-Point Round-Off Errors*. Safety-Critical Avionics Systems Branch Peer Review NASA Langley Research Center, USA

February 2017 *A Static Analysis Framework for the Estimation of Verified Floating-Point Round-Off Errors*. Formal Methods Seminar, NASA Langley Research Center, Hampton VA, USA

March 2016 *Notes on the Compact Position Reporting Algorithm*. Formal Methods Seminar, NASA Langley Research Center, Hampton VA, USA

October 2013 *Bialgebras for Structural Operational Semantics*. DIMI, University of Udine, Italy

May 2012 *Abstractions for Hybrid Systems*. DIMI, University of Udine, Italy

January 2012 *Coinductive Logic Programming*. DIMI, University of Udine, Italy

July 2009 *Semantics and Verification of tccp programs*. DIMI, University of Udine, Italy

March 2009 *Type Systems with abstract interpretation*. DIMI, University of Udine, Italy

October 2008 *Applications of CLP(FD) to scheduling problems*. DIMI, University of Udine, Italy

March 2008 *An algebraic semantics for constraint logic programs*. DIMI, University of Udine, Italy

Attended Conferences

January 6-8, 2018 19th International Conference on Verification, Model Checking, and Abstract Interpretation (VMCAI 2018)

September 12-15, 2017 36th International Conference on Computer Safety, Reliability, and Security (SAFE-COMP 2017), Trento, Italy

July 13-15, 2015 25th International Symposium on Logic-Based Program Synthesis and Transformation (LOPSTR 2015), Siena, Italy

July 13-15, 2015 25th International Symposium on Logic-Based Program Synthesis and Transformation (LOPSTR 2015), Siena, Italy

November 6-7, 2014 3rd International Workshop on Formal Techniques for Safety-Critical Systems (FTSCS 2014), Luxembourg

July 19-22, 2014 Vienna Summer of Logic 2014, Vienna, Austria

July 19-22, 2014 30th International Conference on Logic Programming (ICLP 2014), Vienna, Austria

August 24-28, 2013 29th International Conference on Logic Programming (ICLP 2013), Istanbul, Turkey

July 6-10, 2011 27th International Conference on Logic Programming (ICLP 2011), Lexington, Kentucky, USA

September 6-8, 2010 XI Jornadas sobre Programación y Lenguajes (PROLE 2010), Valencia, Spain

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Scholarships

- January 2011- December 2013 3-years Scholarship issued by the University of Udine to enroll in the PhD program in Computer Science
- September 2005-August 2010 5-years Scholarship issued by the Scuola Superiore of the University of Udine to the best 20 students of the whole University of Udine

Languages

- Italian Mother Tongue
- English C2 (Proficient User)
- Spanish C2 (Proficient User)
- French A1 (Basic User)