Mariano Miguel Moscato

Ph.D. in Computer Science

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Scopus: https://www.scopus.com/authid/detail.uri?authorId=23088699000

Education

University of Buenos Aires, Argentina
***Ph.D.* (grad. 2014), M.S. (grad. 2005), and B.S. (grad. 2003) in Computer Science.**

Relevant and Recent Work Experience

Over 10 years of professional experience in research on and application of formal verification techniques for safety-critical systems as a key member of NASA's LaRC Formal Methods Team, leading or co-leading several high-impact projects such as NASALib, VSCode-PVS, and PRECiSA. In my current role, I've also managed internship programs and fostered strong scientific collaborations with both national and international partners.

Analytical Mechanics Associates, Inc.
21 Enterprise Parkway, Suite 300, Hampton, VA 23666 | +1 757 865-0000

Research Scientist Lead / Research Scientist Sr.
JAN 2024 - PRESENT / JUN 2023 - DEC 2023

National Institute of Aerospace
100 Exploration way, Hampton, VA 23666 | +1 (757) 325-6904

Research Scientist Sr. / Research Scientist II / Research Scientist I / Postdoctoral Scholar
JAN 2019 - MAY 2023 / JAN 2017 - DEC 2018 / JAN 2016 - DEC 2016 / JUL 2014 - DEC 2015

Computer Science Dpt., School of Science, University of Buenos Aires
2160 Intendente Güiraldes, City of Buenos Aires, Argentina

Computer Science Outreach Secretary
APR 2012 - JUL 2014

Planned and deployed a wide range of activities (workshops, courses, symposiums, etc.) to promote the Computer Science discipline among the public and other educational-level students. Coordinated work with diverse public and private institutions with the same aim. Obtained outreach grants to support these activities.

Teaching Assistant, Second Class / Teaching Assistant, First Class / Head of Teacher Assistants
APR 2004 - MAR 2006 / APR 2006 - MAR 2010 / APR 2010 - JUL 2014

Lectured classes. Developed and evaluated homework and tests. Held office hours to ensure students understood theoretical and practical concepts. Worked in several BSC and MSC in Computer Science courses. Mentored C.S. students.

Tratecsa S.A., Fundition S.A., Axxon S.A.
Address: 1949 Malabia, City of Buenos Aires, Argentina

Software Developer
AUG 2003 - OCT 2005

Collected stakeholder requirements. Rapidly prototyped new features. Wrote maintainable and extensible code in a collaborative environment. Developed custom test suites. Technologies: JAVA/J2EE, JavaScript, ASP.Net, Oracle.

Publications

1) **2025**. Mauricio Ayala-Rincón, Thaynara Arielly de Lima, Maria Julia Dias Lima, **Mariano M. Moscato**, and Temur Kutsia. Verification of an Anti-Unification Algorithm in PVS. **Submitted** to the 17th NASA Formal Methods Symposium (NFM2025), Williamsburg, Virginia, USA.
2) **2024**. Laura Titolo, **Mariano Moscato**, Marco Feliu, Paolo Masci, and Cesar Munoz. Rigorous Floating-Point Round-Off Error Analysis in PRECiSA 4.0. In: Platzer, A., Rozier, K.Y., Pradella, M., Rossi, M. (eds) Formal Methods. FM 2024. Lecture Notes in Computer Science, vol 14934. Springer, Cham. https://doi.org/10.1007/978-3-031-71177-0_2.
3) **2023** Nikson Bernardes Fernandes Ferreira, **Mariano Moscato**, Laura Titolo, and Mauricio Ayala-Rincón: **"**A Provably Correct Floating-Point Implementation of Well Clear Avionics Concepts". Proceedings of the 23rd Conference on Formal Methods in Computer-Aided Design (October 23-27, 2023, Ames, Iowa, USA), TU Wien Academic Press.
4) **2023** Cesar A. Muñoz, Mauricio Ayala-Rincón, **Mariano M. Moscato**, Aaron Dutle, Anthony Narkawicz, Ariane Alves Almeida, Andreia B. Avelar da Silva and Thiago M. Ferreira Ramos. "Formal Verification of Termination Criteria for First-Order Recursive Functions." Journal of Automated Reasoning, Volume 67, article 40. https://doi.org/10.1007/s10817-023-09669-z
5) **2023** Laura Titolo, **Mariano Moscato**, Marco Feliu, Aaron Dutle, and Cesar Munoz: "Floating-point round-off error analysis of safety-critical avionics software". In: Arceri, V., Cortesi, A., Ferrara, P., Olliaro, M. (eds) Challenges of Software Verification. Intelligent Systems Reference Library, vol 238. Springer, Singapore. https://doi.org/10.1007/978-981-19-9601-6_11.
6) **2023** Aaron Dutle, **Mariano M. Moscato**, Laura Titolo, César A. Muñoz, Ivan Perez (Eds.). "Selected extended papers of NFM 2021". Innovations in Systems and Software Engineering**,** A NASA Journal. Volume 19, Issue 4. https://link.springer.com/journal/11334/volumes-and-issues/19-4.
7) **2021** Aaron Dutle, **Mariano M. Moscato**, Laura Titolo, Cesar A. Muñoz, and Ivan Perez (Eds.). "NASA Formal Methods: 13th International Symposium, NFM 2021, Virtual Event, May 24-28, 2021: Proceedings". LNCS sub-library: Programming and software engineering. Publisher: Springer International Publishing. ISBN: 9783030763848.

8) **2021** Cesar A. Muñoz, Mauricio Ayala-Rincón, Mariano M. Moscato, Aaron Dutle, Anthony Narkawicz, Ariane Alves Almeida, Andreia B. Avelar da Silva and Thiago M. Ferreira Ramos. “Formal Verification of Termination Criteria for First-Order Recursive Functions”. In proceedings of the 12th International conference on Interactive Theorem Proving (ITP 2021), June 29-July 1, 2021, Rome, Italy.

9) **2020** Aaron Dutle, Mariano M. Moscato, Laura Titolo, Cesar A. Muñoz, Gregory Anderson, and François Bobot. “Formal Analysis of the Compact Position Reporting Algorithm”. In *Formal Aspects of Computing*, Springer, 2020. https://doi.org/10.1007/s00165-019-00504-0

10) **2020** Laura Titolo, Mariano M. Moscato, Marco A. Feliú, César A. Muñoz (2020) Automatic Generation of Guard-Stable Floating-Point Code. In: Dongol B., Troubitsyna E. (eds) Integrated Formal Methods. IFM 2020. Lecture Notes in Computer Science, vol 12546. Springer, Cham. https://doi.org/10.1007/978-3-030-63461-2_8**2019** Mariano M. Moscato, Laura Titolo, Marco A. Feliú, and César A. Muñoz. "Provably Correct Floating-Point Implementation of a Point-in-Polygon Algorithm." In *International Symposium on Formal Methods*, pp. 21-37. Springer, Cham, 2019.

11) **2019** Rocco Salvia, Laura Titolo, Marco A. Feliu, Mariano M. Moscato, Cesar A. Munoz, Zvonimir Rakamaric. 11th NASA Formal Methods Symposium (NFM 2019), Houston, TX, USA.

12) **2018** Marco A. Feliú and Mariano M. Moscato. “Towards a Formal Safety Framework for Trajectories”. In: NASA Formal Methods - 10th International Symposium, NFM 2018, Newport News, VA, USA, April 17-19, 2018, Proceedings. Ed. by Aaron Dutle, César A. Muñoz, and Anthony Narkawicz. Vol. 10811. Lecture Notes in Computer Science. Springer, pp. 179–184. doi: 10.1007/978-3-319-77935-5_13. url: https://doi.org/10.1007/978-3-319-77935-5%5C_13.

13) **2018** Mariano M. Moscato, Carlos Gustavo López Pombo, César A. Muñoz, and Marco A. Feliú. “Boosting the Reuse of Formal Specifications”. In: Interactive Theorem Proving - 9th International Conference, ITP 2018, Held as Part of the Federated Logic Conference, FloC 2018, Oxford, UK, July 9-12, 2018, Proceedings. Ed. by Jeremy Avigad and Assia Mahboubi. Vol. 10895. Lecture Notes in Computer Science. Springer, pp. 477–494. doi: 10.1007/978-3-319-94821-8_28. url: https://doi.org/10.1007/978-3-319-94821-8%5C_28.

14) **2018** Thiago Mendonça Ferreira Ramos, César A. Muñoz, Mauricio Ayala-Rincón, Mariano M. Moscato, Aaron Dutle, and Anthony Narkawicz. “Formalization of the Undecidability of the Halting Problem for a Functional Language”. In: Logic, Language, Information, and Computation - 25th International Workshop, WoLLIC 2018, Bogota, Colombia, July 24-27, 2018, Proceedings. Ed. by Lawrence S. Moss, Ruy J. G. B. de Queiroz, and Maricarmen Martínez. Vol. 10944. Lecture Notes in Computer Science. Springer, pp. 196–209. doi: 10.1007/978-3-662-57669-4_11. url: https: //doi.org/10.1007/978-3-662-57669-4%5C_11.

15) **2018** Laura Titolo, Marco A. Feliú, Mariano M. Moscato, and César A. Muñoz. “An Abstract Interpretation Framework for the Round-Off Error Analysis of Floating-Point Programs”. In: Verification, Model Checking, and Abstract Interpretation - 19th International Conference, VMCAI 2018, Los Angeles,

CA, USA, January 7-9, 2018, Proceedings. Ed. by Isil Dillig and Jens Palsberg. Vol. 10747. Lecture Notes in Computer Science. Springer, pp. 516–537. doi: 10.1007/978-3-319- 73721-8_24. url: https://doi.org/10.1007/978-3-319- 73721-8%5C_24.

16) **2018** Laura Titolo, Mariano M. Moscato, César A. Muñoz, Aaron Dutle, and François Bobot. “A Formally Verified Floating-Point Implementation of the Compact Position Reporting Algorithm”. In: Formal Methods - 22nd International Symposium, FM 2018, Held as Part of the Federated Logic Conference, FloC 2018, Oxford, UK, July 15-17, 2018, Proceedings. Ed. by Klaus Havelund, Jan Peleska, Bill Roscoe, and Erik P. de Vink. Vol. 10951. Lecture Notes in Computer Science. Springer, pp. 364–381. doi: 10.1007/978-3-319-95582- 7_22. url: https://doi.org/10.1007/978-3-319- 95582-7%5C_22.

17) **2018** Laura Titolo, César A. Muñoz, Marco A. Feliú, and Mariano M. Moscato. “Eliminating Unstable Tests in Floating-Point Programs”. In: CoRR abs/1808.04289. Pre-proceedings of the 28th International Symposium on Logic-based Program Synthesis and Transformation (LOPSTR 2018). arXiv: 1808.04289. url: http://arxiv.org/abs/1808.04289.

18) **2017** A. Dutle, M. M. Moscato, L. Titolo & C. A. Muñoz. A Formal Analysis of the Compact Position Reporting Algorithm. Submitted to Conference. Accepted for publication in the 9th Working Conference on Verified Software: Theories, Tools, and Experiments (VSTTE 2017) July 22-23, 2017, Heidelberg, Germany.

19) **2017** M. M. Moscato, L. Titolo, A. Dutle & C. A. Muñoz. Automatic Estimation of Verified Floating-Point Round-Off Errors via Static Analysis. Accepted for publication in the 36th International Conference SAFECOMP 2017 "Computer Safety, Reliability and Security”, Trento, Italy, Sept. 12-15 2017.

20) **2015** M. M. Moscato, C. A. Muñoz & P. A. Smith. Affine Arithmetic and Applications to Real- Number Proving. In Proc. of the 6th International Conference on Interactive Theorem Proving (ITP 2015), Lecture Notes in Computer Science, Vol. 9236, pp. 294-309.

21) **2014** M. M. Moscato, C. G. López Pombo & M. F. Frias. Dynamite: A Tool for the Verification of Alloy Models Based on PVS. ACM Trans. Softw. Eng. Methodol., Vol. 23, Number 2, March 2014. ACM Press, New York, NY, USA.

22) **2013** M. Giménez, M. M. Moscato, C. G. López Pombo & M. F. Frias. HeteroGenius: a framework for hybrid analysis of heterogeneous software specifications. First Latin American Workshop on Formal Methods, LAFM 2013 (affiliated to CONCUR2013); Buenos Aires, Argentina.

23) **2013** P. Abad, N. Aguirre, V. Bengolea, D. Ciolek, M. F. Frias, J. P. Galeotti, T. S. E. Maibaum, M. M. Moscato, N. Rosner & I. Vissani. Improving Test Generation under Rich Contracts by Tight Bounds and Incremental SAT Solving. In Proc. of the 6th IEEE International Conference on So - ware Testing, Veri cation and Validation (ICST 2013), Luxembourg, March 18-22, 2013. IEEE Press, 2013.

24) **2010** M. M. Moscato, C. G. López Pombo & M. F. Frias. Dynamite 2: New Features Based on UnSAT- Core Extraction to Improve Verification of Software Requirements. In Proc. of the 7th International Colloquium on theoretical Aspects of Computing, ICTAC2010, Brazil, Sept. 1-3, 2010. LNCS v.6255. Springer-Verlag.

25) **2009** N. Aguirre, M. F. Frias, M. M. Moscato, T. S. E. Maibaum & A. Wassyng. Describing and Analyzing Behaviors Over Tabular Specifications Using (Dyn)Alloy. In Proc. of the 12th International Conference on Fundamental Approaches to So ware Engineering, FASE 2009, York, UK, March 22-29, 2009. LNCS v.5503. Springer-Verlag.

26) **2009** M. M. Moscato, C. G. López Pombo & M. F. Frias Lessons Learnt on the Verification of Models Using Dynamite. International Symposium on Automatic Program Verification APV09; February 15, 2009. Río Cuarto, Córdoba, Argentina.

27) **2007** M. F. Frias, C. G. López Pombo & M. M. Moscato. Alloy Analyzer + PVS in the Analysis and Verification of Alloy Specifications. In Proc. of the 13th International Conference on Tools and Algorithms for the Construction and Analysis of Systems, TACAS'07, Portugal, March 24-April 1, 2007. LNCS v.4424. Springer-Verlag.

28) **2006** M. F. Frias, C. G. López Pombo & M. M. Moscato. Dynamite: Alloy Analyzer+PVS in the Analysis and Verification of Alloy Specifications. First Alloy Workshop (colocated with the Fourteenth ACM SIGSOFT Symposium on Foundations of So ware Engineer- ing); November 6; Portland, Oregon, EEUU.

TALKS AND PRESENTATIONS

1) **2021** "Automatic Generation of Guard-Stable Floating-Point Code". Talk at NIA Internal Researchers Seminar.

2) **2020** "Automatic Generation of Guard-Stable Floating-Point Code". Talk at the 16th International Conference on integrated Formal Methods (iFM 2020), November 16th, 2020, (virtual).

3) **2019** "Provably Correct Floating-Point Implementation of a Point-in-Polygon Algorithm." Talk at the 23rd *International Symposium on Formal Methods*, Porto, Portugal, October 11th, 2019.

4) **2018** "Boosting the Reuse of Formal Specifications". Talk at the 9th International Conference Interactive Theorem Proving (ITP 2018), held as Part of the Federated Logic Conference, FloC 2018, Oxford, UK, July 9th, 2018.

5) **2018** Invited talk at the International Sound Static Analysis for Security Workshop. Title: "A formally verified floating-point implementation of the Compact Position Reporting algorithm". June 27th, 2018. Gaithersburg, Maryland.

6) **2018** "Validating Critical Systems with PVS". February 19th-24th, 2018. Course in the 25th International Summer School in Computer Science, Río Cuarto, Córdoba, Argentina.

7) **2017** A Static Analysis Framework for the Estimation of Verified Floating-Point Round-Off Errors (w. Laura Titolo). At the D320 Safety-Critical Avionics System Branch Peer Review. March 28. NASA Langley Research Center, Hampton VA, USA.

8) **2016** A Formal Analysis of the ADS-B Position Codification System. At the NIA's Sandwich Seminar. December 6th. National Institute of Aerospace, Hampton VA, USA.

9) **2016** Notes on the Compact Position Reporting Algorithm (w. Laura Titolo and Andrew Smith). At the Formal Methods Seminar. March 11th. NASA Langley Research Center, Hampton VA, USA.

10) **2015** Affine Arithmetic and Applications to Real- Number Proving. At the Formal Methods Seminar. May 29th. NASA Langley Research Center, Hampton VA, USA.

11) **2015** M. M. Moscato, C. A. Muñoz & P. A. Smith. Affine Arithmetic and Applications to Real- Number Proving. At the 6th International Conference on Interactive Theorem Proving (ITP 2015), Nanjing, China.

12) **2014** Dynamite: a Tool for the Verification of Alloy Models Based on PVS. At the Formal Methods Seminar. September 26th. NASA Langley Research Center, Hampton VA, USA.

13) **2014** Mejoras a la demostración interactiva de propiedades Alloy utilizando SAT-solving. At the 2nd. Argentinian Workshop of Foundations for Automatic Software Analysis and Construction. March 6th, 2014. Santa Fe, Argentina.

14) **2010** M. M. Moscato, C. G. López Pombo & M. F. Frias. Dynamite 2: New Features Based on UnSAT- Core Extraction to Improve Verification of Software Requirements. At the 7th International Colloquium on theoretical Aspects of Computing (ICTAC 2010), Natal, Brazil.

15) **2009** M. M. Moscato, C. G. López Pombo & M. F. Frias Lessons Learnt on the Verification of Models Using Dynamite. At International Symposium on Automatic Program Verification (APV 09) Rosario, Argentina.

16) **2007** M. F. Frias, C. G. López Pombo & M. M. Moscato. Alloy Analyzer + PVS in the Analysis and Verification of Alloy Specifications. At the 13th International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS 07) Braga, Portugal.

AWARDS and RECOGNITIONS

- **2024** Awarded with internal AMA IRAD for the project "Estimate Numerical Errors in Quantized Neural Networks" (ongoing).
- **2022** NASA Group Achievement Award: "For outstanding contributions verifying the Compact Position Reporting Algorithm to support safety of Automatic Dependent Surveillance-Broadcast in the National Airspace System." Shared with Aaron Dutle, César Muñoz, and Laura Titolo.
- **2018** National Institute of Aerospace Best Paper Award 2018 for: "A Formally Verified Floating-Point Implementation of the Compact Position Reporting Algorithm".

- **2007** EASST's Best Paper Award at ETAPS 2007 for the paper: "Alloy Analyzer + PVS in the Analysis and the Verification of Alloy Specifications".
- **2007** TACAS'07 Student Coauthor Award Sponsored by Microsoft Research Cambridge.

EDUCATIONAL

- **Ongoing** Co-Advisor in the PhD in CS Program from the University of Brasilia, Brazil. Student: Nikson Bernardes. Co-Advisor: Mauricio Ayala. Expected graduation: 2027.
- **2023** Co-Advisor in the MS in CS Program from the University of Brasilia, Brazil. Title: "Improving the Safety of Automatically Generated Implementations." Student: Nikson Bernardes. Co-Advisor: Mauricio Ayala. Graduated July 2023.
- **2021** Co-Advisor in the MS in CS Program from the University of Buenos Aires, Argentina. Title: "Finite Model Finder for the PVS Interactive Theorem Prover." Student: Leonardo Teren. Co-Advisor: Carlos Gustavo López Pombo. Graduated December 2021.
- **2021** "Program Validation and Verification in PVS". Tutorial at the 28th International Conference on Automated Deduction, July 11th, 2021, virtual.
- **2021** Member of PhD Evaluation Committee at the University of Brasilia, Brazil. Thesis Title: "On Termination by Dependency Pairs and Termination of First-Order Functional Specifications in PVS." Candidate: Ariane Alves Almeida. July 9th, 2021, virtual.
- **2018** "Validating Critical Systems with PVS". One week class in the context of the Summer School Rio 2018, February 19th-24th, University of Rio Cuarto, Córdoba, Argentina.
- **2017** "PVS for Computer Scientists". Tutorial at the 8th International Conference on Interactive Theorem Proving ITP 2017, September 25th, 2017, Brasília, Brazil.
- **2013** Co-Advisor in the MSCS Program from the University of Buenos Aires, Argentina. Title: "HeteroGenius: a framework for hybrid analysis of heterogeneous software specifications." Student: Manuel Giménez. Co-Advisor: Carlos Gustavo López Pombo. Graduated May 2013.