Mariano Miguel Moscato

Ph.D. in Computer Science

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WORK EXPERIENCE

National Institute of Aerospace

Address: 100 Exploration way, Hampton, VA 23666 | *Phone*: (757) 325-6904 | *Fax*: (757) 325-6701

– Sr. Research Scientist
JAN 2O19 - PRESENT

- Conducting research on formal verification of safety-critical systems as member of the NASA Formal Methods Group.
- Coordination of the program of researching visitors
- Main current research topics:
    - round-off analysis for floating-point programs
    - data type isomorphism in high-order logic
    - proof automation of non-linear arithmetic properties
    - formalization of termination criteria.

– Research Scientist II
DEC 2O16 – DEC 2018

– Research Scientist I
JAN 2016 - DEC 2016

– Postdoctoral Research Scholar
JUL 2014 - JAN 2016

Computer Science Dpt., School of Science, University of Buenos Aires
Address: 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 general 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.

Last update: May 19th, 2021

– Teaching Assistant
APR 2004 - 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 students of the C.S. career.

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.

EDUCATION

University of Buenos Aires

Address: 2160 Intendente Güiraldes, City of Buenos Aires, Argentina

– Doctor of Philosophy in Computer Science
2006 - 2014

Advisor: Professor Dr. Marcelo F. Frias.

Thesis Title: "Improvements to Interactive Theorem Proving of Alloy Properties Using SAT-Solving"

Thesis Committee:
- Dr. Daniel Jackson (Professor, Massachusetts Institute of Technology, USA),
- Dr. Natarajan Shankar (Principal Scientist, SRI International, USA), and
- Dr. Santiago Figueira (Professor, University of Buenos Aires, Argentina).

– Master of Science in Computer Science
2004 - 2005

Advisor: Dr. Verónica Becher (UBA) -- Co-Advisor: Dr. Santiago Figueira (UBA).

Thesis Title: "On the Algorithmic Entropy of Abstract Objects"

Thesis Committee:
- Dr. Marcelo Frias (Professor, University of Buenos Aires, Argentina),
- Dr. Jooz Heintz (Professor Emeritus, University of Buenos Aires, Argentina), and
- Sergio Mera (Teacher Assistant, University of Buenos Aires, Argentina).

– *Bachelor of Science in Computer Science*
1998 - 2003

PUBLICATIONS

1) **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.

2) **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

3) **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

4) **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.

5) **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*.*

6) **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.

7) **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.

8) **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.

9) **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.

10) **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.

11) **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.

12) **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.

13) **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.

14) **2016** (under evaluation) S. Gebreyohannes, W. Edmonson, A. Esterline & M. M. Moscato. Formalizing SysML Activity Diagrams in PVS. Submitted to Journal

15) **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.

16) **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.

17) **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.

18) **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.

19) **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.

20) **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.

21) **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.

22) **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.

23) **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

- **2020** Session Chair in the 12th NASA Formal Methods Symposium (NFM 2020), Moffett Field, CA, USA.

- **2018** National Institute of Aerospace Best Paper Award 2018 for: "A Formally Verified Floating-Point Implementation of the Compact Position Reporting Algorithm".

- **2015** Session Chair in the 6th International Conference on Interactive Theorem Proving (ITP 2015), Nanjing, China.

- **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.

SCHOLARSHIPS

- **2009** Two-year Scholarship for completion of PhD Studies, granted by the National Council of Science and Technology (CONICET). Advisor: Dr. M.F. Frias.

- **2005** Two-year PhD-Scholarship, granted by the Agency for the Promotion of Science and Technology, Ministry of Education, Argentina. Advisor: Dr. M.F. Frias.

GRANTS

- **2017** High-Integrity SAFIT - Unmanned Aircraft Systems Technology.
  (NASA SBIR 2017). Proposal Number: 171 A2.02-8360. P.I.: Ms. Sally Johnson.
  NASA Small Business Innovation Research/Small Business Technology Transfer.

- **2011 – 2014** Scalable Analysis of Models and Applications Based on SAT-Solving (PICT-2010-1690).
  P.I.: Dr. M.F. Frias. National Agency for Science and Technology Promotion, ANPCyT, Argentina.
  Granted: AR$ 250,000.00.

- **2008 – 2011** Software Analysis and Verification Based on SAT-Solving Techniques (UBACyT – 08 / X082).
  P.I.: Dr. M.F. Frias. University of Buenos Aires, Argentina. Granted: AR$ 34,500.00.

- **2008 – 2011** Scalable Software Analysis Using Techniques Based on SAT-Solving (PICT 2006-2484).
  P.I.: Dr. M.F. Frias. National Agency for Science and Technology Promotion – ANPCyT, Argentina.
  Granted: AR$ 256,653.00.

EVALUATION of the WORK of OTHERS

Participation in Program Committee of Conferences

- **2019** Member of the Program Committee for the 15th Latin American Computing Conference (CLEI 2019), September 30th-October 4th, 2019, City of Panamá, Panamá.

- **2018** Member of the Program Committee for the 9th International Conference on Interactive Theorem Proving (ITP2018), July 9-12, 2018, Oxford, UK.

- **2018** Member of the Program Committee for the Latin American Symposium on Theory of Computation (SLTC 2018), held as part of the 44th Latin American Computing Conference (CLEI 2018), October 1-5, 2018, São Paulo, Brazil.

- **2017** Member of the Program Committee of the Automated Formal Methods (AFM), May 19, 2017, NASA Ames Research Center, Moffett Field, CA, USA. http://fm.csl.sri.com/AFM17/

- **2017** Member of the Program Committee of the 5th Workshop on Proof Exchange for Theorem Proving (PxTP 2017) 23-24 September 2017, Brasilia, Brazil. https://pxtp.github.io/2017/

Evaluation of Proposals

- **2015** Evaluated research proposals as *external evaluator* for the Clemente Estable Fund of the National Agency for Research and Innovation (ANII), Uruguay.

- **2010** Evaluated company-developing grant proposals for the National Software Promotion Fund, Argentina.

Reviewed scientific papers for the following events:

1) **2020** 9th ACM SIGPLAN International Conference on Certified Programs and Proofs (CPP 2020), New Orleans, Louisiana, United States. Invited by PC Member: Dr. César Muñoz (cesar.a.munoz@nasa.gov).

2) **2017** 8th International Conference on Interactive Theorem Proving (ITP 2017), Brasília, Federal District, Brazil. Invited by PC Member: Dr. César Muñoz (cesar.a.munoz@nasa.gov).

3) **2017** 8th International Conference on Interactive Theorem Proving (ITP 2017), Brasília, Federal District, Brazil. Invited by PC Member: Dr. Aaron Dutle (aaron.m.dutle@nasa.gov).

4) **2017** Journal of Automated Reasoning (Springer). Special Issue: NFM 2016. Invited by Editor: Dr. César Muñoz (cesar.a.munoz@nasa.gov).

5) **2016** 5th International ABZ Conference (ABZ 2016), Linz, Austria. Invited by PC Member: Dr. César Muñoz (cesar.a.munoz@nasa.gov).

6) **2014** 22nd ACM SIGSOFT International Symposium on the Foundations of Software Engineering (FSE 2014), Hong Kong. Invited by PC Member: Dr. Victor Braberman (victor.braberman@gmail.com).

7) **2013** 10th International Symposium on Formal Aspects of Component Software (FACS 2013), Nanchang, China. Invited by PC Member: Dr. Marcelo Frias (mffrias@gmail.com).

8) **2011** 13th International Conference on Formal Engineering Methods (ICFEM 2011), Durham, UK. Invited by PC Member: Dr. Laura Kovacs (lkovacs@complang.tuwien.ac.at).

9) **2011** 33rd International Conference on Software Engineering (ICSE 2011), Honolulu, Hawaii, USA. Invited by PC Member: Dr. Sebastian Uchitel (suchitel@dc.uba.ar).

10) **2010** 17th Workshop on Logic, Language, Information and Computation (Wollic 2010), Brasilia, Brazil. Invited by PC Member: Dr. Verónica Becher (vbecher@dc.uba.ar).