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Personal Details:

Born August 1984; Romanian nationality.

I - Education

2019 **Habilitation à Diriger des Recherches (HDR)** at Université Toulouse III Paul Sabatier. *Validated symbolic-numeric algorithms and practical applications in aerospace.*

2008 - 2011 **PhD in Computer Science** at École Normale Supérieure de Lyon. *Rigorous polynomial approximations and applications.* Advisors: N. Brisebarre and J.-M. Muller.

2007 - 2008 **Master Diploma in Computer Science** at École Normale Supérieure de Lyon. Advisors: N. Brisebarre and J.-M. Muller.

2003 - 2008 **Engineer Diploma** obtained in June 2008 from Technical University of Cluj-Napoca, Computer Science Department.

II - Work

Jan 2013 - CNRS Researcher (CRCN, Section 06) in MAC Team (until Aug. 2019), ROC team (since Sept. 2019), LAAS-CNRS, Toulouse, France.

2011 - 2013 Postdoctorant, Computer-aided proofs in analysis (CAPA) Team, Uppsala Univ., Sweden.

III - Research

Keywords: **Rigorous/Validated Computing, Computer Arithmetic, Symbolic-Numeric Computing, Applications to Optimal Control and Aerospace**

Goals: Use numerical computations, but provide mathematical statements about the obtained result, such as sure, yet reasonably tight, error bounds. Build efficient symbolic-numeric objects, algorithms and software tools with direct application in control of dynamical systems and particularly the aerospace domain. Use and develop expertise and ideas from *Computer Arithmetic, Computer Algebra, Dynamical Systems*.

Invited conferences, seminars (selection)

- **February 2020:** Invited talk at Imperial/UCL Numerics Seminar, London, UK.
- **March 2019:** Invited talk at National Days of Informatics-Mathematics, (Journées du GDR IM), Orléans, France.
- **October 2018:** Invited talk at the conference Dynamics, Topology and Computations, Bedlewo, Poland.
- **October 2017:** Plenary talk at RAIM 2017: Rencontres Arithmétique de l'Informatique Mathématique, Lyon, France.
- **July 2017 :** Semi-plenary talk at Foundations of Computational Mathematics, FOCM2017, Barcelona, Spain.
- **May 2017 :** Invited talk at the Department of Mechanical & Aerospace Engineering, University of Strathclyde, Glasgow, UK.
- **September 2016 :** Plenary talk at SCAN conference, 17th International Symposium on Scientific Computing, Computer Arithmetics and Verified Numerics, Sweden.
- **August 2016 :** Talk at ACA, 20th IFAC Symposium on Automatic Control in Aerospace - 21-25 Août, 2016, Sherbrooke, Quebec, Canada.

- **July 2016** : Talk at 5th International Congress on Mathematical Software, Berlin.
- **April 2016** : Talk at Specfun Team Seminar Computations and Proofs, Inria Saclay, France.
- **March 2016** : Talk at Dali Team Seminar, Perpignan, France.
- **June 2015** : Talk at 2015 CMS Summer Meeting in Charlottetown, University of Prince Edward Island, Canada.
- **June 2015** : Talk at SIAM 13th International Symposium on Orthogonal Polynomials, Special Functions and Applications, Juin 1-5, NIST, Gaithersburg MD, USA.
- **June 2014** :Talk at ASAP conference, Zurich, Switzerland.
- **February 2014** : Talk at Mathematical Structures of Computation - Formal Proof, Symbolic Computation and Computer Arithmetic (SMC2014), Lyon, France.
- **November 2013** : Talk at "13ème forum des jeunes mathématicien-ne-s", Lyon, France.
- **Avril 2012**: Talk at National Institute of Aerospace, Hampton, Virginia, USA.

Software

- **CAMPARY** –Cuda Multiple Precision ARithmetic librarY–. Multiple precision arithmetic routines based on Floating-Point Expansions for CPUs/GPUs <http://homepages.laas.fr/mmjoldes/campary/>. Developed with O. Marty, J.-M. Muller, V. Popescu et W. Tucker.
- **Unifapprox** Experimental Maple code for Rigorous Uniform Approximation of D-Finite Functions using Chebyshev Expansions; <http://homepages.laas.fr/mmjoldes/Unifapprox/>. Developed with A. Benoit and M. Mezzarobba.
- **ChebModels**, Maple package for rigorous univariate polynomial approximations; <http://www.ens-lyon.fr/LIP/Arenaire/Ware/ChebModels/>. Developed with N. Brisebarre.

IV - Supervision

Students supervision: Starting 2013, I supervised or co-supervised 5 undergraduate internships, 5 master internships and 3 PhD theses.

PhD Students:

- 2016–2019 F. Bréhard, PhD defense on July 12, 2019, *Certified numerics in function spaces: Polynomial approximations meet computer algebra and formal proof*: co-supervision (40%) with N. Brisebarre and D. Pous (LIP, ÉNS Lyon).
- 2015– 2018 P.R. Arantes Gilz, PhD defense on Octobre 17, 2018, *Embedded and validated control algorithms for the spacecraft rendezvous*: co-supervision (50%) with C. Louembet (MAC, LAAS).
- 2014–2017 V. Popescu, PhD defense on July 6, 2017, *Towards Fast and Certified Multiple Precision Arithmetic Libraries*: co-supervision (50%) with J.-M. Muller (LIP, ÉNS Lyon).

Master internships:

- 2018-2019 M.-F. Montaruli, 6 months Master 2 internship: co-supervision (33%) with D. Arzelier et S. Laurens (CNES).
- 2018 D. Guého, 4 months Master 1 internship: co-supervision (40%) with S. Laurens (CNES), D. Arzelier and A. Rondepierre (ROC, LAAS).
- 2017 L. Martire, 6 months Master 2 internship: co-supervision (33%) with D. Arzelier and A. Rondepierre.
- 2016 F. Bréhard, 6 months Master 2 internship: supervision (100%).
- 2014 V. Popescu, 6 months Master 2 internship: supervision (100%).

Undergraduate internships (1.5 - 3 months) :

- 2018 A.-M. Nanes, co-supervision (30%) with J.-M. Muller and N. Brisebarre.
- 2015 N. Deak, co-supervision (40%) with D. Arzelier and C. Louembet.
- 2015 B. Fulop, co-supervision (70%) with N. Brisebarre.
- 2014 O. Marty, supervision (100%).
- 2013 V. Popescu, co-supervision (70%) with W. Tucker.

V - Teaching

- October 2018: Invited class (2h), Master 2 level, *Approximation Theory and Proof Assistants: Certified Computations*, Fundamental Informatics, ÉNS de Lyon, France.
- June 2018: Invited class (2h), PhD level, CEA-EDF-INRIA Summer School, Paris, France.
- January 2018: Invited class (3h), Master/PhD level at Winter Workshop on Dynamics, Topology and Computations, Bedlewo, Poland.
- 2014, 2015: Small classes (Travaux dirigés et travaux pratiques 6+2x24h), Master 1 level, C programming language, at l'Université Toulouse 3, Paul Sabatier.
- 2014, 2015: Course (2x5h), L2 level, Automatic Control at ENSICA Toulouse.
- 2012 : Qualification MdC in CNU Section 26 (Applied Mathematics) ad 27 (Computer Science).
- 2008-2011: Teaching assistant at ÉNS Lyon and Université Lyon 1.

VI - Collaborations, Research Projects, Scientific Transfer, Evaluation, Coordination

- March 2020 (Postponed) SQuaRE AIM (American Institute of Mathematics) project *Approximation Theory and Semidefinite Programming*. (Participant). The other participants are M. Dressler (Univ. of California, San Diego), E. de Klerk (Delft Univ.), J. B. Lasserre (LAAS-CNRS), Y. Xu (Univ. of Oregon). Project head: Simon Foucart (Texas A&M Univ.).
- 2014-2019 ANR FASTRELAX : *Fast and reliable approximation*. Project financed by French ANR. (Scientific responsible of LAAS-CNRS partner). Other partners: INRIA Grenoble Centre Rhône-Alpes, INRIA Saclay-Idf, INRIA-Centre Sophia Antipolis-Méditerranée, Université Pierre et Marie Curie (UPMC)-Paris 6. Project head: Bruno Salvy.
- 2016-2018 Research collaboration contract with Centre National d'Études Spatiales (CNES): *Global Collision Probability and Satellites Station Keeping*. (Project head). Other participants: D. Arzelier (LAAS-CNRS), J.-B. Lasserre (LAAS-CNRS), A. Rondepierre (LAAS-CNRS, IMT).
- 2013-2015 ANR VORACE : *Verification of fast optimization algorithms applied in critical embedded control*. (Participant). Other partners: INPT, ONERA, Rockwell Collins France. Project head: Marc Pantel (IRIT).
- 2012-2015 Research collaboration contract with Airbus Defence and Space: *Méthodes d'optimisation probabiliste pour l'évitement de collision spatiale*. (Participant). Project head: Denis Arzelier (LAAS-CNRS).

Reviewing: I have reviewed $\simeq 100$ articles for the following journals: ACM Transactions on Math Software, Automatica, IEEE Transactions in Computers, Mathematics in Computer Science, Numerical Algorithms, VLSI Journal, Communications in Nonlinear Science and Numerical Simulation, Nonlinear Dynamics, Journal of Approximation Theory, as well as the following conferences: ASAP, Arith, ISSAC, SYNASC. I was member of the Program Committee of the following conferences: SYNASC2016, ISSAC2017, ARITH2019.

PhD Juries:

- Reviewer (Principal Opponent) of F. M. Bartha's Phd Thesis, *Computer-aided proofs and algorithms in analysis*, Bergen Univ., Math Department, Norway, June 14, 2013;
- Member of R. Serra's Phd Thesis committee, *In-orbit Servicing: Collision Risk Assessment and Optimal Maneuvers for Collision Avoidance and Rendezvous*, defended 10-12-2015 in Toulouse, INSA, LAAS-CNRS;
- Member of G. Rance's Phd Thesis committee, *Commande H-infinie paramétrique et application aux viseurs gyro-stabilisés*, defended 9-07-2018 at Centrale Supélec, France.

Conference Organization:

- 2018-2020 Co-organizer of Journées Nationales de Calcul Formel, CIRM, Luminy, France, <http://www.jncf2019.uvsq.fr/>.
- 2017 Publicity and Media Chair of IFAC –International Federation of Automatic Control 2017.
- 2016 Organizer of the *Computer Arithmetic* session for RAIM 2016 : 8ème Rencontres Arithmétique de l'Informatique Mathématique, Banyuls-sur-mer (France).
- 2014 Organizer of the *Symbolic-Numeric* session at SEAMAC Days (MAC Team seminar).

Exhaustive List of Publications

Books

- [B1] J.-M. Muller, N. Brunie, F. de Dinechin, C.-P. Jeannerod, M. Joldes, V. Lefèvre, G. Melquiond, N. Revol, and S. Torres, *Handbook of Floating-Point Arithmetic*. Birkhäuser, 2018.

International peer-reviewed journals

- [J1] N. Brisebarre, M. Joldes, J.-M. Muller, A.-M. Naneş, and J. Picot, “Error analysis of some operations involved in the Cooley-Tukey Fast Fourier Transform,” *ACM Trans. Math. Softw.*, vol. 46, May 2020. <https://hal.archives-ouvertes.fr/hal-01949458/file/Bounds-FFT-HAL.pdf>.
- [J2] P. R. Arantes Gilz, M. Joldes, C. Louembet, and F. Camps, “Stable Model Predictive Strategy for Rendezvous Hovering Phases Allowing for Control Saturation,” *Journal of Guidance, Control, and Dynamics*, vol. 42, no. 8, pp. 1658–1675, 2019. <https://hal.archives-ouvertes.fr/hal-01678768>.
- [J3] F. Bréhard, N. Brisebarre, and M. Joldes, “Validated and numerically efficient Chebyshev spectral methods for linear ordinary differential equations,” *ACM Transactions on Mathematical Software (TOMS)*, vol. 44, no. 4, p. 44, 2018. <https://hal.archives-ouvertes.fr/hal-01526272/>.
- [J4] M. Joldes, J.-M. Muller, and V. Popescu, “Tight and rigorous error bounds for basic building blocks of double-word arithmetic,” *ACM Transactions on Mathematical Software (TOMS)*, vol. 44, no. 2, p. 15, 2017. <https://hal.archives-ouvertes.fr/hal-01351529v3>.
- [J5] A. Benoit, M. Joldes, and M. Mezzarobba, “Rigorous uniform approximation of D-finite functions using Chebyshev expansions,” *Mathematics of Computation*, vol. 86, no. 305, pp. 1303–1341, 2016. <https://hal.archives-ouvertes.fr/hal-01022420>.
- [J6] R. Serra, D. Arzelier, M. Joldes, J.-B. Lasserre, A. Rondepierre, and B. Salvy, “Fast and accurate computation of orbital collision probability for short-term encounters,” *Journal of Guidance, Control, and Dynamics*, vol. 39, no. 5, pp. 1009–1021, 2016. <https://hal.archives-ouvertes.fr/hal-01132149/>.
- [J7] M. Joldes, O. Marty, J.-M. Muller, and V. Popescu, “Arithmetic algorithms for extended precision using floating-point expansions,” *IEEE Transactions on Computers*, vol. 65, pp. 1197–1210, April 2016. <https://hal.archives-ouvertes.fr/hal-01111551v2>.
- [J8] M. Joldes, V. Popescu, and W. Tucker, “Searching for sinks for the Hénon map using a multiple-precision GPU arithmetic library,” *SIGARCH Comput. Archit. News*, vol. 42, no. 4, pp. 63–68, 2014. <https://hal.archives-ouvertes.fr/hal-00957438>.
- [J9] S. Chevillard, J. Harrison, M. Joldes, and C. Lauter, “Efficient and accurate computation of upper bounds of approximation errors,” *Theoretical Computer Science*, vol. 16, no. 412, pp. 1523–1543, 2011.

Publications in the peer-reviewed proceedings of international conferences

- [C1] M. Joldes and B. Paşca, “Efficient Floating-Point Implementation of the Probit Function on FPGAs,” in *Application-specific Systems, Architectures and Processors (ASAP), 2020 IEEE 31st International Conference on*, pp. –to appear–, 2020.
- [C2] M. Joldes and J.-M. Muller, “Algorithms for manipulating quaternions in floating-point arithmetic,” in *Computer Arithmetic (ARITH), 2020 IEEE 27th Symposium on*, pp. –to appear–, 2020. <https://hal.archives-ouvertes.fr/hal-02470766/>.
- [C3] D. Arzelier, F. Bréhard, and M. Joldes, “Exchange algorithm for evaluation and approximation error-optimized polynomials,” in *Computer Arithmetic (ARITH), 2019 IEEE 26th Symposium on*, pp. 30–37, 2019. <https://hal.archives-ouvertes.fr/hal-02006606/>.
- [C4] F. Bréhard, M. Joldes, and J.-B. Lasserre, “On moment problems with holonomic functions,” in *Proceedings of the 2019 on International Symposium on Symbolic and Algebraic Computation, ISSAC ’19*, (New York, NY, USA), pp. 66–73, ACM, 2019. Distinguished Paper Award, <https://hal.archives-ouvertes.fr/hal-02006645>.

- [C5] R. Serra, D. Arzelier, F. Bréhard, and M. Joldes, “Fuel-optimal impulsive fixed-time trajectories in the linearized circular restricted 3-body-problem,” in *IAF Astrodynamics Symposium in 69TH international astronomical congress*, pp. 1–9, 2018. <https://hal.archives-ouvertes.fr/hal-01830253>.
- [C6] F. Camps, P. R. A. Gilz, M. Joldes, and C. Louembet, “Embedding a SDP-based control algorithm for the orbital rendezvous hovering phases,” in *Proceedings of the IEEE International Conference on Integrated Navigation Systems, Jun 2018, Saint Petersburg, Russia*. 10.23919/ICINS.2018.8405931, pp. 1–7, IEEE, 2018. <https://hal.laas.fr/hal-01729956>.
- [C7] M. Joldes, J.-M. Muller, and V. Popescu, “Implementation and performance evaluation of an extended precision floating-point arithmetic library for high-accuracy semidefinite programming,” in *Computer Arithmetic (ARITH), 2017 IEEE 24th Symposium on*, pp. 27–34, IEEE, 2017. <https://hal.archives-ouvertes.fr/hal-01491255/>.
- [C8] S. Boldo, M. Joldes, J.-M. Muller, and V. Popescu, “Formal verification of a floating-point expansion renormalization algorithm,” in *International Conference on Interactive Theorem Proving*, pp. 98–113, Springer, 2017. <https://hal.archives-ouvertes.fr/hal-01512417/document>.
- [C9] P. R. A. Gilz, M. Joldes, C. Louembet, and F. Camps, “Model predictive control for rendezvous hovering phases based on a novel description of constrained trajectories,” in *IFAC-PapersOnLine*, vol. 50, pp. 7229–7234, Elsevier, 2017. <https://hal.laas.fr/hal-01484764>.
- [C10] D. Arzelier, F. Bréhard, N. Deak, M. Joldes, C. Louembet, A. Rondepierre, and R. Serra, “Linearized impulsive fixed-time fuel-optimal space rendezvous: A new numerical approach,” in *Proceedings of the 20th IFAC Symposium on Automatic Control in Aerospace, 21-25 August, 2016, Sherbrooke, Quebec, Canada*, vol. 49, pp. 373–378, 2016. <https://hal.archives-ouvertes.fr/hal-01275427>.
- [C11] S. Collange, M. Joldes, J.-M. Muller, and V. Popescu, “Parallel floating-point expansions for extended-precision GPU computations,” in *Proceedings of ASAP 2016: The 27th Annual IEEE International Conference on Application-specific Systems, Architectures and Processors, 6-8 July 2016, London, England*, pp. 139–146, IEEE, 2016. <https://hal.archives-ouvertes.fr/hal-01298206>.
- [C12] F. Bréhard, N. Brisebarre, and M. Joldes, “A new efficient algorithm for computing validated Chebyshev approximations solutions of linear differential equations,” in *SCAN 2016: 17th International Symposium on Scientific Computing, Computer Arithmetic and Verified Numerics, Uppsala, Sweden, Sept. 2016*, pp. 41–43, 2016.
- [C13] M. Joldes, J.-M. Muller, V. Popescu, and W. Tucker, “Campary: Cuda multiple precision arithmetic library and applications,” in *Mathematical Software – ICMS 2016: 5th International Conference, Berlin, Germany, July 11-14, 2016, Proceedings* (G.-M. Greuel, T. Koch, P. Paule, and A. Sommese, eds.), (Cham), pp. 232–240, Springer International Publishing, 2016. <https://hal.archives-ouvertes.fr/hal-01312858>.
- [C14] R. Serra, D. Arzelier, M. Joldes, J.-B. Lasserre, A. Rondepierre, and B. Salvy, “A new method to compute the probability of collision for short-term space encounters,” in *Astrodynamics Specialist Conference*, pp. 1–7, Aug 2014.
- [C15] R. Serra, D. Arzelier, M. Joldes, and A. Rondepierre, “Probabilistic collision avoidance for long-term space encounters via risk selection,” in *Advances in Aerospace Guidance, Navigation and Control*, pp. 679–698, Springer, Dec 2015. <https://hal.archives-ouvertes.fr/hal-01995936/document>.
- [C16] M. Joldes, J. Muller, and V. Popescu, “On the computation of the reciprocal of floating point expansions using an adapted Newton-Raphson iteration,” in *IEEE 25th International Conference on Application-Specific Systems, Architectures and Processors, ASAP 2014, Zurich, Switzerland, June 18-20, 2014*, pp. 63–67, IEEE, 2014. <https://hal.archives-ouvertes.fr/docs/00/95/73/79/PDF/invNewton.pdf>.
- [C17] N. Brisebarre, M. Joldes, É. Martin-Dorel, M. Mayero, J. Muller, I. Pasca, L. Rideau, and L. Théry, “Rigorous polynomial approximation using Taylor Models in Coq,” in *NASA Formal Methods - 4th International Symposium, NFM 2012, Norfolk, VA, USA, April 3-5, 2012. Proceedings* (A. Goodloe and S. Person, eds.), vol. 7226 of *Lecture Notes in Computer Science*, pp. 85–99, Springer, 2012.

- [C18] N. Brisebarre, M. Joldes, P. Kornerup, É. Martin-Dorel, and J. Muller, “Augmented precision square roots and 2-d norms, and discussion on correctly rounding $\sqrt{x^2+y^2}$,” in *20th IEEE Symposium on Computer Arithmetic, ARITH 2011, Tübingen, Germany, 25-27 July 2011* (E. Antelo, D. Hough, and P. Jenne, eds.), pp. 23–30, IEEE Computer Society, 2011.
- [C19] N. Brisebarre and M. Joldes, “Chebyshev interpolation polynomial-based tools for rigorous computing,” in *Symbolic and Algebraic Computation, International Symposium, ISSAC 2010, Munich, Germany, July 25-28, 2010, Proceedings* (W. Koepf, ed.), pp. 147–154, ACM, 2010.
- [C20] F. de Dinechin, M. Joldes, and B. Pasca, “Automatic generation of polynomial-based hardware architectures for function evaluation,” in *21st IEEE International Conference on Application-specific Systems Architectures and Processors, ASAP 2010, Rennes, France, 7-9 July 2010* (F. Charot, F. Hannig, J. Teich, and C. Wolinski, eds.), pp. 216–222, IEEE, 2010.
- [C21] F. de Dinechin, M. Joldes, B. Pasca, and G. Revy, “Multiplicative square root algorithms for FPGAs,” in *International Conference on Field Programmable Logic and Applications, FPL 2010, August 31 2010 - September 2, 2010, Milano, Italy*, pp. 574–577, IEEE, 2010.
- [C22] S. Chevillard, M. Joldes, and C. Q. Lauter, “Sollya: An environment for the development of numerical codes,” in *Mathematical Software - ICMS 2010, Third International Congress on Mathematical Software, Kobe, Japan, September 13-17, 2010. Proceedings* (K. Fukuda, J. van der Hoeven, M. Joswig, and N. Takayama, eds.), vol. 6327 of *Lecture Notes in Computer Science*, pp. 28–31, Springer, 2010.
- [C23] S. Chevillard, M. Joldes, and C. Q. Lauter, “Certified and fast computation of supremum norms of approximation errors,” in *19th IEEE Symposium on Computer Arithmetic, ARITH 2009, Portland, Oregon, USA, 9-10 June 2009* (J. D. Bruguera, M. Cornea, D. D. Sarma, and J. Harrison, eds.), pp. 169–176, IEEE Computer Society, 2009.

Publications in the peer-reviewed proceedings of national conferences

- [NC1] M. Joldes, V. Popescu, and W. Tucker, “Searching for sinks of Hénon map using a multiple-precision GPU arithmetic library,” in *Forum des Jeunes Mathématicien-ne-s*, p. 6, Nov 2013.
- [NC2] M. Joldes, “When a logarithm is a misspelled algorithm,” in *Proceedings of the Association Femmes et mathématiques*, Sept. 2010.
- [NC3] F. de Dinechin, M. Joldes, B. Pasca, and G. Revy, “Racines carrées multiplicatives sur FPGA,” in *SYMposium en Architectures nouvelles de machines (SYMPA)*, (Toulouse), Sept. 2009.

Articles under submission, research reports

- [R1] M. Joldes, *Validated symbolic-numeric algorithms and practical applications in aerospace*. Habilitation à Diriger des Recherches, Université Toulouse III Paul Sabatier. <http://homepages.laas.fr/mmjoldes/HDR/HDR.pdf>.
- [R2] D. Arzelier, F. Bréhard, M. Joldes, J.-B. Lasserre, M. Léo, and A. Rondepierre, “Global probability of collision: Problem modeling via occupation measures,” Tech. Rep. Version 2.0, LAAS-CNRS, June 2018. CNES Research and Transfer Contract, <https://hal.laas.fr/hal-02077552>.
- [R3] M. Joldes, *Rigorous Polynomial Approximations and Applications*. Thèse, École Normale Supérieure de Lyon - ENS LYON, Sept. 2011. <https://tel.archives-ouvertes.fr/tel-00657843>.