Thibaut Verron

Post-doctoral researcher, Johannes Kepler University

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Research interests

- Computer algebra, algorithms for commutative algebra and algebraic geometry
- Polynomial system solving, Gröbner bases, signature-based algorithms
- Algorithmic and algebraic structures of polynomial systems
- Tropical Gröbner bases, Gröbner bases for Tate series, Gröbner bases over rings
- Algorithms for real algebraic geometry
- D-finite functions and sequences
- Combinatorics

Employment

2017 – 2021 **Post-doctoral researcher at JKU (Linz, Austria)**
Supervisor: Manuel Kauers (Institute for Algebra)
Keywords: computer algebra, algorithmic combinatorics, D-finite functions

2016 – 2017 **Post-doctoral researcher at INP-ENSEEIHT (Toulouse, France)**
Supervisors: Joseph Gergaud, Olivier Cots
(Team *Parallel algorithms and optimization*)
Keywords: optimal control

Education and diplomas

2017 **French qualification to work as an assistant professor**
Sections 25 (Mathematics), 26 (Applied mathematics) and 27 (Computer science)

2012 – 2016 **Ph.D thesis, University Pierre et Marie Curie (Paris, France)**
Computer science

2011 – 2012 **Masters degree, University Paris-Sud 11 (Orsay, France)**
Pure and Applied Mathematics, specialty Algebra, Analysis and Geometry

2009 – 2013 **École Normale Supérieure de Paris (France)**
Diploma of the ENS, Major in Mathematics, minor in Computer Science

Ph.D. thesis

Dates September 2012 – September 2016 (defense: 26 September 2016)

Location PolSys team, LIP6, Université Pierre et Marie Curie (Paris, France)

Supervisors Jean-Charles Faugère, Mohab Safey El Din

Title Regularization of Gröbner basis computations for weighted and determinantal systems, and an application to medical imagery

Keywords polynomial systems; Gröbner bases; structured systems; weighted-homogeneous systems; determinantal systems; real algebraic geometry

Committee

Director	Jean-Charles Faugère	Research director, Inria
Advisor	Mohab Safey El Din	Professor, UPMC
Reviewer	Laurent Busé	Researcher, Inria, HdR
Reviewer	Bruno Salvy	Research director, Inria
Examiner	Bernard Bonnard	Professor, Université de Bourgogne
Examiner	Stef Graillat	Professor, UPMC

Publications

Journal papers

1. Tristan Vaccon, Thibaut Verron, and Kazuhiro Yokoyama. "On affine tropical F5 algorithms". In: *Journal of Symbolic Computation* 102 (Jan. 2021), pp. 132–152. DOI: 10.1016/j.jsc.2019.10.012

2. Bernard Bonnard, Olivier Cots, Jérémy Rouot, and Thibaut Verron. "Time minimal saturation of a pair of spins and application in Magnetic Resonance Imaging". In: *Mathematical Control & Related Fields* 10.1 (2020), pp. 47–88. DOI: 10.3934/mcrf.2019029

3. Maria Francis and Thibaut Verron. "A Signature-Based Algorithm for Computing Gröbner Bases over Principal Ideal Domains". In: *Mathematics in Computer Science* 14.2 (Dec. 2019), pp. 515–530. DOI: 10.1007/s11786-019-00432-5

4. Jean-Charles Faugère, Mohab Safey El Din, and Thibaut Verron. "On the complexity of computing Gröbner bases for weighted homogeneous systems". In: *Journal of Symbolic Computation* 76 (2016), pp. 107–141. DOI: 10.1016/j.jsc.2015.12.001

Conference papers

5. Alin Bostan, Manuel Kauers, and Thibaut Verron. "The generating function for Kreweras walks with interacting boundaries is not algebraic". In: *Formal Power Series and Algebraic Combinatorics 2021 (accepted for a poster)* (2021). arXiv: 2012.00816 [math.CO]

6. Xavier Caruso, Tristan Vaccon, and Thibaut Verron. "Signature-based algorithms for Gröbner bases over Tate algebras". In: *Proceedings of the 45th International Symposium on Symbolic and Algebraic Computation* (July 2020). DOI: 10.1145/3373207.3404035

7. Shaoshi Chen, Lixin Du, Manuel Kauers, and Thibaut Verron. "Integral bases for P-recursive sequences". In: *Proceedings of the 45th International Symposium on Symbolic and Algebraic Computation* (July 2020). DOI: 10.1145/3373207.3404004

8. Xavier Caruso, Tristan Vaccon, and Thibaut Verron. "Gröbner Bases Over Tate Algebras". In: *Proceedings of the 2019 International Symposium on Symbolic and Algebraic Computation* (July 2019). DOI: 10.1145/3326229.3326257

9. Tristan Vaccon, Thibaut Verron, and Kazuhiro Yokoyama. "On Affine Tropical F5 Algorithms". In: *Proceedings of the 2018 ACM International Symposium on Symbolic and Algebraic Computation - ISSAC '18* (July 2018). DOI: 10.1145/3208976.3209012

10. Bernard Bonnard, Jean-Charles Faugère, Alain Jacquemard, Mohab Safey El Din, and Thibaut Verron. "Determinantal Sets, Singularities and Application to Optimal Control in Medical Imagery". In: *Proceedings of the 41st ACM International Symposium on Symbolic and Algebraic Computation - ISSAC '16* (2016). DOI: 10.1145/2930889.2930916

11. Jean-Charles Faugère, Mohab Safey El Din, and Thibaut Verron. "On the complexity of computing Gröbner bases for quasi-homogeneous systems". In: *Proceedings of the 38th ACM International Symposium on Symbolic and Algebraic Computation - ISSAC '13* (2013). DOI: 10.1145/2465506.2465943

Note on the conferences:

- The *International Symposium on Symbolic and Algebraic Computations* (ISSAC) is the reference conference in computer algebra. Presentations are selected after peer-review, and articles are published in proceedings.
- *Formal Power Series and Algebraic Combinatorics* (FPSAC) is a well-regarded conference in algebraic combinatorics. Articles are selected for presentation in a talk or as a poster after a unique peer-review process, and published in proceedings.

Other publications

12. Manuel Kauers and Thibaut Verron. "Why you should remove zeros from data before guessing". In: *ACM Communications in Computer Algebra* 53.3 (Dec. 2019). Extended abstract of a poster presented at ISSAC 2019, pp. 126–129. DOI: 10.1145/3377006.3377017

Preprints

13. Maria Francis and Thibaut Verron. *On Two Signature Variants Of Buchberger's Algorithm Over Principal Ideal Domains*. 2021. arXiv: 2102.03339 [cs.SC]

14. Xavier Caruso, Tristan Vaccon, and Thibaut Verron. *On FGLM Algorithms With Tate Algebras*. 2021. arXiv: 2102.05324 [cs.SC]

15. Maria Francis and Thibaut Verron. *Signature-based Möller's Algorithm for strong Gröbner Bases over PIDs*. Jan. 2019. arXiv: 1901.09586 [cs.SC]

16. Bernard Bonnard, Olivier Cots, Jean-Charles Faugère, Alain Jacquemard, Jérémy Rouot, Mohab Safey El Din, and Thibaut Verron. *Algebraic-geometric techniques for the feedback classification and robustness of the optimal control of a pair of Bloch equations with application to Magnetic Resonance Imaging*. 2017. HAL: hal-01556806

Software

Tate Algebras

- SageMath package for working with Tate series over $\mathbb{Z}_p$ and $\mathbb{Q}_p$
- Implementation of algorithms presented at ISSAC 2019 and ISSAC 2020
- Distributed with SageMath since version 8.5 (22/12/2018)
- 5200 lines of code (Python, Cython)
- Joint development with X. Caruso and T. Vaccon
- Link: https://doc.sagemath.org/html/en/reference/power_series/sage/rings/tate_algebra.html.

Integral bases in Ore algebras

- Addition of functions to compute integral bases in quotients of Ore algebras, to the Sagemath package `ore_algebra` (developed and maintained by M. Kauers)
- Implementation of algorithms presented at ISSAC 2020
- 700 new lines of code (Python)
- Joint development with M. Kauers
- Link: https://github.com/mkauers/ore_algebra

Signature Gröbner bases over PIDs

- Toy implementation in Magma of signature-enabled versions of Möller's algorithms for computing Gröbner bases over PIDs
- Implementation of algorithms presented at *Applications of Computer Algebra* 2018 and *SIAM conference on Applied Algebraic Geometry* 2019
- 1600 lines of code (Magma)
- Link: https://gitlab.com/thibaut.verron/signature-groebner-rings

Real algebraic classification algorithms for determinantal varieties

- Implementation in Maple of algorithms computing a classification of the real singularities of determinantal varieties
- Implementation of algorithms presented at ISSAC 2016
- 450 lines of code (Maple)
- Example run on an application to optimal control in medical imagery
- Joint development with M. Safey El Din
- Link: https://sourcesup.renater.fr/www/mercurey/

Communications

Conference talks

- *Signature-based algorithms for Gröbner bases over Tate algebras*. International Symposium on Symbolic and Algebraic Computation (ISSAC). Kalamata, Greece (online), 2020. URL: https://youtu.be/pDDY9ChBYAw
- *Algorithmes avec signatures pour le calcul de bases de Gröbner sur les algèbres de Tate*. Journées Nationales de Calcul Formel 2020. CIRM, Luminy, France, 2020
- *Gröbner bases over Tate algebras*. International Symposium on Symbolic and Algebraic Computation (ISSAC). Beihang University, Beijing, China, 2019
- *Signature-based Möller's algorithm for strong Gröbner bases over PIDs*. SIAM Conference on Applied Algebraic Geometry, Mini-symposium "Algebraic methods for polynomial system solving solving". University of Bern, Bern, Switzerland, 2019
- *Algorithme de Möller avec signatures pour le calcul de bases de Gröbner fortes à coefficients dans un anneau principal*. Journées Nationales de Calcul Formel 2019. CIRM, Luminy, France, 2019
- *Signature-based criteria for computing weak Gröbner bases over PIDs*. 24th Conference on Applications of Computer Algebra (ACA 2018), session "Algorithms for zero-dimensional ideals". University of Santiago de Compostela, Santiago de Compostella, Spain, 2018
- *Méthodes algébriques pour le contrôle optimal en Imagerie à Résonance Magnétique*. 8^{e} Biennale Française des Mathématiques Appliquées et Industrielles (SMAI 2017), Mini-symposium "Contrôle et applications". La Tremblade, France, 2017
- *Determinantal set, singularities and application to optimal control in medical imagery*. International Symposium on Symbolic and Algebraic Computation (ISSAC). Wilfrid Laurier University, Waterloo, Canada, 2016
- *Algebraic classification related to contrast optimization for MRI*. Journées annuelles du GdR Mathématiques de l'Optimisation et Applications 2015. IMB, Université de Bourgogne, Dijon, France, 2015
- *Classification algébrique associée à l'optimisation de contraste pour l'IRM*. Journées Nationales de Calcul Formel 2015. ENSAM, Cluny, France, 2015
- *Complexité du calcul de bases de Gröbner pour les systèmes homogènes avec poids*. Journées Nationales de Calcul Formel 2014. CIRM, Luminy, France, 2014
- *Bases de Gröbner et systèmes structurés*. Rencontres doctorales Henri Lebesgue 2014. IRMAR, Rennes, France, 2014
- *On the complexity of computing Gröbner bases for quasi-homogeneous systems*. International Symposium on Symbolic and Algebraic Computation (ISSAC). Northeastern University, Boston, USA, 2013
- *Complexité du calcul de bases de Gröbner pour les systèmes quasi-homogènes*. Journées Nationales de Calcul Formel 2013. CIRM, Luminy, France, 2013

In addition, I have presented my work in many seminars in France, Austria and Germany.

Posters

- Manuel Kauers and Thibaut Verron. *Why you should remove zeros from data before guessing*. International Symposium on Symbolic and Algebraic Computation (ISSAC). Beihang University, Beijing, China, 2019

Teaching experience

2018 – 2020 : Guest lecturer / teaching assistant in Mathematics, JKU, Linz (Austria)

- **Lecture** (planned): *Mathematics for AI 2*
  (Bachelor level, half semester, 30h, ∼340 students)
  Preparation of lecture contents and lecture notes, preparation and grading of exams, coordination of the teaching team
- **Special lecture**: *Computer Algebra 2*
  (Accessible from bachelor level, 15 lectures, 30h)
  Preparation of lecture notes, final evaluation on programming exercises as homework
- **Exercise sessions**: *Linear Algebra for computer scientists*
  (Bachelor level, 60h)
  Preparation of exercise sheets, preparation and grading of exams, online teaching

2016 – 2017 : Teaching assistant in Applied Mathematics, INP Toulouse (France)

- **Programming sessions**: *Ordinary Differential Equations* (Python with Scipy, Matlab)
  (Bachelor level, 26h)
  Evaluation of mini-projects (based on a short interview and written report)

2013 – 2016 : Teaching assistant in Computer Science, UPMC, Paris (France)

- **Exercise and programming sessions**: *Working environment*, *Databases*
  (Bachelor level, 129h)
  Participation in the preparation of the exams, setup of a framework for automated correction of the homework and exams, grading of homework throughout the semester and of finals, preparation and grading of short written tests
- **Programming sessions**: *Introduction to programmation* (Python), *Scientific computing* (C), *Computer Architecture* (Asm)
  (Bachelor level, 60h)
  Grading of homework throughout the semester

Service

- **Software presentation award committee** for the International Symposium on Symbolic and Algebraic Computation (ISSAC) 2019
- **Poster chair** for the 6th International Congress on Mathematical Software (ICMS), 2018
- **Reviewer** for SODA, JSC, FPSAC, MACIS...

Other information

- **Languages**: French (native), English (fluent), German (advanced), Russian, Turkish (basic)
- **Programming languages**: Python, C, C++, OCaml, Haskell
- **Computer algebra**: Sage, Magma, Maple, Mathematica
- **Others**: Bash, Emacs Lisp, LaTeX, Manim