

Thibaut Verron

Senior post-doctoral researcher, Johannes Kepler University

Date of birth: 21 March 1991

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1 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

2 Education and employment

- 2021 – 2023 Senior post-doctoral researcher at JKU (Linz, Austria)**
PI of the project: “Weighted homogeneous structure of polynomial equations”
Keywords: computer algebra, structured polynomial systems
- 2017 – 2021 Post-doctoral researcher at JKU (Linz, Austria)**
Supervisor: Manuel Kauers
Keywords: computer algebra, algorithmic combinatorics, D-finite functions
- 2017 French qualification to work as an assistant professor**
Sections 25 (Mathematics), 26 (Applied mathematics) and 27 (Computer science)
- 2016 – 2017 Post-doctoral researcher at INP-ENSEEIH (Toulouse, France)**
Supervisors: Joseph Gergaud, Olivier Cots
Keywords: optimal control
- 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

3 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	Senior researcher, Inria
Advisor	Mohab Safey El Din	Professor, UPMC
Reviewer	Laurent Busé	Researcher, Inria, habilitated
Reviewer	Bruno Salvy	Senior researcher, Inria
Examiner	Bernard Bonnard	Professor, Université de Bourgogne
Examiner	Stef Graillat	Professor, UPMC

4 Publications

4.1 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](https://doi.org/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](https://doi.org/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](https://doi.org/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](https://doi.org/10.1016/j.jsc.2015.12.001)

4.2 Conference papers

5. Xavier Caruso, Tristan Vaccon, and Thibaut Verron. “On FGLM Algorithms with Tate Algebras”. In: *Proceedings of the 2021 International Symposium on Symbolic and Algebraic Computation* (July 2021). doi: [10.1145/3452143.3465521](https://doi.org/10.1145/3452143.3465521)
6. Maria Francis and Thibaut Verron. “On Two Signature Variants of Buchberger’s Algorithm over Principal Ideal Domains”. In: *Proceedings of the 2021 International Symposium on Symbolic and Algebraic Computation* (July 2021). doi: [10.1145/3452143.3465522](https://doi.org/10.1145/3452143.3465522)

7. Alin Bostan, Manuel Kauers, and Thibaut Verron. “The generating function for Kreweras walks with interacting boundaries is not algebraic”. In: *Séminaire Lotharingien de Combinatoire* 85B (2022). Proceedings of Formal Power Series and Algebraic Combinatorics 2021. arXiv: [2012.00816 \[math.CO\]](#)
8. 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](#)
9. 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](#)
10. 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](#)
11. 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](#)
12. 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](#)
13. 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](#)

4.3 Other publications

14. 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](#)

4.4 Preprints

15. Thibaut Verron. *On the computation of Gröbner bases for pluriweighted-homogeneous systems*. 2022. arXiv: [2202.05742 \[cs.SC\]](#)
16. Xavier Caruso, Tristan Vaccon, and Thibaut Verron. *On Polynomial Ideals And Overconvergence In Tate Algebras*. 2022. arXiv: [2202.07509 \[cs.SC\]](#)
17. Clemens Hofstadler and Thibaut Verron. *Signature Gröbner bases, bases of syzygies and cofactor reconstruction in the free algebra*. 2021. arXiv: [2107.14675v1 \[cs.SC\]](#)
18. Maria Francis and Thibaut Verron. *Signature-based Möller’s Algorithm for strong Gröbner Bases over PIDs*. 2019. arXiv: [1901.09586 \[cs.SC\]](#)
19. 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](#)

5 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)
- 5 200 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
- 2000 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, *SIAM conference on Applied Algebraic Geometry* 2019 and ISSAC 2021
- 5 000 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/>

6 Communications

6.1 Conference talks

- *Integral bases for P-recursive sequences.* 26th Conference on Applications of Computer Algebra (ACA 2021), session "Algebraic and Algorithmic Aspects of Differential and Integral Operators Session". Online, 2021
- *On FGLM algorithms for Tate algebras.* International Symposium on Symbolic and Algebraic Computation (ISSAC). Saint-Petersburg, Russia (online), 2021
- *Algorithme FGLM pour les algèbres de Tate.* Journées Nationales de Calcul Formel 2021. CIRM, Luminy, France (online), 2021
- *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.

6.2 Posters

- Alin Bostan, Manuel Kauers, and Thibaut Verron. *The generating series for interacting Kreweras walks is not algebraic*. Formal Power Series and Algebraic Combinatorics (FPSAC'21). University of Ramat Gan, Ramat Gan, Israel, 2022
- 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

6.3 Dissemination of scientific knowledge

- Co-animation of the station of the Institute for Algebra (JKU, Linz) at the *Long Night of Research 2018* (Austria-wide night with vulgarisation and open-doors events in research institutions): animation of mathematical games for children and families

7 Teaching experience

2018 – 2021 : Guest lecturer / teaching assistant in Mathematics, JKU, Linz (Austria)

- **Lecture:** *Mathematics for AI 2*
(Bachelor level, half semester, 30h, ~200 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:** *Algebra for computer scientists*
(Bachelor level, 90h)
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 programming (Python), Scientific computing (C), Computer Architecture (Asm)*
(Bachelor level, 60h)
Grading of homework throughout the semester

8 Projects managed

- **Weighted homogeneous structure of polynomial equations** (October 2021 – September 2023)
(Standalone project P34872 of the *Austrian Science Fund* (FWF), 161k€ covering the salary of the PI (24 man-months at the “senior post-doc” level) and travel costs)
The project concerns the study of polynomial systems which are weighted homogeneous for several systems of weights, and systems which are homogeneous for systems of weights where some of the weights are zero or negative. Those structures are very general, encompassing the known cases of homogeneous, weighted homogeneous and multi-homogeneous systems. The project intends to design and implement algorithms for computing Gröbner bases taking this structure into account. A goal is to obtain algorithms with satisfactory complexity bounds, which will require understanding regularity properties for the structured systems. Among the applications we hope to tackle is the design of algorithms with intrinsic complexity bounds for polynomial elimination.

9 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...

10 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

11 References

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- **J.-C. Faugère**, Senior researcher, Inria Paris, Paris, France
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- **M. Francis**, Assistant Professor, Indian Institute of Technology, Hyderabad, India
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