Thibaut Verron

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

2024 –	**Software developer at Mindbreeze GmbH (Linz, Austria)**
2022	**French requalification to work as an associate professor** Mathematics, Applied mathematics and Computer science
2021 – 2023	**Senior post-doctoral researcher at JKU (Linz, Austria)** PI of the project: "Weighted homogeneous structure of polynomial equations" Keywords: computational algebra, structured polynomial systems
2017 – 2021	**Post-doctoral researcher at JKU (Linz, Austria)** Supervisor: Manuel Kauers Keywords: computational algebra, algorithmic combinatorics, D-finite functions
2017	**French qualification to work as an associate professor** Mathematics, Applied mathematics and Computer science
2016 – 2017	**Post-doctoral researcher at INP-ENSEEIHT (Toulouse, France)** Supervisors: Joseph Gergaud, Olivier Cots Keywords: optimal control, dynamical systems
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 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 intended to design and implement algorithms for computing Gröbner bases taking this structure into account. A goal was to obtain algorithms with satisfactory complexity bounds, which will require understanding regularity properties for the structured systems. Among the applications we hoped to tackle is the design of algorithms with intrinsic complexity bounds for polynomial elimination.

The project has resulted in three algorithms for computing Gröbner bases while taking the structure into account, and a comparison on their differences and overlaps, as well as early results on the regularity of the systems and its consequences on the complexity. In a second phase, the project has focused on applications of the weighted structure, and has yielded in algorithms for tropical geometry, and algorithms suitable for polynomial elimination in two new contexts.

5 Publications

For all publications, the authors are listed in alphabetical order, as is usual in the community. The reference publication venues in computational algebra are the conference *International Symposium on Symbolic and Algebraic Computation* (ISSAC), and the *Journal of Symbolic Computation* (JSC). Traditionally, in this field, conferences represent the main peer-review publication channel, and high-profile conferences such as ISSAC are reputed more competitive and prestigious than journals. Those conferences offer a dynamical platform for broadcasting new contributions, engage in scientific discussions, and altogether advance our collective knowledge of computational algebra.

5.1 Journal papers

1. Thibaut Verron. "On the computation of Gröbner bases for matrix-weighted homogeneous systems". In: *Journal of Symbolic Computation* (Apr. 2024). DOI: 10.1016/j.jsc.2024.102327

2. Clemens Hofstadler and Thibaut Verron. "Short proofs of ideal membership". In: *Journal of Symbolic Computation* (Apr. 2024). DOI: 10.1016/j.jsc.2024.102325

3. Clemens Hofstadler and Thibaut Verron. "Signature Gröbner bases, bases of syzygies and cofactor reconstruction in the free algebra". In: *Journal of Symbolic Computation* 113 (Nov. 2022), pp. 211–241. DOI: 10.1016/j.jsc.2022.04.001

4. 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

5. 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

6. 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

7. 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

5.2 Conference papers (with peer-review and proceedings)

8. Tristan Vaccon and Thibaut Verron. "Universal Analytic Gröbner Bases and Tropical Geometry". In: *Proceedings of the 2023 International Symposium on Symbolic and Algebraic Computation*. ISSAC 2023. ACM, July 2023. DOI: 10.1145/3597066.3597110

9. Clemens Hofstadler and Thibaut Verron. "Signature Gröbner bases in free algebras over rings". In: *Proceedings of the 2023 International Symposium on Symbolic and Algebraic Computation*. ISSAC 2023. ACM, July 2023. DOI: 10.1145/3597066.3597071

10. Manuel Kauers, Christoph Koutschan, and Thibaut Verron. "Transcendence Certificates for D-finite Functions". In: *Proceedings of the 2023 International Symposium on Symbolic and Algebraic Computation*. ISSAC 2023. ACM, July 2023. DOI: 10.1145/3597066.3597091

11. Xavier Caruso, Tristan Vaccon, and Thibaut Verron. "On Polynomial Ideals and Overconvergence in Tate Algebras". In: *Proceedings of the 2022 International Symposium on Symbolic and Algebraic Computation*. ISSAC '22. ACM, July 2022. DOI: 10.1145/3476446.3535491

12. 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

13. 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

14. 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]

15. 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

16. 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

17. 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

18. 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

19. 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`

20. 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`

5.3 Other publications

21. 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`

5.4 Preprints

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

23. 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`

6 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

- The algorithms were 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 (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/

Magma-mode for Emacs

- Package for the Emacs text editor, for editing Magma source code and interacting with the Magma software

- 4000 lines of code (Emacs lisp)

- Link: https://melpa.org/#/magma-mode

7 Communications

7.1 Conference talks

- *Universal Analytic Gröbner Bases and Tropical Geometry.* International Symposium on Symbolic and Algebraic Computation (ISSAC). Tromsø, Norway, 2023

- *Using signature Gröbner bases to find short ideal representations.* SIAM Conference on Applied Algebraic Geometry, Mini-symposium "Multivariate Polynomials, Ideals, and Modules: Algorithms and Applications". Eindhoven, The Netherlands, 2023

- *How to certify the transcendence of D-finite functions?* Journées Nationales de Calcul Formel 2023. CIRM, Luminy, France, 2023

- *Signature Gröbner bases and cofactor computation in the free algebra.* Journées Nationales de Calcul Formel 2022. CIRM, Luminy, France, 2022

- *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$^{\text{e}}$ 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. IR-MAR, 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.

7.2 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

7.3 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

8 Teaching experience

2018 – 2023 : Guest lecturer / teaching assistant in Mathematics, JKU, Linz (Austria)

- **Co-advisor for a bachelor thesis**, together with Manuel Kauers

- **Lecture**: *Mathematics for AI 2*
  (Bachelor level, half semester, 30h, $\sim$200 students)
  Preparation of 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*, *Mathematics for physicists 2*
  (Bachelor level, 240h)
  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

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, ISSAC, FPSAC, MACIS…

10 Other information

- **Languages**: French (native), English (fluent), German (advanced), Swedish, Russian, Turkish (basic)

- **Programming languages**: Python, C, C++, OCaml, Haskell

- **Computer algebra**: Sage, Magma, Maple, Mathematica

- **Others**: Bash, Emacs Lisp, LaTeX, Manim

11 References

- **B. Bonnard**, Professor, Université de Bourgogne, Dijon, France
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