Rizeng Chen

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Education

Peking University (PKU) Beijing, China
School of Mathematical Sciences Sept. 2021 - Present

- Ph.D. in Mathematics

Beihang University (BUAA) Beijing, China
Hua Loo-keng Honorary Class, School of Mathematics Sciences Sept. 2017 - June 2021

- B.Sc in Mathematics

Teaching

As **Teaching Assistant** in **Peking University**

- **Advanced Algebra II** (**2022 Spring**, **2023 Spring**, **2024 Spring**, **2025 Spring**), School of Mathematical Sciences
  I graded the exercises and exam papers. I also taught the tutoring sessions.
- **Linear Algebra C** (**2021 Fall**), School of Mathematical Sciences
  I graded the exercises and exam papers.

Research Interests

- **Computational Algebraic Geometry**
- **Real Algebraic Geometry**
- **Symbolic Computation**
- **Computability** of Mathematical Theory

Publications

- **Chen, R.** (2025, February). What Kind of Morphisms Induces Covering Maps over a Real Closed Field? *arXiv preprint arXiv:2502.05834.*
  This paper proposes a new family of morphisms between varieties, namely the q-étale morphisms (= flat + finitely and constantly many geometric points in fibers). It is shown in the paper that q-étale morphisms become finite étale after reduction, therefore induce covering maps on the real points for real varieties.
- **Chen, R.**, & Xia, B. Reduction of Transcendental Decision Problems over the Reals. *In Proceedings of the 2024 International Symposium on Symbolic and Algebraic Computation* (pp. 56-64).
  This paper shows that reduction can be widely performed in a class of problems called "Trigonometric Extension", which generalizes our previous result. Some new decidability results, including a special kind of reachability problem, are derived from the reduction (conditional on Schanuel's Conjecture).

Last Update: April 1, 2025.

- **Chen, R.** (2023, November). A Geometric Approach to Cylindrical Algebraic Decomposition. *arXiv:2311.10515.* Accepted by *Mathematics of Computation*

  This paper is about the geometry behind the cylindrical algebraic decomposition (CAD, a classical construction in real algebraic geometry). We discovered a link between real and complex algebraic geometry: for a finite free morphism of real varieties, the geometric fiber size (geometric property) decides the existence of semi-algebraic continuous sections (semi-algebraic property). From the link, a new algorithm for CAD that can exploit all equations is developed. The new algorithm largely outperforms the existing methods.

  Slogan: Understanding something ℂomplex is the beginning of knowing it for ℝeal (pun intended).

- **Chen, R.**, & Xia, B. (2023, July). Deciding first-order formulas involving univariate mixed trigonometric-polynomials. *In Proceedings of the 2023 International Symposium on Symbolic and Algebraic Computation* (pp. 145-154).

  This paper is about the computability of the first-order theory of univariate mixed trigonometric-polynomials. We prove that this theory is surprisingly unconditionally decidable and a decision algorithm is proposed in the paper.

- **Chen, R.**, Li, H., Xia, B., Zhao, T., & Zheng, T. (2024). Isolating all the real roots of a mixed trigonometric-polynomial. *Journal of Symbolic Computation*, 121, 102250.

  This paper is about a real root isolation algorithm for rational univariate mixed trigonometric-polynomials.

Misc.

- I enjoy coding. The algorithms in my papers are all implemented and the code can be found at my GitHub page.
- I used to participate in competitive programming before going to university, but that was long ago.
- I like cats.

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