curriculum vitæ of

Mohit Kumar Tekriwal

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Research interests

I am interested in programming languages, type theory, formal verification, numerical analysis, and large language models for proof engineering. My current research work is on applying formal methods to the field of scientific computing, robotics and additive manufacturing.

Education

2018– 2023	**Ph.D.** in Aerospace engineering	University of Michigan, Ann Arbor
2018 – 2020	**M.Sc.** in Aerospace engineering (GPA: 3.85/4)	University of Michigan, Ann Arbor
2014 – 2018	**B.Tech** in Aerospace engineering (GPA: 9.0/10)	Indian Institute of Technology, Kanpur

Publications

Conference and Journal Publications

1. V. K. Suman, Siva Viknesh S.,**Mohit K. Tekriwal**, Swagata Bhaumik, Tapan K. Sengupta. **"Grid sensitivity and role of error in computing a lid-driven cavity problem"**. In *Phys. Rev. E 99, 013305.* https://link.aps.org/doi/10.1103/PhysRevE.99.013305

2. **Mohit K. Tekriwal**, Karthik Duraisamy, Jean-Baptiste Jeannin. **"A formal proof of the Lax equivalence theorem in finite difference schemes"** [NFM 2021]. https://doi.org/10.1007/978-3-030-76384-8_20

3. Heiko Becker, **Mohit K. Tekriwal**, Eva Darulova, Anastasia Volkova, Jean-Baptiste Jeannin. **"Certified approximation of transcendental functions".** *In Interactive Theorem Proving conference (ITP), 2022.* 10.4230/LIPIcs.ITP.2022.6

4. **Mohit K. Tekriwal**, Ariel Kellison, Jean-Baptiste Jeannin, Geoffrey Hulette. **"Towards Verified Rounding-Error Analysis for Stationary Iterative Methods"**. *In Correctness workshop, 2022.*

5. **Mohit K. Tekriwal**, Andrew W. Appel, Ariel E. Kellison, David Bindel, Jean-Baptiste Jeannin. **"Verified Correctness, Accuracy, and Convergence of a Stationary Iterative Linear Solver: Jacobi Method"**. *In 16th Conference on Intelligent Computer Mathematics, 2023.*

6. Ariel E. Kellison, Andrew W. Appel, **Mohit K. Tekriwal**, David Bindel. **"LAProof: a library of formal accuracy and correctness proofs for sparse linear algebra programs"**. *In 30th IEEE International Symposium on Computer Arithmetic, 2023.*

Under review

1. **Mohit K. Tekriwal**, Joshua Miller, Jean-Baptiste Jeannin. **"Formal verification of iterative convergence for numerical solutions of differential equations".** https://doi.org/10.48550/arXiv.2202.05587.

2. **Mohit K. Tekriwal**, Avi Tachna-Fram, Jean-Baptiste Jeannin, Manos Kapritsos, Dimitra Panagou. **"Formally verified asymptotic consensus in robust networks".** https://doi.org/10.48550/arXiv.2202.13833.

Skills

- Programming Languages: C, C++, OCaml, Rust
- Software and Utilities: MATLAB, TecPlot, Coq Proof Assistant, HOL4 theorem prover, Frama-C, Microsoft office suite, AutoCad, SolidWorks, LabVIEW
- Operating System: Linux, Windows, Mac

Service To The Scientific Community

Student Volunteer — **Verification Mentoring Workshop**, Computer Aided Verification(CAV) 2020.

Reviewing — **Artifact Evaluation committee:** CAV 2021, Architectural Support for Programming Languages and Operating Systems (ASPLOS) 2022.

Research Experience

Sept.2018– Aug. 2023 **Formal Verification of Numerical schemes**
Advisor: Prof. Jean-Baptiste Jeannin, Dept. of Aerospace Engineering, University of Michigan

- Formalized the Lax–equivalence theorem in Coq
- Formally verified the convergence properties of classical iterative methods in Coq
- Explored light weight verification techniques like Frama-C/VST to carry verification at the code level
- Developed a mechanized error analysis framework for end-to-end verification of numerical programs

Jun. 2022–Aug. 2022 **Verified QR factorization algorithm**
Manager: Randy Lober, Sandia National Laboratories

- Worked on formalization of the QR factorization algorithm
- Formalized properties of Givens rotation algorithm for QR factorization

Jun. 2021–Aug. 2021 **Certified approximation of Transcendental functions**
Advisor: Prof. Eva Darulova, formerly at MPI-SWS, currently at the University of Uppsala

- Worked on formalization of the Remez algorithm for approximation of transcendental functions in HOL4 theorem prover
- Implemented a first version of the certificate checker in a static analysis tool, Daisy
- Formalized the McLaurin series approximation of transcendental functions and root finding methods in HOL4 theorem prover

May 2017–Jul. 2017 **Active Flow Control for Drag Reduction in wall bounded Turbulent Flows**
Mentor: Prof. Mitul Luhar, Dept. of Aerospace and Mechanical Engineering, University of Southern California, Los Angeles

- Addressed challenges associated with feedback flow control that include development of a robust control law, and development of small and reliable actuators
- Implemented Genetic Algorithm (GA) based techniques to find optimal values of PID control law constants
- Fabricated a prototype of a piston-based actuator using 3-D printing

Aug. 2017–May 2018 **Instability and receptivity studies in Lid Driven Cavity Problem**
Mentor: Prof. Tapan K Sengupta, Dept. of Aerospace Engineering, Indian Institute of Technology, Kanpur, India

- Simulated and analyzed flow in a 2D Lid Driven Cavity
- Successfully obtained a narrow range of optimal excitation amplitude responsible for onset of temporal instabilities in the system for Reynolds number in the range: 8000 - 8660
- Carried Flow visualization studies and post processing using TecPlot

Teaching Experience

Fall–2019, Fall–2020 **Graduate Student Instructor** AEROSP 495: Introduction to Aerospace computing

I was responsible for grading homework, take home examinations and conducting office hours. I was also in-charge of weekly labs for the course, and delivered a couple of lectures in the class.
Student feedback rating: 4.6/5.0

Honors

2022 **Chateaubriand fellowship**
Awarded the fellowship to conduct a part of my PhD research in France.

2021 **Max Planck research fellowship**
Awarded the fellowship for summer research internship at MPI-SWS

2018 **General Proficiency Medal**
Awarded for the best academic performance in the graduating batch of Aerospace engineering

2018 **Proficiency Medal**
Awarded for the best undergraduate Project in the graduating batch of Aerospace engineering department

2017 **SN Bose Scholarship**
Selected for summer internship program in the United States of America. A total of 50 students from 78 reputed institutions in India, were selected for this award.

2016–2017 **Academic Excellence award**

2014 **Kishore Vaigyanik Protsahan Yojna (KVPY) Fellowship**

Coursework

- Compiler Construction
- Inference, Estimation and Learning
- Data driven modeling of Complex systems
- Advanced Programming Languages
- Formal Verification of Software and Hardware systems
- Linear Systems theory
- Non-linear Systems theory
- Computational Fluid Dynamics
- Optimization methods in engineering applications
- Applied numerical methods

Extracurricular Activities

Apr. 2016–Apr. 2017 **Coordinator, Astronomy Club, IIT Kanpur**

- Responsible for maintenance of OAAR (Observatory for Astronomical Research), fully automated 10 feet state- of- the-art computerized telescope
- Initiated and guided sophomore and freshman students on projects like auto focuser for obtaining sharp images and photometric studies using CCD camera
- Successfully organized inter college astronomy fest and inter IIT astronomy meet