

PROMOTION RECOMMENDATION
The University of Michigan
College of Engineering
Department of Mechanical Engineering

Vikram Gavini, associate professor of mechanical engineering, with tenure, Department of Mechanical Engineering, and associate professor of materials science and engineering, without tenure, Department of Materials Science and Engineering, College of Engineering, is recommended for promotion to professor of mechanical engineering, with tenure, Department of Mechanical Engineering, and professor of materials science and engineering, without tenure, Department of Materials Science and Engineering, College of Engineering.

Academic Degrees:

Ph.D.	2007	California Institute of Technology, Mechanical Engineering, Pasadena, CA
M.S.	2004	California Institute of Technology, Applied Mechanics, Pasadena, CA
B.Tech.	2003	Indian Institute of Technology, Madras, Mechanical Engineering, Chennai, India

Professional Record:

2013 – present	Associate Professor (with tenure), Department of Mechanical Engineering, University of Michigan
2013 – present	Associate Professor (without tenure), Department of Materials Science and Engineering, University of Michigan
2008 – present	Faculty Affiliate, Program in Applied Physics, University of Michigan
2007 – 2013	Assistant Professor, Department of Mechanical Engineering, University of Michigan

Summary of Evaluation:

Teaching: Professor Gavini is a compassionate and engaging teacher, advisor, and mentor. He teaches several courses at the graduate and undergraduate levels, including ME 211, Introduction to Solid Mechanics and ME 382, Behavior of Materials, which are two of the highest attended introductory courses on north campus. His consistently highly rated teaching evaluation scores, for both courses, are indicators of a sustained record of teaching excellence. Professor Gavini has significantly revised ME 501, now named Mathematical Methods in Mechanical Engineering, which is a core graduate course in mathematical methods. He also developed a new, advanced graduate-level course, ME 599, Materials Physics, which provides a firm background in Quantum Mechanics and derives various materials theories used in computational materials science. Professor Gavini is committed and dedicated to his students. He has advised eight Ph.D. students (three as co-chair) to graduation, and has mentored three M.S. and three undergraduate students. He is currently advising three Ph.D. students, and one undergraduate student. He has also mentored two outstanding post-doctoral researchers, who have received external recognition. Professor Gavini has always believed in the philosophy of ‘no student being left behind,’ and his students consistently applaud his availability, inclusivity, and patience in and out of the classroom.

Research: Professor Gavini has established a world-leading research program in computational methods for large scale electronic structure computations and calculations. He is using these methods to understand materials properties and behavior, and recently released the open source density functional theory code (DFT-FE) that is being downloaded at an increasing rate (over 200 clones in nine months). His specific contributions involve solving the problems that have limited the use of the Kohn-Sham DFT, the forerunner of computational quantum mechanical models, in the advancement of science through electronic structure calculations. He is known internationally as the pre-eminent researcher who has enabled the solution of important engineering problems involving crystalline solids at the atomic scale. He has published over 30 full articles in prominent journals, including *Physical Review*, *Journal of The Minerals, Metals & Materials Society*, *Journal of the Mechanics and Physics of Solids*, and *Journal of Computational Physics*. Professor Gavini's funding sources include the National Science Foundation, Department of Energy, Department of Defense, and the Toyota Research Institute. Regard for his research is evidenced by numerous awards, including being selected as one of two finalists for the Gordon Bell Prize for 2019, which is the most prestigious competitive award in the world of high-performance scientific computing.

Recent and Significant Publications:

- S. Das, V. Gavini, "Electronic structure study of screw dislocation core energetics in Aluminum and core energetics informed forces in a dislocation aggregate," *Journal of the Mechanics and Physics of Solids*, 104:115-143, 2017.
- P. Motamarri, V. Gavini, "Configurational forces in electronic structure calculations using Kohn-Sham density functional theory," *Physical Review B*, 97: 165132, 2018.
- P. Motamarri, S. Das, S. Rudrarajub, K. Ghosha, D. Davydovc, V. Gavini, "DFT-FE: A massively parallel adaptive finite-element code for large-scale density functional theory calculations," *Computer Physics Communications*, arXiv:1903.10959, 2019.
- B. Kanungo, P. Zimmerman, V. Gavini, "Exact exchange-correlation potentials from ground-state electron densities," *Nature Communications*, 10, 4497, 2019.
- S. Das, P. Motamarri, V. Gavini, B. Turcksin, Y.-W Li, B. Leback, "Fast, Scalable and Accurate Finite-Element Based Ab Initio Calculations Using Mixed Precision Computing: 46 PFLOPS Simulation of a Metallic Dislocation System," *Proceedings of SC19, The International Conference for High Performance Computing, Networking, Storage, and Analysis*, 2019.

Service: Professor Gavini has an extensive service record within the university, as well as externally. He currently serves on the ME Information Technology Committee (as chair since 2015), and has served on ME's Department Seminar Committee and served as the chair of the Faculty Search Committee, 2015-2017. He has served on the College of Engineering Undergraduate Mathematics Curriculum Committee and the university's Steering Committee and Management Committee of the Michigan Institute for Computational Discovery and Engineering (MICDE). Professor Gavini has served his scientific community well having co-organized 11 minisymposia in reputable technical meetings and conferences, including the SIAM meeting on Mathematical Aspects of Materials Science, the U.S. National Congress on Computational Mechanics, and the Society of Engineering Sciences annual meeting. He has served as a guest editor for the *International Journal of Multiscale Computational Engineering* and a guest co-editor for the *Journal of Materials Research*. He has served as a proposal

reviewer for DOE, ARO, and NSF, among others, and has reviewed manuscripts for several leading journals such as *Science*, *NanoLetters*, and the *Journal of the American Chemical Society*.

External Reviewers:

Reviewer A: “I have high regard for the quality of the research Vikram does and the scholarly impact it is having.”

Reviewer B: “Dr. Gavini has a strong expertise in both atomic-scale materials science and high-performance scientific computing.... Dr. Gavini is now recognized as a leader in the field of computational materials science...”

Reviewer C: “He currently can be considered the world leader on quasicontinuum-type methods based on accurate atomic forces.... Gavini is the top scientist worldwide who is pushing the boundaries of Mechanical Engineering into areas of quantum mechanics.”

Reviewer D: “...Vikram Gavini has established himself as an international leader in mechanical engineering, materials science, mechanics of materials, computational mechanics and computational materials science, with seminal breakthroughs to his credit.”

Reviewer E: “Prof. Gavini’s works are of the highest quality. His papers are consistently original, rigorous, and highly detailed.... his focus has stayed squarely on pushing back the current limits of both system complexity and accuracy attainable in quantum mechanical materials calculations.”

Summary of Recommendation: Professor Gavini is a dedicated and ambitious teacher and mentor. He has established a world-leading research program in computational methods for electronic structure computations. He has an extensive service record within the university, as well as externally. It is with the support of the College of Engineering Executive Committee that I recommend Vikram Gavini for promotion to professor of mechanical engineering, with tenure, Department of Mechanical Engineering, and professor of materials science and engineering, without tenure, Department of Materials Science and Engineering, College of Engineering.



Alec D. Gallimore, Ph.D.
Robert J. Vlasic Dean of Engineering
College of Engineering

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