

Rajat Arora

RESEARCH SCIENTIST · SOFTWARE DEVELOPMENT

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Education

Carnegie Mellon University (CMU)

Pittsburgh, PA

PH.D. IN COMPUTATIONAL MECHANICS, GPA: 4.0

Jul. 2015 - Feb. 2019

- Dissertation: Computational Approximation of Mesoscale Field Dislocation Mechanics (MFDM) at Finite Deformation
- Advisor: Prof. Amit Acharya

M.S. IN COMPUTATIONAL MECHANICS, GPA: 4.0

Jul. 2015 - Dec. 2017

Indian Institute of Technology (IIT) Kanpur

Kanpur, India

M.TECH. IN MECHANICAL ENGINEERING, GPA: 9.7/10

Jan. 2013 - Oct. 2014

- Dissertation: Shape Evolution of Precipitates using Extended Finite Element Method Coupled with Level Set Method
- Advisor: Prof. Anurag Gupta

B.TECH. IN MECHANICAL ENGINEERING, GPA: 8.2/10

Jul. 2009 - Oct. 2014

Professional Appointments

3+ Y.O.E.

Siemens Corporate Technology

Princeton, NJ

RESEARCH SCIENTIST: COMPUTATIONAL AND APPLIED MATHEMATICS

Aug. 2020 - Present

- Focus on developing AI-assisted simulations tools in the field of materials science and mechanics of materials. Languages: C++ and Python.
- Develop and implement Physics-Informed Neural Networks to solve nonlinear differential equations to accelerate battery design.

Ansys, Inc.

Pittsburgh, PA

RESEARCH & DEVELOPMENT ENGINEER II

Mar. 2019 - Jul. 2020

- Lead developer (C++) of the digital twin development framework used for generating cross-platform digital twins.
- Develop and maintain core solver (C++) for physics-based, high-fidelity, circuit and system simulation software.
 - Added support for multiple linear algebra solvers to improve simulation convergence and speed.
 - Enabled multi-threaded output of high volume complex data collection to improve simulation speed and reduce data file size.

Eaton Technologies Pvt. Ltd.

Pune, India

ENGINEER

Aug. 2014 - Jan. 2015

- Performed bearing analysis using ROMAX software to optimize bearing life for various parameters: lubrication, clearance, misalignment

Academic Appointments

Carnegie Mellon University

Pittsburgh, PA

GRADUATE RESEARCH ASSISTANT

Jun. 2015 - Feb. 2019

- Developed (C++) a massively parallel finite element based theoretical-computational framework for modeling elasto-plastic deformation in metals
- The theory fundamentally accounts for static and dynamic (stress and energy) fields of dislocation distributions and their non-uniform spatio-temporal evolution at finite strain.

Indian Institute of Technology Kanpur

Kanpur, India

GRADUATE RESEARCH ASSISTANT

Jan. 2013 - Oct. 2014

- Developed framework in C++ to analyze morphological evolution of arbitrarily shaped precipitates coherently embedded in a matrix.
- The approach involved coupling Extended Finite Element Method (XFEM) with PDE based Level Set Method (LSM) to capture interfacial motion.

Independent Projects

- Optimized code for parallel and distributed programming models to run on Bridges supercomputer to obtain 3X improvement in performance.
- Employed Automatic Differentiation using Sacado to solve a non-linear minimal surface equation

- Learned and Implemented Isogeometric Analysis to solve Laplace equation in a $2d$ domain
- Contributed to development of open source FEM package *Deal.II*

Teaching Experience

CARNEGIE MELLON UNIVERSITY

- Introduction to Civil Engineering
- Engineering Mechanics

Pittsburgh, PA
Spring 2017 & 2018
Spring 2016

INDIAN INSTITUTE OF TECHNOLOGY KANPUR

- Design of Machine Elements
- Experiments in Solid Mechanics

Kanpur, India
Spring 2014
Fall 2013

Honors & Awards

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| 2018 | Fenves Travel Grant , Civil Engineering Department, CMU | Pittsburgh, PA |
| 2015 | Dean's Fellowship , Civil Engineering Department, CMU | Pittsburgh, PA |
| 2014 | Inclusion & Diversity Council Member , Eaton | Pune, India |
| 2012 | Boeing Research Scholarship , IIT Kanpur | Kanpur, India |
| 2012 | 5th Place , Robotics Competition, IIT Bombay | Mumbai, India |
| 2010 | 3rd Award , Robotics Competition, IIT Kanpur | Kanpur, India |
| 2010 | 3rd Award , Electronics Competition, IIT Kanpur | Kanpur, India |
| 2009 | Rank 761 , IIT Joint Entrance Examination among over 0.4 million aspirants | India |
| 2009 | 99.42 percentile , All India Engineering Entrance Exam (AIEEE) among over 1 million aspirants | India |
| 2008 | Rank 671 , Uttar Pradesh State Entrance Examination (UPSEE) among over 0.25 million aspirants | India |

Journal Articles

A unification of finite deformation J_2 Von-Mises plasticity and quantitative dislocation mechanics

R. ARORA, A. ACHARYA

Journal of the Mechanics and Physics of Solids p. 104050. Elsevier, 2020

Dislocation pattern formation in finite deformation crystal plasticity

R. ARORA, A. ACHARYA

International Journal of Solids and Structures 184 pp. 114–135. Elsevier, 2020

Finite element approximation of finite deformation dislocation mechanics

R. ARORA, X. ZHANG, A. ACHARYA

Computer Methods in Applied Mechanics and Engineering 367 p. 113076. Elsevier, 2020

Equilibrium shape of misfitting precipitates with anisotropic elasticity and anisotropic interfacial energy

T. JOSHI, R. ARORA, A. BASAK, A. GUPTA

Modelling and Simulation in Materials Science and Engineering 28.7 p. 075009. IOP Publishing, 2020

Technical Publications

RAJAT ARORA. **Shape Evolution of Precipitates using Extended Finite Element Method Coupled with Level Set Method.** Master's thesis, Indian Institute of Technology Kanpur, Department of Mechanical Engineering, Kanpur, India. 2014.

RAJAT ARORA. **Computational Approximation of Mesoscale Field Dislocation Mechanics at Finite Deformation.** Ph.D. thesis, Carnegie Mellon University, Department of Civil & Environmental Engineering, Pittsburgh, PA. 2019.

Technical Presentations

1. Field Dislocation Mechanics

Mechanical Engg. Dept. Colloquium, IIT Bombay, Mumbai, India, Nov. 2019

2. **Finite Deformation Mesoscale Field Dislocation Mechanics**
International Mechanical Engineering Congress & Exposition 2019, Salt Lake City, Utah, Nov. 2019
3. **Dislocation patterning in Finite Deformation Dislocation Mechanics and toward plasticity without phenomenological assumptions**
Dislocations 2019, Haifa, Israel, Sept. 2019
4. **Finite Deformation Mesoscale Field Dislocation Mechanics**
XV Conference on Computational Plasticity, Fundamentals and Applications, Barcelona, Spain, Sept. 2019
5. **Finite Deformation Mesoscale Field Dislocation Mechanics**
Multiscale Materials Modeling, Osaka, Japan, Oct. 2018
6. **Computational Approximation of Mesoscale Field Dislocation Mechanics (MFDM) at Finite Deformation**
World Congress of Computational Mechanics (WCCM), New York, NY, Jul. 2018
7. **Computational Approximation of Mesoscale Field Dislocation Mechanics (MFDM) at Finite Deformation**
Society of Industrial and Applied Mathematics, Portland, OR, Jul. 2018
8. **Finite Deformation Mesoscale Field Dislocation Mechanics**
Physics and Mechanics of Random Structures: From morphology to material properties, Conference in honor of Dominique Jeulin, Peninsula of Oléron, France, Jun. 2018
9. **Finite Deformation Mesoscale Field Dislocation Mechanics**
Euromech symposium on Micromechanics of Defects, Sevilla, Spain, Jun. 2018
10. **Towards modeling longitudinally propagating shear bands**
Nonconvexity, Nonlocality and Incompatibility: From Materials to Biology, Pittsburgh, PA, May. 2017

Invited Talks

1. **Computational Approximation of Mesoscale Field Dislocation Mechanics at Finite Deformation**
Siemens Corporate Technology, Princeton, NJ, Feb. 2020
2. **Computational Approximation of Mesoscale Field Dislocation Mechanics at Finite Deformation**
Ansys, Inc., Canonsburg, PA, Dec. 2018

Workshops

- One day **OpenMP** workshop organized by *XSEDE HPC* *Oct. 2016*
- Two day training session on **Scientific Visualization** organized by *XSEDE HPC* *Oct. 2016*
- Two day workshop on **MPI** conducted by *XSEDE HPC* *Sept. 2015*
- Participant **Future Faculty Program**, Eberly center for Teaching Excellence & Educational Innovation, CMU *Aug. 2015 - Feb. 2019*

Program Committees

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| 2014 | Member , Inclusion & Diversity Council, Eaton | <i>Pune, India</i> |
| 2013 | Technical Head , Science & Technology Council, IIT Kanpur | <i>Kanpur, India</i> |
| 2012 | Overall Coordinator , IIT Kanpur Science & Technology Championship, IIT Kanpur | <i>Kanpur, India</i> |
| 2011 | Coordinator , Electronics Club, Science & Technology Council, IIT Kanpur | <i>Kanpur, India</i> |

Professional Service Activities

- Active **contributor** to the Deal.II repository, an open-source Finite Element library *2015 - Present*
- **Reviewer** for the journals: a) Materials Science and Technology, and b) Computational Mechanics.

Skills

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| Programming | C/C++, Python, MATLAB, \LaTeX |
| Computational | Git, PyTorch, TensorFlow, PETSc, Deal.II, P4est, VTK, High Performance Computing (OpenMP, MPI) |