

# 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

## Skills

<b>Programming</b>	C/C++, Python, MATLAB
<b>Computational</b>	Git, PyTorch, TensorFlow, High Performance Computing (OpenMP, MPI, CUDA), Data Visualization, Cloud Deployment
<b>Software</b>	Autodesk Inventor, SolidWorks, ANSYS Mechanical, Abaqus

## Professional Appointments

3+ Y.O.E.

### Siemens Corporation, Technology

Princeton, NJ

RESEARCH SCIENTIST: PHYSICS AWARE ARTIFICIAL INTELLIGENCE

Aug. 2020 - Present

- Develop Physics-Informed Neural Network to study elastic-viscoplastic behaviour of metals under different temperature and loading rate conditions.
  - Research aims to speed-up scientific computing and accelerate battery design. Research paper in preparation.
- Developed physics-informed super-resolution framework to reconstruct high-resolution data from low-resolution data on coarse mesh
  - Research work published in 1st Annual AAAI Workshop on AI to Accelerate Science and Engineering (AI2ASE)

### 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 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.

- 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*

## Honors & Awards

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

## Journal Articles

### MACHINE LEARNING

- **Physics-Informed Neural Networks for elastic-viscoplastic loading**  
R. ARORA, P. KAKKAR, B. DEY, A. CHAKRABARTY. *In Preparation*, 2021.
- **Super-resolution in computational solid mechanics without high resolution labels. Part I: Hyperelasticity**  
R. ARORA. *In Preparation*, 2021.
- **Machine learning-accelerated computational solid mechanics: Application to linear elasticity**  
R. ARORA. *1st Annual AAAI Workshop on AI to Accelerate Science and Engineering (AI2ASE)*

### MECHANICS OF MATERIALS

- **Confronting modeling and simulation with a critical experimental test of strain gradient plasticity**  
A. ARORA, R. ARORA, A. ACHARYA. *In Preparation*, 2021.
- **Dislocation pattern formation in finite deformation crystal plasticity**  
R. ARORA, A. ACHARYA. *International Journal of Solids and Structures*, 2020.
- **Finite element approximation of finite deformation dislocation mechanics**  
R. ARORA, X. ZHANG, A. ACHARYA. *Computer Methods in Applied Mechanics and Engineering*, 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*, 2020.
- **A unification of finite deformation  $J_2$  Von-Mises plasticity and quantitative dislocation mechanics.**  
A. ARORA, A. ACHARYA. *Journal of the Mechanics and Physics of Solids*, 2020.

## 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