Vignesh **Babu Rao**

PH.D. CANDIDATE · FRACTURE MECHANICS AND DEEP LEARNING

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Education

M.S./Ph.D. Mechanical Engineering
UNIVERSITY OF UTAH

Salt Lake City, UT, USA
Aug. '19 - Apr. '24 (expected)

- GPA: 3.87/4
- Specialization: Fracture mechanics and Deep learning
- Research Topic: Accelerating high-fidelity fracture simulations in 3D microstructures using deep learning
- Advisor: Dr. Ashley Spear

B.E. Mechanical Engineering
ANNA UNIVERSITY

Chennai, India
Aug. '11 - May. '15

- GPA: 9.01/10
- University rank holder with 99.9 percentile

Research Experience

University of Utah (Multiscale Mechanics & Materials Laboratory)
GRADUATE RESEARCH ASSISTANT

Salt Lake City, UT, USA
Aug. '19 - Present

Advised by Dr. Ashley Spear and funded by National Science Foundation (NSF)

- Developing a hybrid finite element - machine learning framework to accelerate microstructurally small crack (MSC) growth predictions
- Extensively used Abaqus along with crystal plasticity material model in an integrated setting to simulate microstructurally small crack growth on high-performance computers
- Developed, debugged, tested, and automated various components of the simulation framework using Python, C++, and bash
- Developed Python code to extract, pre-process and transform 3D data from simulation results for use in deep learning algorithms
- Conducted data-driven correlation analysis to aid in feature engineering
- Set up and trained multiple 3D convolutional neural network (CNN) architectures using Tensorflow and Keras libraries on GPUs

ARCI (Advanced Nanomechanical Characterization Laboratory)
SENIOR RESEARCH FELLOW

Hyderabad, India
Apr. '17 - Jun. '19

Advised by Dr. Sudharshan Phani

- Conducted hands-on research on thermal barrier coatings using high-speed, high-throughput property mapping by nanoindenter
- Performed nanoindentation data analysis and generated property maps using MATLAB
- Established a structure-property correlation at micrometer length scale and derived key insights for thermal barrier coating degradation
- Developed a methodology for deconvoluting property maps based on an unsupervised ML algorithm
- Implemented the methodology in C# and delivered it to Nanomechanics Inc (Now KLA), which was later included in their data analysis software

India Piston Rings
RESEARCH INTERN

Chennai, India
Dec. '14 - Mar. '15

Advised by Dr. M. Malathi and Dr. V.S. Raghunathan

- Conducted feasibility study on the reuse of waste Ni-Mo powder recovered from air plasma spray coating machine
- Characterized coating powder wasted during plasma spray coating process
- Ascertained the quality conformance of a 10% recycled powder through various performance evaluation tests

Professional Experience

Cognizant *Chennai, India*
Programmer analyst *Feb. '16 - Mar. '17*
- Completed a training program on C# and SQL
- Contributed to the development and maintenance of Cognizant internal applications as a team member

Technical Skills

Programming	Python (Tensorflow, Keras, Pytorch, Scikit-learn libraries), C++, MATLAB, C#, Racket, Bash
Modeling & Simulation	ABAQUS, DREAM.3D, Paraview, FRANC3D, Creo parametric
General	Linux, Git, LaTeX, MS Office

Relevant Coursework

Machine Learning	Fracture and Fatigue	Continuum Mechanics
Deep Learning	Engineering Material Science	Mechanics of Composite Materials
Probabilistic Machine Learning	Advanced Finite Element Method	Experimental Solid Mechanics

Course/Other Projects

- Predicting semiconductor wafer processing equipment failure using LSTM networks with the data collected during normal production
- A deep learning approach to predict the onset of yield in a polycrystalline material
- Predicting crack tip displacement of microstructurally small cracks using convolutional neural networks

Awards and Notable Involvement

- Won 1st place (as a team) in NIST AM Bench Challenge for predicting subcontinuum tensile behavior (2022)
- University rank holder award for securing 22nd rank among 26643 candidates under the faculty of Mechanical Engineering (2015)
- Ranked among top 4% of candidates who appeared for GATE-Graduate Aptitude Test in Engineering (2015)
- President of Mechanical Engineers Student Forum (MESF), a collegiate club at MSEC, Chennai (2014-2015)
- Event organizer of "YANTRA'14", a national level symposium conducted by MSEC, Chennai (2014)

Publications

- **B. Vignesh**, W.C. Oliver, G. Siva Kumar, P. Sudharshan Phani, "Critical assessment of high speed nanoindentation mapping technique and data deconvolution on thermal barrier coatings", *Materials & Design 181* (2019) 108084.
  https://doi.org/10.1016/j.matdes.2019.108084

Conference Presentations

- **Vignesh Babu Rao***, Brian Phung, Bjorn Johnsson, Ashley Spear, "Using deep learning for predicting microstructurally small fatigue crack growth parameters in polycrystalline materials", 15th *International Conference on Fracture*, Atlanta, GA, June 2023.

- **Vignesh Babu Rao**, Brian Phung*, Bjorn Johnsson, Ashley Spear, "Accelerating microstructurally small crack growth predictions in three-dimensional microstructures using deep learning", *TMS 2023 Annual Meeting & Exhibition*, San Diego, CA, March 2023.

- **Vignesh Babu Rao***, Brian Phung, Ashley Spear, "Accelerating microstructurally small crack growth predictions in three-dimensional microstructures using deep learning", *MMM 10*, Baltimore, MD, October 2022.

- P. Sudharshan Phani, **B. Vignesh**, G. Siva Kumar, W.C. Oliver*, "High speed Nanomechanical property mapping and data deconvolution", *TMS 2019 Annual Meeting & Exhibition*, San Antonio, TX, March 2019.

- **B. Vignesh***, P. Sudharshan Phani, G. Siva Kumar, "High speed Nanomechanical property mapping of thermal barrier coating", *Second International Structural Integrity Conference & Exhibition*, Hyderabad, July 2018.