Deepak Kumar Pokkalla

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Education

- **National University of Singapore (NUS)** — **Singapore**
  Ph.D. in Computational Mechanics (ASCE Best Paper Award) — *Aug 2016 – Sep 2020*
  - **Thesis**: Isogeometric Shape Optimization of Auxetics with Prescribed Nonlinear Deformation
- **Indian Institute of Technology (BHU) Varanasi** — **India**
  B.Tech. in Civil Engineering (Department Rank 1) — *July 2012 – May 2016*
  - **Accolades**: IIT (BHU) Varanasi Gold Medal; CRS Iyengar Memorial Gold Medal

Technical Skills

- **Specialization:** Computational Mechanics, Simulations (multiscale/multiphysics: structural, thermal, CFD), Deep Learning (PINNs, Transformers, GNNs; data-parallel, model-parallel), High Performance Computing
- **Programming | DevOps:** Python, Matlab, Shell (Bash) | Git, Docker
- **Libraries:** PyTorch (Geometric), NVIDIA Modulus, HuggingFace, Scikit-Learn, Pandas, Numpy, TensorFlow
- **Scientific Visualization:** Paraview, Matplotlib, GNU Octave, SciPy
- **CAE | CAD:** ABAQUS, ANSYS, AutoForm, IGA simulation codes | SolidWorks, CATIA, Rhino3D - NURBS

Work Experience

- **Senior R&D Engineer, Dassault Systèmes** — **United States**
  Scientific Machine Learning (SciML) | Modeling & Simulations (CAD/CAE) — *Oct 2023 – Present*
  - Implemented a **physics-informed neural networks** (PINN)-based domain decomposition approach for building accurate, and efficient surrogate models for large simulation domains (Structural/CFD).
  - Developing a **Graph Neural Network** (GNN)-based surrogate modeling and design framework for automotive crashworthiness. Performed numerous **explicit dynamic FEA simulations** under diverse loading and geometry conditions to generate a dataset.

- **Research Associate, Oak Ridge National Laboratory (ORNL)** — **United States**
  Scientific Machine Learning (SciML) | Simulations & Manufacturing (3D Printing) — *Dec 2021 – Sept 2023*
  - Developed a **deep residual network** (ResNet)-based surrogate model and rapid inverse design framework for metamaterials with prescribed **nonlinear** mechanical responses and manufacturability constraints.
  - Developed a **deep learning**-based data driven metal stamping process monitoring and control system using AutoForm for the United States Council for Automotive Research (USCAR) - Ford, General Motors, Stellantis.
  - Performed **modeling** & **simulations** for optimization of automotive components (bumper, seatback assembly) and manufacturing processes (large-scale 3D printing, additive manufacturing - compression molding, metal stamping).

- **Research Fellow, McGill University** — **Canada**
  Simulations & Design Optimization | Materials & Manufacturing — *Nov 2020 – Nov 2021*
  - Developed shape morphable multi-stable deployable space structures using numerical modeling, **nonlinear simulation models** (ABAQUS with custom Python scripts), and experiments (tensile testing with DIC).

- **Modeling** & **Simulations Intern, Larsen & Toubro - Chiyoda Ltd.** — **India**
  Structural simulations & Design Optimization — *May – July 2014*
  - Designed an industrial steel pipe rack through **modeling** & **nonlinear simulations** for various loads in STAAD and performed an adequacy check of pedestal and foundation using MS Excel and Mat3D.

Machine Learning Competitions

- **Named Entity Recognition:** Detecting personally identifiable information (PII) in educational data through fine-tuned Large Language Models (LLMs) such as Mistral-7B-v0.1, deberta-v3-large, gemma-2b.
- **Unintended Bias Detection:** Implemented and optimized NLP models using algorithms like BERT, GPT-2, and XLNET to mitigate unintended bias in filtering toxic comments within online discussions.
- **Image** & **Text Classification:** Utilized CNN, LSTM, and GRU models to categorize e-commerce items based on images and title descriptions, employing a multimodal approach.

Certifications and Coursework

- **Coursera:** Python Data Structures, Machine Learning, Deep Learning Specialization (Neural Networks and Deep Learning, Improving Deep Neural Networks: Hyperparameter Tuning, Regularization and Optimization, Structuring Machine Learning Projects, Convolutional Neural Networks, Sequence Models)
- **Courses:** Numerical Methods, Convex Optimization, Finite Element Analysis, Continuum Mechanics, Solid Mechanics, Structural Mechanics, Fluid Mechanics, Topology Optimization, Computer Graphics, 3D Printing

Research Experience

- **Research Scholar, NUS**   **Singapore**

  Isogeometric Shape Optimization of Auxetics with Prescribed Nonlinear Deformation   *Aug 2016 – Sep 2020*
  - Developed a **nonlinear isogeometric analysis (IGA) solver** in MATLAB for numerous constitutive models by integrating traditional FEA with spline-based CAD design tools for efficient **CAD-CAE** workflow.
  - Developed an adjoint-based **nonlinear shape optimization** framework using nonlinear programming (SQP algorithm) for the design and 3D printing of auxetic metamaterials over large strains.
  - Implemented Genetic Algorithm (GA) among other global optimization techniques for the design and 3D printing of mechanical metamaterials in strain sensors using **Mixed-Integer Nonlinear Programming (MINLP)**.

- **Research Assistant, Ghent University**   **Belgium**

  Computational Analyses for a Fretting Fatigue Contact Problem   *May – July 2016*
  - Performed fretting fatigue stress analysis of an aluminium specimen to investigate the effect of micro-voids on stress distribution by conducting **nonlinear FE simulations** with ABAQUS and Python scripts.
  - Modelled the macroscopic fretting fatigue contact problem using effective mechanical properties extracted from the underlying microstructure as per first-order **multiscale** computational homogenization technique.

- **Research Assistant, NUS**   **Singapore**

  Computational Homogenization of Heterogeneous Materials   *July – Aug 2015*
  - Implemented a first-order **multiscale** homogenization technique by adopting the effective mechanical properties of the microstructure at the structural level using **ABAQUS** with User subroutines and Python Scripts.

Honors & Awards

- 2023 R&D100 Award, "***The Oscars of Innovation***" or "***Nobel Prize of Engineering***"
- **Best Paper Award**, Engineering Mechanics Institute (EMI) Conference 2020 by ASCE
- Silver medal in Kaggle Data Science Competition for developing novel NLP models, 2019.
- **IIT (BHU) Varanasi Gold Medal**; CRS Iyengar Memorial Gold Medal in 2016
- **NUS Research Scholarship** for excellence in studies & research towards Ph.D, 2016.
- Rai Bahadur Taracharan Gue Memorial Award for excellence in studies, 2016.
- Late Prof. Manoranjan Sengupta Platinum Jubilee Merit Award for exceptional academic performance, 2016.
- **JNV Academic Scholarship** for excellence in studies for entire middle/high school, 2005 - 2012.
- Top Scorer Award in XLI National Mathematics Talent Competitions, 2009.

Patents

- **Pending**: Oak Ridge National Laboratory (ORNL) - *Precise High-Speed Manufacturing of Thermoplastic Composites Using Additive Manufacturing - Compression Molding (AM-CM)*
- **Pending**: McGill University - *Symmetry breaking in bistable auxetic kirigami for anisotropic shape morphing*

Selected Publications (16 journal articles, 15 conferences, 10 invited talks, 300+ Citations)

- *In-Review*: **Pokkalla, DK.** et.al., 2024. Inverse design of auxetic materials with prescribed nonlinear response using isogeometric analysis and deep learning.
- Li, J., **Pokkalla, D.K.**, et. al., 2023. Deep learning-enhanced design for functionally graded auxetic lattices. Engineering Structures, 292, p.116477.
- **Pokkalla, DK. et.al.,** 2022. Soft missing rib auxetics with controllable negative Poisson's ratios over large strains via isogeometric design optimization, Journal of Engineering Mechanics.
- **Pokkalla, DK. et.al.,** 2021. Isogeometric shape optimization of missing rib auxetics with prescribed negative Poisson's ratio over large strains using genetic algorithm. International Journal of Mechanical Sciences, 193, p.106169.
- **Pokkalla, DK. et.al.,** 2019. Isogeometric shape optimization of smoothed petal auxetics with prescribed nonlinear deformation. Computer Methods in Applied Mechanics and Engineering, 356, pp.16-43.
- **Pokkalla, DK. et.al.,** 2017. Fretting fatigue stress analysis in heterogeneous material using direct numerical simulations in solid mechanics. Tribology International, 109, pp.124-132.