Aaditya **Chandrasekhar**

Doctoral Candidate · Mechanical Engineering

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Summary

I am a Doctoral candidate in Mechanical Engineering at UW Madison, advised by Prof. Krishnan Suresh. My thesis research focuses on topology representation and optimization directly using neural networks. My research directions include exploring how current interests in topology optimization such as multiple materials, controlling length scales, consider multi-physics interactions and multi-scale design can be solved by combining recent advances and ideas in machine learning. I have pursued prior research in simulating and optimizing designs for additive manufacturing.

My short term research goals involve further bridging design generation and topology optimization by applying recent advances in neural networks and machine learning. My long term goals involve broadening my research into other areas of computational mechanics while simultaneously identifying interesting relations to research in machine learning.

Education

University of Wisconsin - Madison — *Madison, WI, USA*

PhD (pursuing) in Mechanical Engineering — *Jan. 2016 - Exp. May 2022*

SRM Institute of Science and Technology, Chennai — *Chennai, India*

B.Tech in Mechanical Engineering — *2011 - 2015*

Publications

AuTO: Automatic Differentiation for sensitivity analysis in Topology Optimization — *Under Submission*

Aaditya Chandraskhar, Saketh Sridhara and Krishnan Suresh — *2021*

- Overcome the need to manually derive and implement sensitivity expressions in topology optimization.
- Applied automatic differentiation for compliance minimization, compliant mechanism design and microstructural design in JAX (machine learning library) .

Length Scale Control in Topology Optimization using Fourier Enhanced Neural Networks — *Under Submission*

Aaditya Chandraskhar and Krishnan Suresh — *2021*

- Enables length scale control in designs through projecting coordinates to frequency space.
- Extract smooth differentiable boundaries at sub-element length scales

Multi-Material Topology Optimization Using Neural Networks — *CAD*

Aaditya Chandraskhar and Krishnan Suresh — *2021*

- Extends the TOuNN framework to handle designing with multiple materials.
- Computationally efficient method to obtain checkerboard-free designs.

TOuNN: Topology Optimization using Neural Networks — *SAMO*

Aaditya Chandraskhar and Krishnan Suresh — *2020*

- Directly execute topology optimization using neural networks. The primary concept is to use the NN's activation functions to represent the popular Solid Isotropic Material with Penalization density field.
- Impose design and manufacturing constraints within the proposed framework are described. A byproduct of representing the density field via activation functions is that it leads to a crisp and differentiable boundary.

Build optimization of fiber-reinforced additively manufactured components — *SAMO*

Aaditya Chandraskhar, Tej Kumar, Krishnan Suresh — *2019*

- Optimization of the build direction, topology, and fiber orientation of Short Fiber Reinforced Polymer components for Additive Manufacturing.
- Effect of layer-wise printing on anisotropic material properties was considered.

Towards Assembly-Free Methods for Additive Manufacturing Simulation — *ASME-IDETC*

Anirudh Krishnakumar, Aaditya Chandraskhar, Krishnan Suresh — *2015*

- Increase simulation speed for modelling transient thermo-mechanical interactions during Additive Manufacturing.
- Extended assembly-free finite element analysis to nonlinear physics models.

Conferences & Talks

Optimization of Support Structure for Additive Manufacturing Via Pseudo-Fiber Material Model

Topology Optimization Roundtable *2019*

Build Optimization of Fiber Reinforced 3D-Printed Components

World Congress for Computational Mechanics, *2018*

Limited-memory assembly free finite element simulation of fused deposition modeling process

United States National Congress on Computational Mechanics *2017*

A Memory-efficient Finite Element Simulation to Predict Warping in Metal Additive Manufacturing

Solid Freeform Symposium *2016*

Exploratory Projects

Design and Analysis of 3D Printed Heat Exchangers *DOE Project*

Supervised by Prof. Krishnan Suresh

- Improve the thermal efficiency of additively manufactured dry-cooled condensers by reducing the air-side thermal resistance.
- Performed stress and thermal analysis to assess the feasibility of proposed designs and suggested design modifications.

Slicing on a GPU *Course Project*

CS/ME 759

- Implemented 3D printer slicing algorithms on multi-core CPU and GPU.
- Evaluated performance gains and identified core algorithms that accelerate performance.

Parametric Solid Modeling *Course Project*

ME 535

- Developed a lightweight command based parametric solid modeling tool in Python.
- Explored design optimization of parametric solids using the tool.

Teaching Experience

Introduction to Design Optimization (ME 548), Spring 2020 *Madison, WI, USA*

Teaching Assistant *Jan. 2020 - May 2020*

- Conducted discussions. Aided with regular lectures, content preparation, setting exams and grading.
- Taught by Prof. Krishnan Suresh.

Computer Aided Engineering (ME 331), Fall 2019 *Madison, WI, USA*

Teaching Assistant *Sep. 2019 - Dec. 2019*

- Conducted tutorials and discussions. Lab sessions included teaching SolidWorks- theory and practical. Aided with regular lectures, setting exams and grading.
- Taught by Prof. Jeff Roessler.

Software Skills

Languages

Primary: C++, Python, MATLAB. Secondary: Java, Julia, CUDA

Modeling & Analysis

SolidWorks, Ansys, Comsol, Rhino

References

Prof. Krishnan Suresh *UW-Madison*

PhD Advisor (ksuresh@wisc.edu) *2014 - Present*

Dr. Shiva Rudraraju *UW Madison*

Assistant Professor (shiva.rudraraju@wisc.edu) *2017 - Present*