

# Mehul Bagaria

## PERSONAL INFORMATION

*Portfolio*                      [mehulbagaria.com](https://mehulbagaria.com)  
*GitHub*                        [mehul-bagaria](https://github.com/mehul-bagaria)  
*email*                         [mehul@avkalanlabs.com](mailto:mehul@avkalanlabs.com)  
*phone*                        +91 80850-82026



## GOAL

Leverage research expertise and entrepreneurial drive to create innovative, custom-engineered solutions that tackle complex industry challenges. Focus on developing advanced engineering algorithms and hardware products that integrate multiple domains, such as design, analysis, machine learning, and IoT.

## RESEARCH INTEREST

Finite element analysis · Metamaterials · Topology optimization ·  
Molecular Dynamics · Nanophotonics · Electromagnetism · Photonics ·  
Thermomechanics

## SKILLS SUMMARY

|                    |                                                                                                                                                |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Languages</i>   | Python, C++                                                                                                                                    |
| <i>Tools</i>       | GIT, ParaView, Zotero, L <sup>A</sup> T <sub>E</sub> X, Notion, Chitubox, Cura, Gmsh, KiCAD, COMSOL Multiphysics, LS-DYNA, Autodesk Fusion 360 |
| <i>Frameworks</i>  | FEniCS, Meshio, Numpy, Pandas, Matplotlib, Plotly                                                                                              |
| <i>Platforms</i>   | Linux, Windows, macOS, Web, Android                                                                                                            |
| <i>Soft Skills</i> | Team work, Leadership, Collaboration, Project Management, Communication                                                                        |

## EDUCATION

|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Master of Technology</i>   | <p>2020-2022                      Indian Institute of Technology, Roorkee, India</p> <p>THESIS: NANO-TOPOLOGY OPTIMIZATION OF PHOTONIC METAMATERIAL</p> <ul style="list-style-type: none"><li>Enhanced the performance of a nanophotonic metamaterial-based selective absorber to achieve perfect stealth while preserving the thermal stability of the object.</li><li>TO algorithm was proposed and implemented under two different physics: heat transfer and nano-photonics.</li><li>Developed a topology optimization algorithm in FEniCS to optimize the performance of a ground-heat exchanger, targeting maximum heat dissipation.</li><li>Conducted studies to modify electromagnetic wave propagation by implementing the caustic phenomenon in FEniCS.</li></ul> |
| <i>Bachelor of Technology</i> | <p>2015-2019                      Govt. Engineering College, Ujjain, India</p> <p>THESIS: DESIGN AND FABRICATION OF HILL CLIMB ASSISTANCE SYSTEM FOR AUTOMOTIVE VEHICLE</p> <ul style="list-style-type: none"><li>Developed and fabricated a mechanically actuated hill climb assistance system with a working model to prevent vehicles from rolling backwards on hills.</li></ul>                                                                                                                                                                                                                                                                                                                                                                                         |

- Incorporated a one-way clutch bearing inside the vehicle's gearbox, which restricts motion in one direction, ensuring reliable hill climb assistance.

## EXPERIENCE

|                  |                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Entrepreneurship | 2023-till date                                                                                | Avkalan Labs Private Limited, India                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                  | DIRECTOR / CEO                                                                                | <ul style="list-style-type: none"> <li>• Leading the strategic direction and product development roadmap as the CEO/co-founder of the startup.</li> <li>• Secured partnerships and funding to drive the growth and innovation of the company's product offerings.</li> <li>• Managing end-to-end project execution and led the hardware product development team.</li> <li>• Developed code for visualizing sensor data and implemented on-device processing with wireless connectivity for the IoT-based smart insole.</li> <li>• Engineered and assembled the full hardware architecture for the smart insole technology from the ground up.</li> <li>• Designed and 3D printed metamaterial-based custom insoles for diabetic patients.</li> <li>• Currently developing and deploying the machine learning model in the smart insole.</li> </ul>                                                                                                                        |
| Research Fellow  | 2022-2023                                                                                     | Indian Institute of Technology, Roorkee, India                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                  | EXPERIMENTAL AND THEORETICAL STUDIES OF HIGH BALLISTIC IMPACT ON MULTI-LAYERED NANOCOMPOSITES | <ul style="list-style-type: none"> <li>• Conducted numerical studies on ballistic impact using smooth particle hydrodynamics to analyze the behaviour of nanocomposites under high-impact conditions.</li> <li>• Utilized LS-DYNA for explicit dynamic simulations, incorporating non-linearities and experimentally verified properties in multi-layered nanocomposites for accurate ballistic impact modelling.</li> </ul> <p>DEVELOPMENT OF A DESIGN-THROUGH-ANALYSIS ISOGEOMETRIC MODULE IN FEAST (ISRO): TOWARDS STRUCTURAL ANALYSIS AND OPTIMIZATION</p> <ul style="list-style-type: none"> <li>• Developing a GUI-based software package for isogeometric analysis (IGA) with support for single-patch.</li> <li>• Implementing static and eigenvalue analysis modules for 2D and 3D geometries using IGA.</li> <li>• Generating and validating test modules against standard benchmark problems to ensure the accuracy of the developed computer codes.</li> </ul> |

## SELECTED PROJECTS

|                  |                                                                                                                                                                                                                            |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Electromagnetism | Modulating electromagnetic wave propagation through caustics                                                                                                                                                               |
|                  | Developed working implementation to alter the wave propagation within the material to achieve a caustic phenomenon. The code and corresponding G-code generation workflow can generate a caustic projection for any image. |
| Embedded System  | Development of a smart insole for diabetic patients and athletes                                                                                                                                                           |
|                  | Designed the entire product development strategy and engineered essential aspects of the smart insole technology, featuring advanced sensors, IoT, and ML.                                                                 |
| Machine Learning | ML algorithm deployment for estimating foot pressure distribution                                                                                                                                                          |
|                  | Developing and deploying multiple machine learning models in the smart                                                                                                                                                     |

insole to estimate foot pressure distribution and implement an active alarming system to minimize foot complications from prolonged high-pressure zones.

Development and integration of GUI-based visualization tool to capture the smart insole data

*Programming*

Developed code for visualizing sensor data, implemented on-device processing with wireless connectivity and engineered the full hardware architecture for the IoT-based smart insole technology.

Design and fabrication of metamaterial-based custom insole for pressure offloading

*Additive  
Manufacturing*

Engineered and 3D printed metamaterial custom insoles for diabetics, incorporating inputs from AIIMS doctors on material studies and design.

Image to 3D printable model generation for implementation in custom insole designing

*Machine Learning*

Created a workflow utilizing machine learning models to generate 3D models and produce 3D printed objects from images.

#### OTHER INFORMATION

*Achievements and  
Awards*

- 2024 · Best Startup Idea award in the E-Summit IIT, Roorkee, India.
- 2023 · Awarded a NIDHI Prayas grant from DST, Government of India.
- 2022 · Received a research fellowship for a DRDO-sponsored project.
- 2022 · Got selected in IISC, Bangalore for the PhD.
- 2022 · Awarded the Departmental Gold Medal at IIT Roorkee, India.
- 2021 · Selected as the CAPC representative at IIT Roorkee, India.
- 2020 · Received fellowship from MHRD, India
- 2020 · Secured 737 score in GATE 2020 - ME.
- 2016 · Built an electro-mechanically powered vehicle for SAE, India.
- 2015 · Received State Govt. scholarship during higher secondary.

*Interests*

Articles and blogs writing · Scientific discussion · Product building

#### LIST OF PUBLICATIONS AND CONFERENCES

*Patent-Pending*

**Bagaria M.**, Gupta, A., Krishnan, U.M., Patel, K. and Chowdhury, R.  
Insole-Based Foot Pressure Monitoring System with Mobile Alerts for Diabetic Foot Ulcer Prevention

#### TEACHING EXPERIENCE

*Graduate Teaching  
Assistant*

- 2022 · Numerical Methods and Statistics with Python