

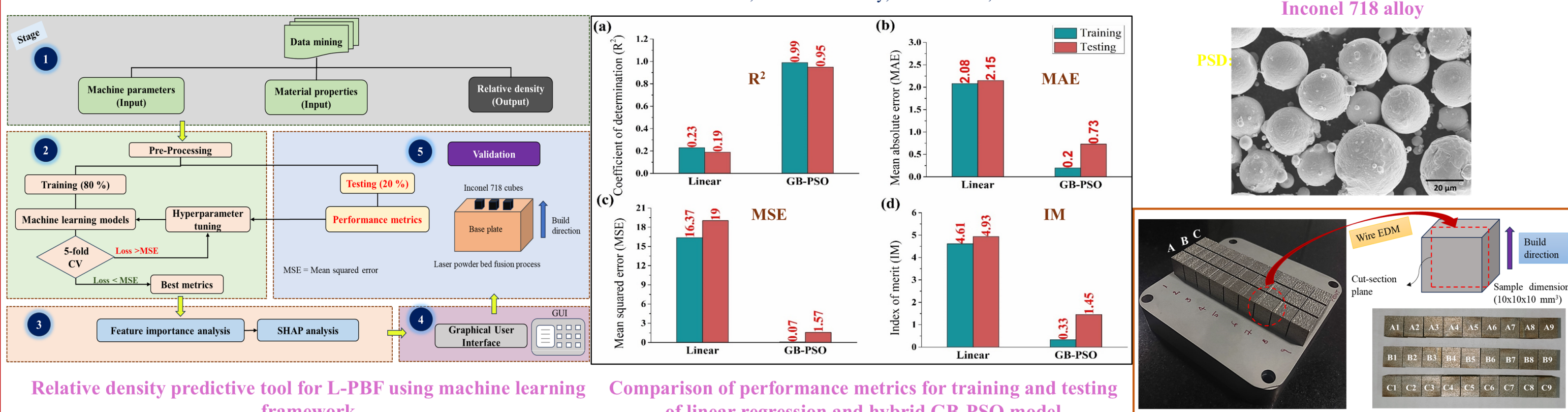


Computational Solid Mechanics

Data-driven prediction of relative density for laser powder bed fusion parts: machine learning-based parameter tuning

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Relative density predictive tool for L-PBF using machine learning framework

Comparison of performance metrics for training and testing of linear regression and hybrid GB-PSO model

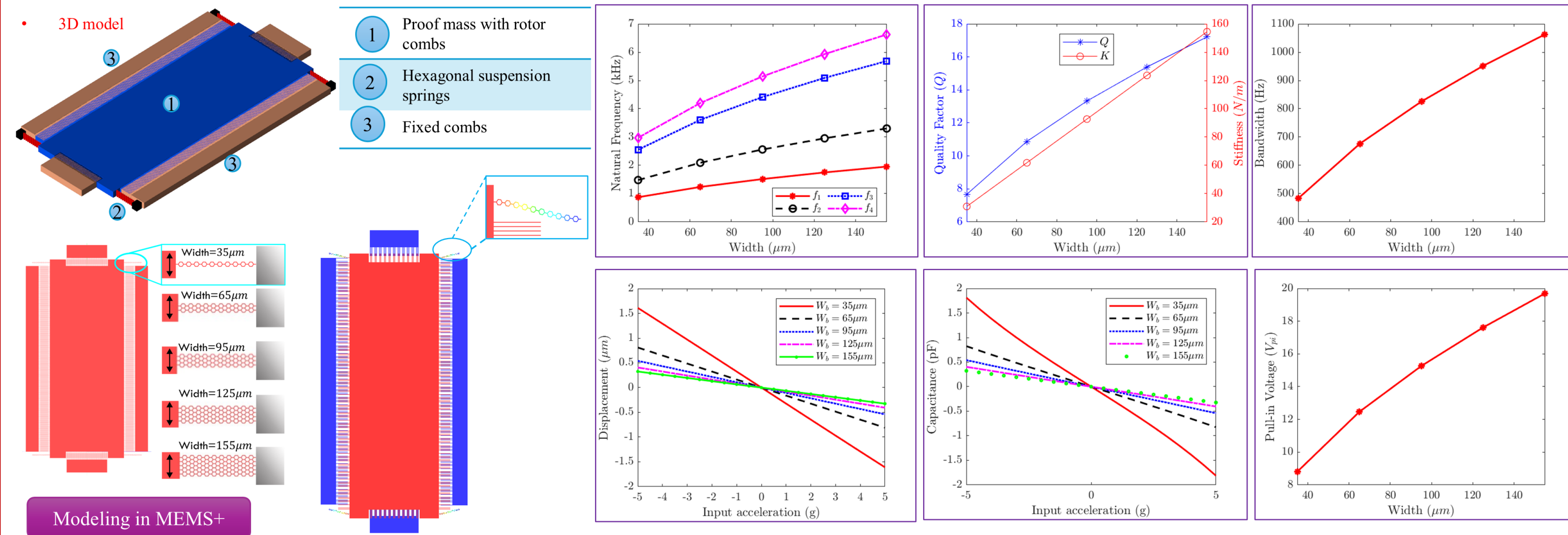
- Using a Data-driven ML approach and SHAP analysis, optimized process parameters for AM (L-PBF) are obtained. The model captures data complexities and nonlinearities.
- The hybrid GB-PSO ML model outperformed various traditional, hierarchical, and hybrid models.

Publication:
1. A Generalized Machine Learning Framework for Data-Driven Prediction of Relative Density in Laser Powder Bed Fusion Parts. Submitted to *The International Journal of Advanced Manufacturing Technology* (Under Review).

Design and Modeling of Differential Capacitive Hexagonal Beam based MEMS Accelerometer

Sai Kishore Jujjuvarapu¹ and Ashok Kumar Pandey¹

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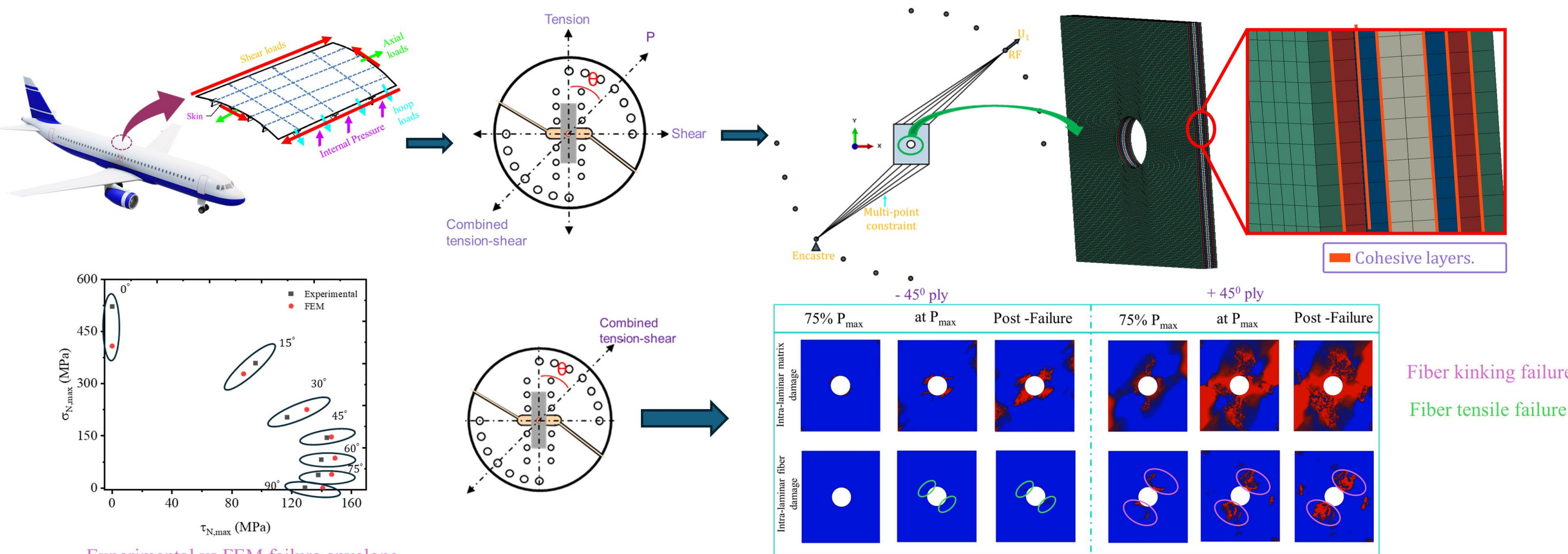
- Frequency tuning of MEMS accelerometer is achieved by varying the width of the suspension springs
- There has been substantial improvement in mechanical and capacitive sensitivities by using hexagonal suspensions springs

Publication:
1. Design and Modeling of Differential Capacitive Hexagonal Beam Based MEMS Accelerometer," *2024 Symposium on Design, Test, Integration and Packaging of MEMS/MOEMS (DTIP)*, Dresden, Germany, 2024, pp. 1-6,

Progressive damage analysis of open-hole CFRP laminates under combined tension-shear loading

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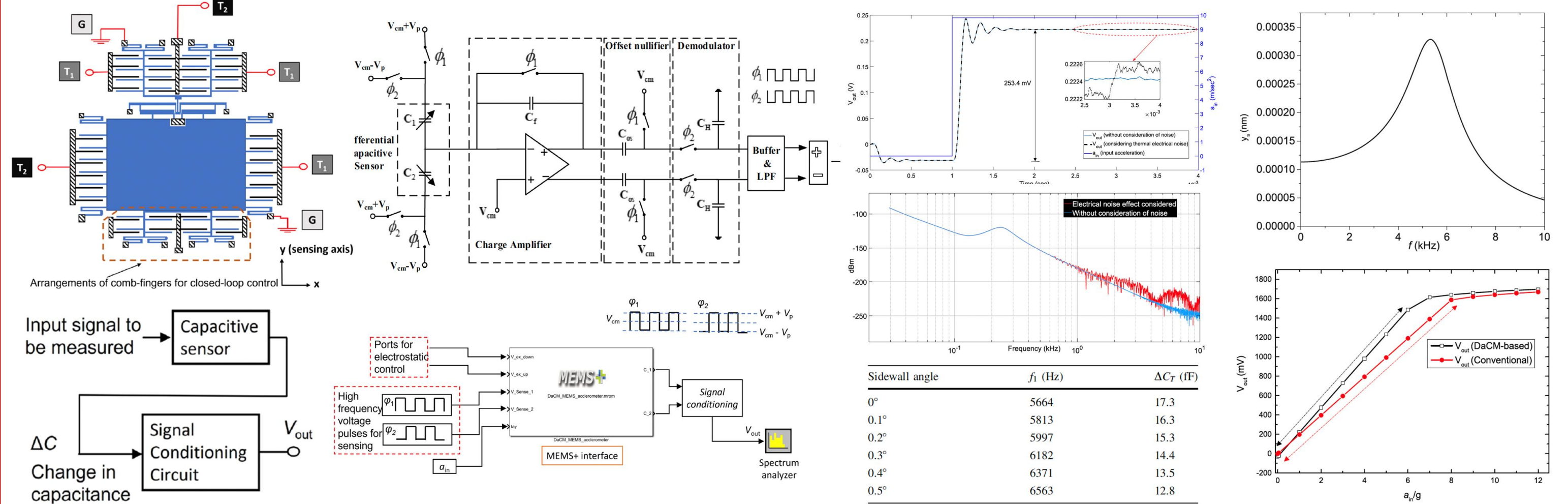


- LaRC05 criteria used for intra-laminar damage initiation.
- B-K law used for inter-laminar damage initiation.
- Linear degradation is assumed after damage initiation for both intra and inter laminar damage.

Modelling and optimization of compound lever-based displacement amplifier in a MEMS accelerometer

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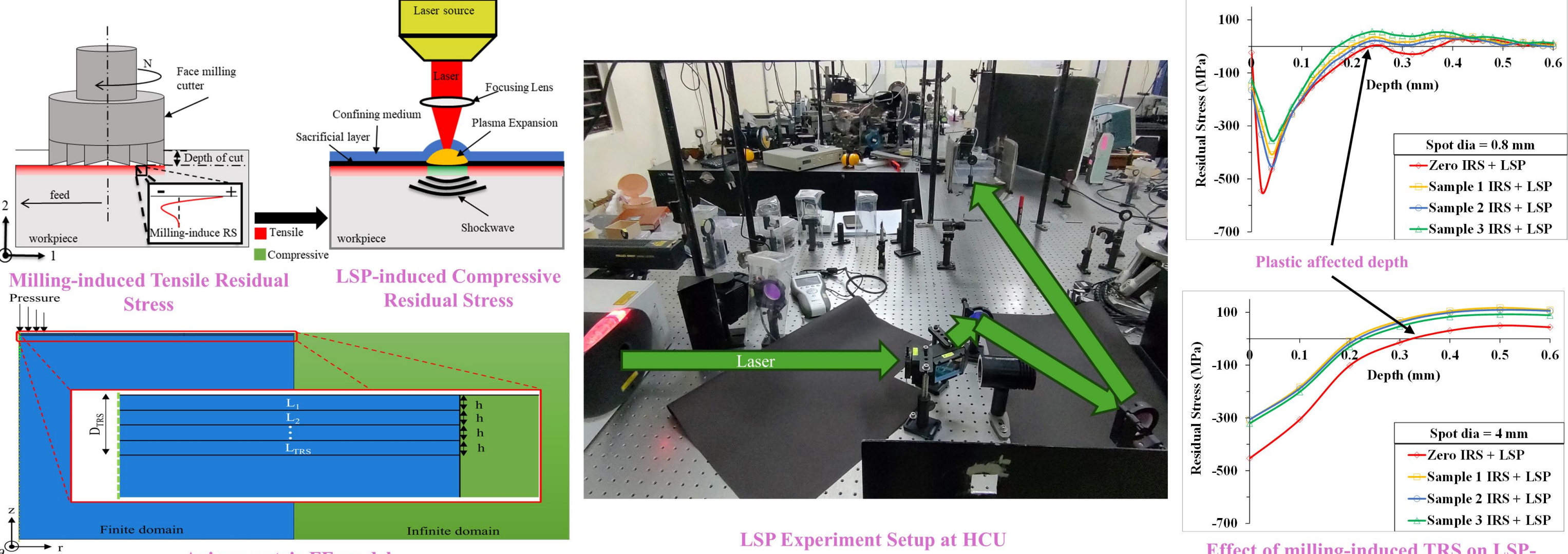
- A compliant displacement amplifier based single-axis MEMS accelerometer is designed.
- Sensitivity of the MEMS accelerometer, nonlinearity in the response have been determined through Simulink based analysis.
- It can provide nonlinearity less than 0.5 % for the input acceleration up to 6 g. For comparatively smaller in-plane size of proof mass, larger FOM has been achieved.

Publication:
1. Modelling and optimization of compound lever-based displacement amplifier in a MEMS accelerometer. *Microsystem Technologies* (2024): 1-20.

Role of Pre-existing Residual Stresses on Laser Shock Peening Efficacy

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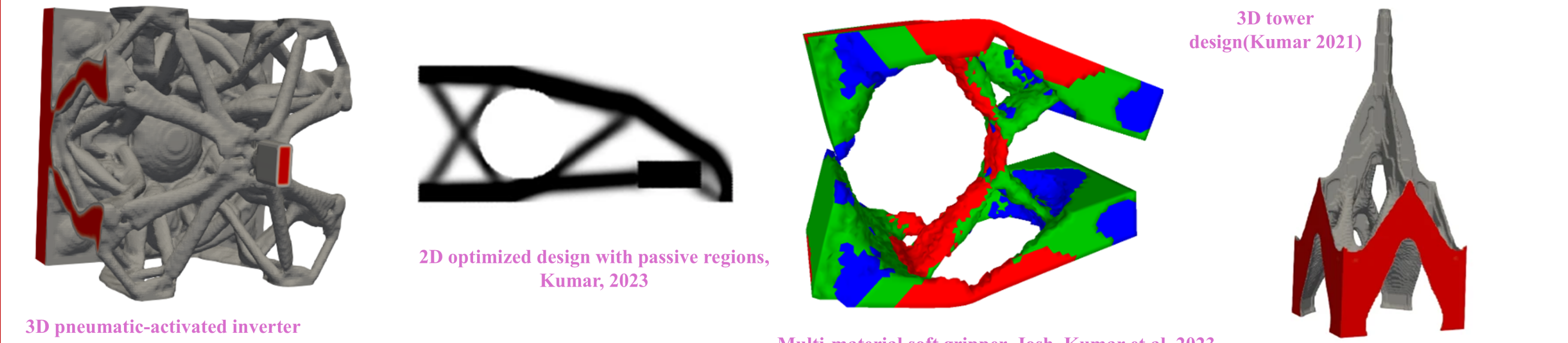
- Pre-existing subsurface Tensile Residual Stresses (TRS) are introduced from Milling operations.
- Pre-existing TRS decreases the efficacy of LSP-induced compressive residual stress (CRS), plastic-affected depth.

Publication:
1. Efficacy of Laser Shock Peening Post-milling: A Semi-numerical Study. *Journal of Materials Engineering and Performance*, 2024, 33:4106-4113

Topology Optimization Computational Design and Experiment (TOCoDe)

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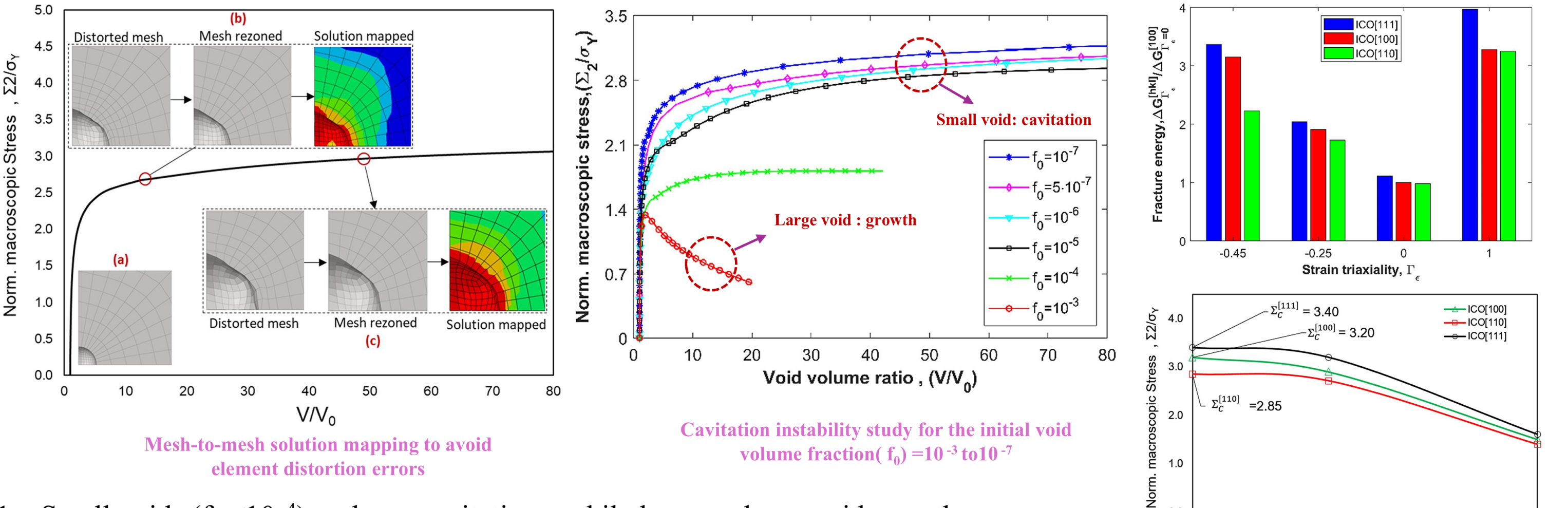
- Topology optimization (TO) is a computational approach used to optimize material distribution within a given design domain, driven by specific performance objectives and constraints.
- With the rapid advancements in additive manufacturing, these optimized, complex designs can now be fabricated more easily, fuelling a growing demand for TO across various applications.

Publications based Codes
1. HoneyTop90: A 90-line MATLAB code for topology optimization using honeycomb tessellation;
2. TOPress: a MATLAB implementation for topology optimization of structures subjected to design-dependent pressure loads;
3. SoRoTop: a hitchhiker's guide to topology optimization MATLAB code for design-dependent pneumatic-driven soft robots;
4. PyHexTop: a compact Python code for topology optimization using hexagonal elements;

Effect of anisotropy on the ductile fracture in metal reinforcements of brittle matrix composites

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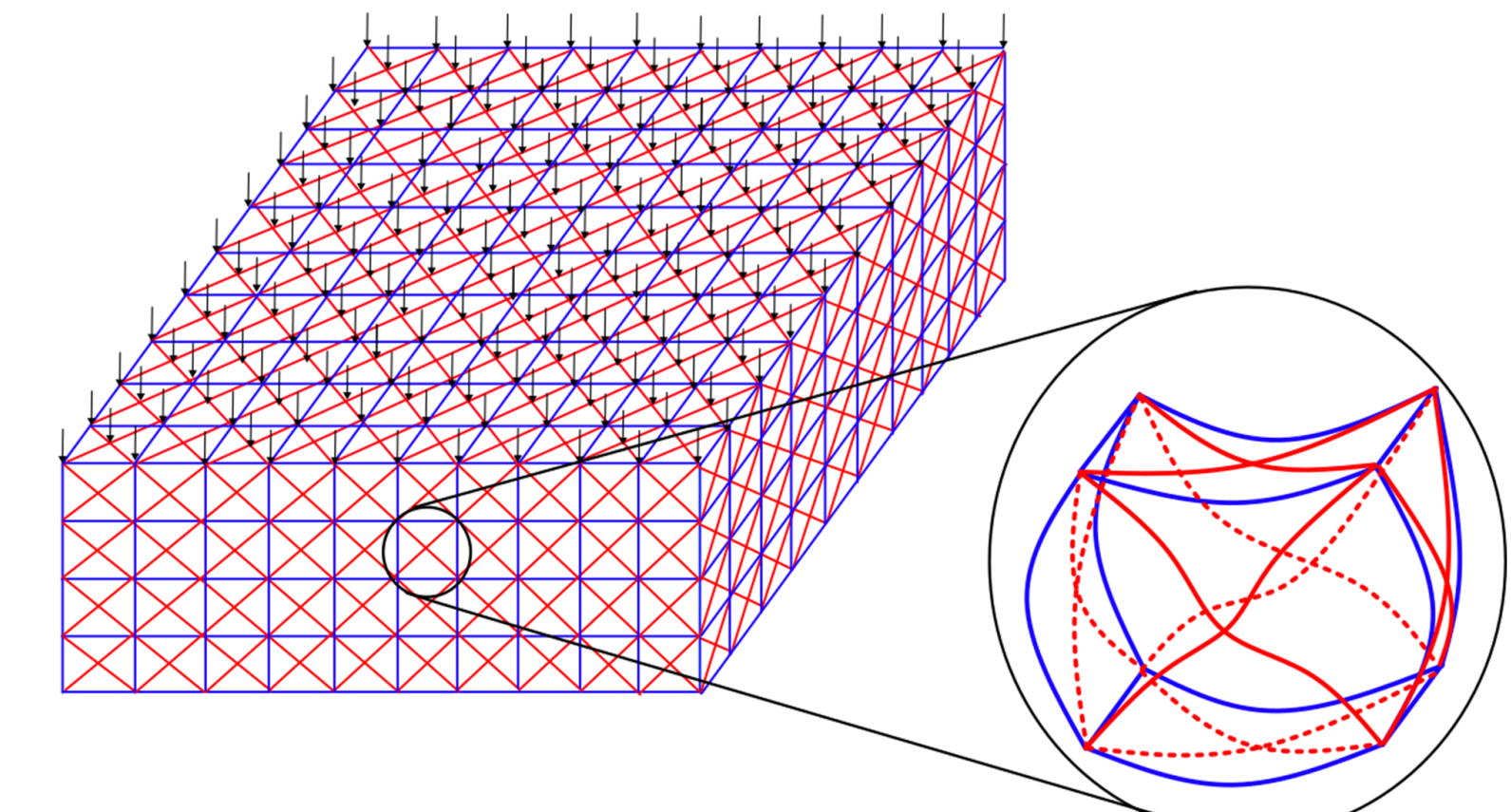
- Small voids ($f_0 \leq 10^{-4}$) undergo cavitations, while large undergo void growth
- Critical cavitation Stress, fracture energy, and the total energy absorbed are directional dependent.

Publication:
1. Effect of anisotropy on the ductile fracture in metal reinforcements of brittle matrix composites. *Theoretical and Applied Fracture Mechanics*. April 2021, 102923

Finite element simulations of rods

Prakhar Gupta^{1,*}

1. Searching Unique Class of Small-scale High-performance Materials, Indian Institute of Technology, Hyderabad, India



- We explore a wide range of Multiscale and Multiphysics phenomena, from designing smart fabrics to smart nano/micro metamaterials without using piezoelectric materials.
- Our focus lies in performing finite element simulations of one-dimensional structures undergoing large rotations of the cross-sections. We are highly interested in simulating electromechanical coupled problems using our in-house codes.
- The architected metamaterial developed using mathematical rigor can be utilized for next-gen light weight applications.

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