Engineering Portfolio

Simulation-Driven R&D · Precision Mechatronics · High-Pressure Systems

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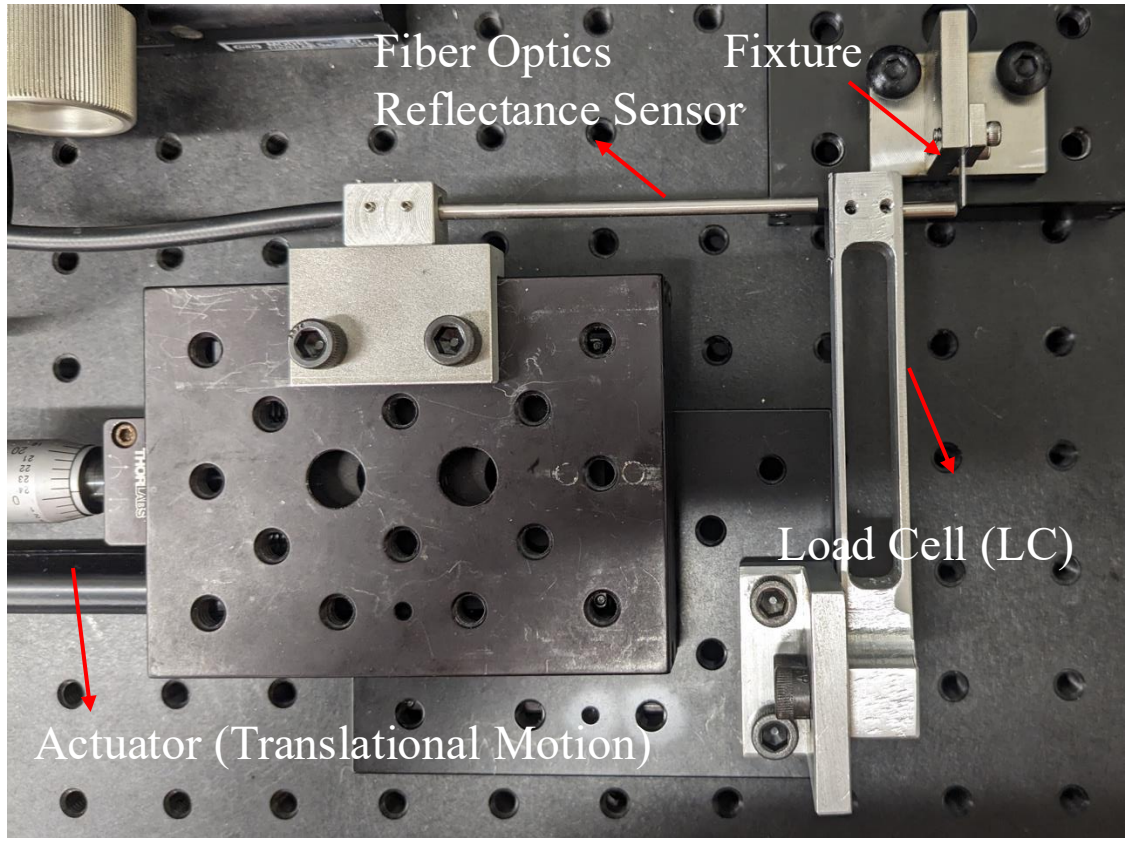
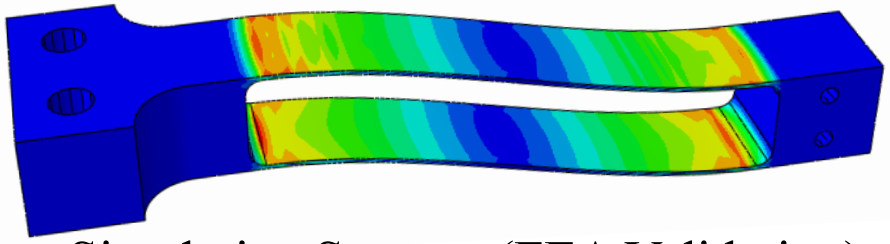
Project – Precision Mechanical Test System (Mechatronics + DAQ Integration)

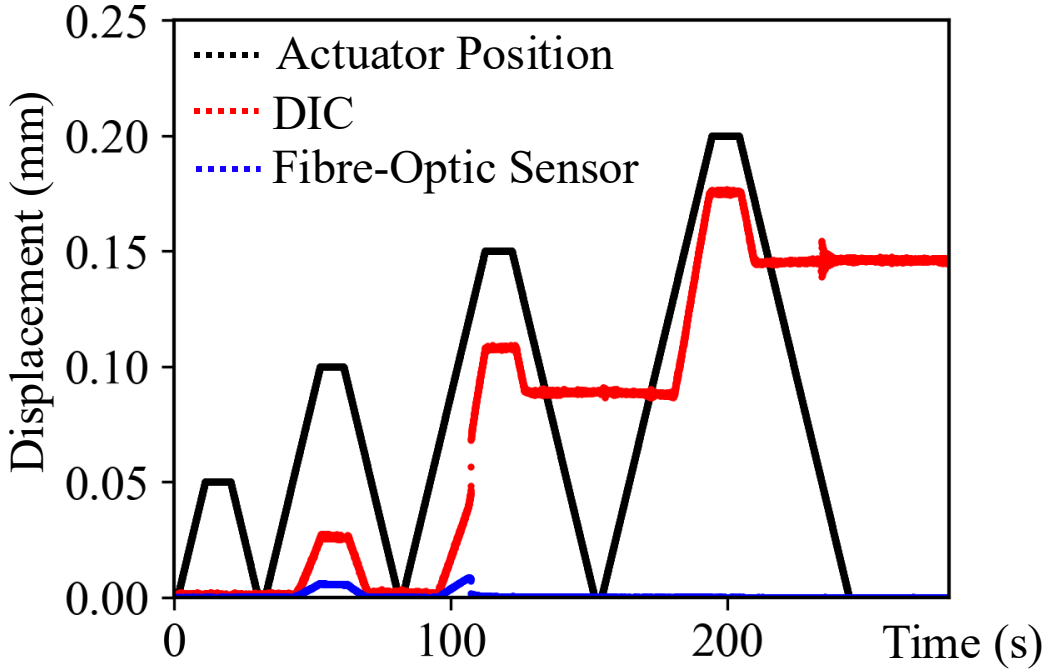


System Overview (Hardware Integration)

Custom precision test rig integrating:
Motorized actuator (translational motion), Load cell (force), Fiber-optic displacement sensor (sub-µm resolution), Custom fixtures and alignment guides



Simulation Support (FEA Validation)
Validated stiffness, bending mode, and expected load–deflection curve.



Sensing & DAQ (LabVIEW Integration)

Noise filtering + signal alignment in Python.

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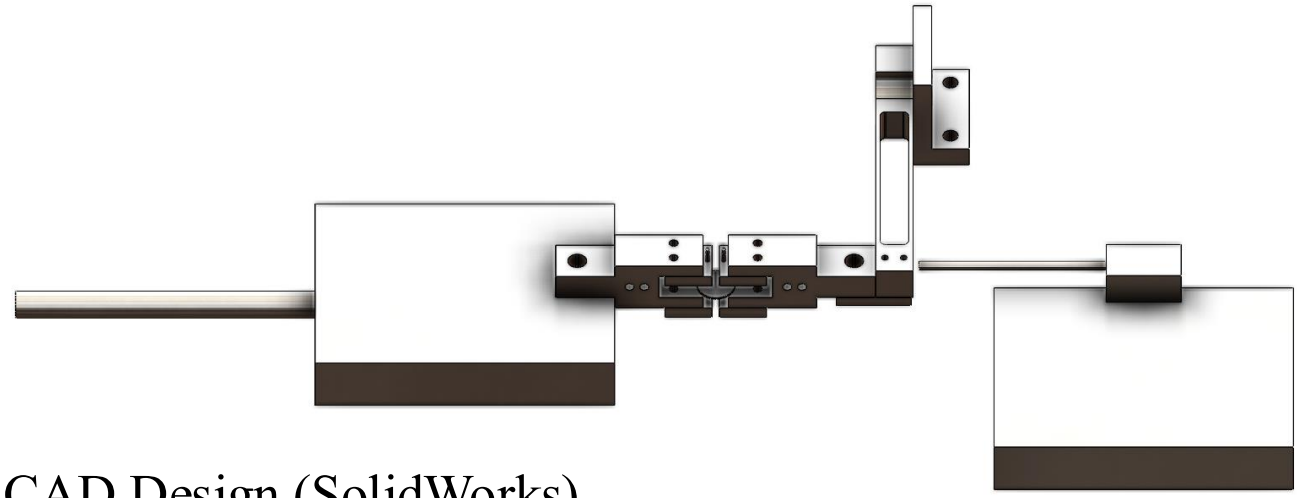
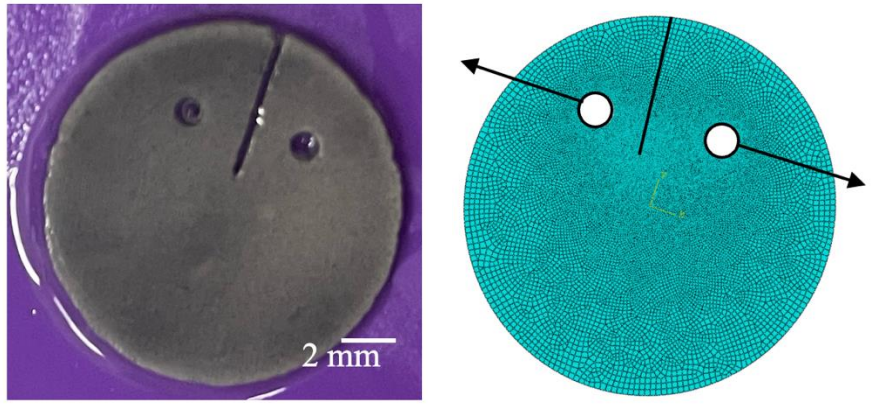
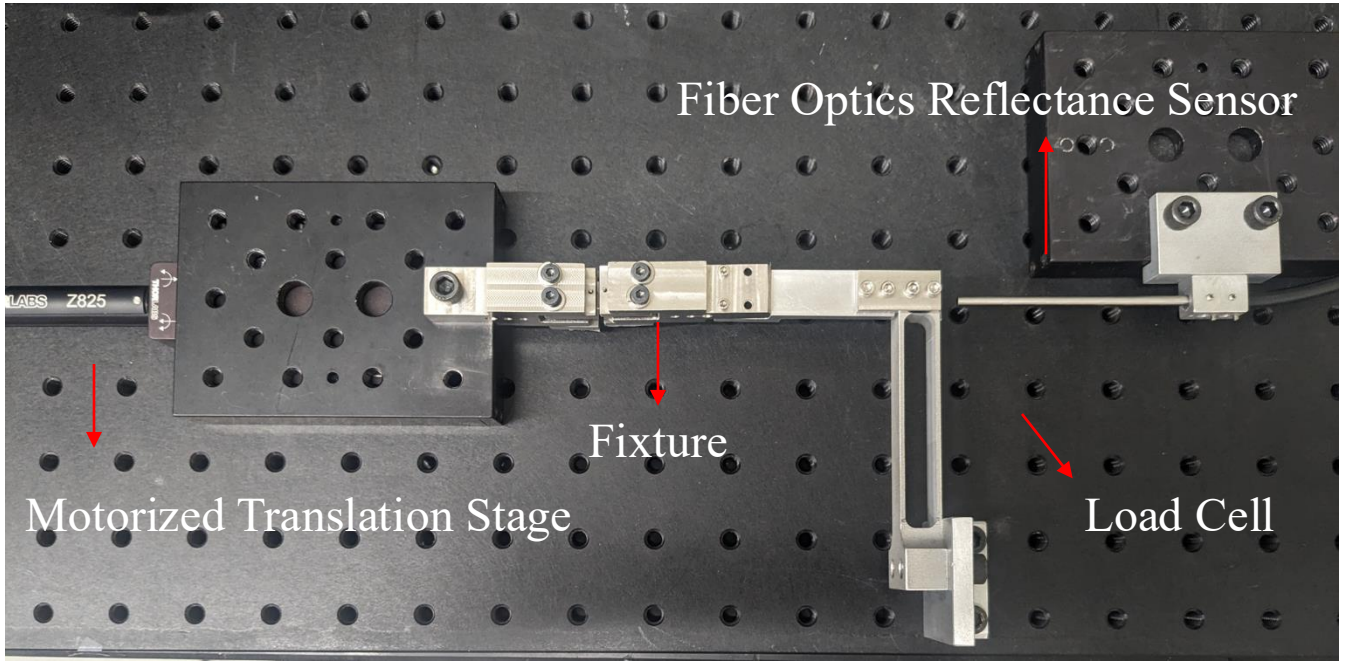


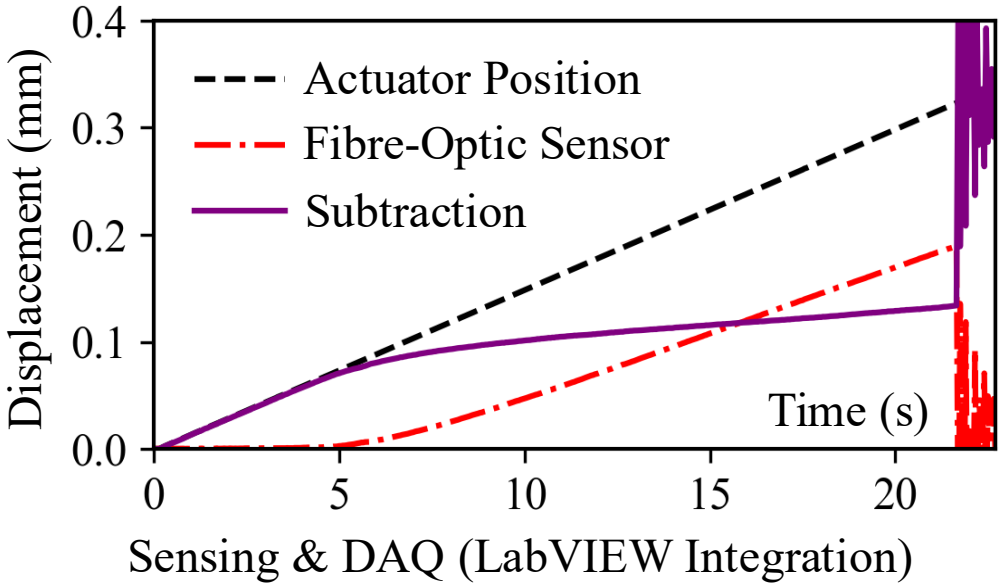
CAD Design (SolidWorks)



Simulation Support (FEA-Based Parameter Identification)

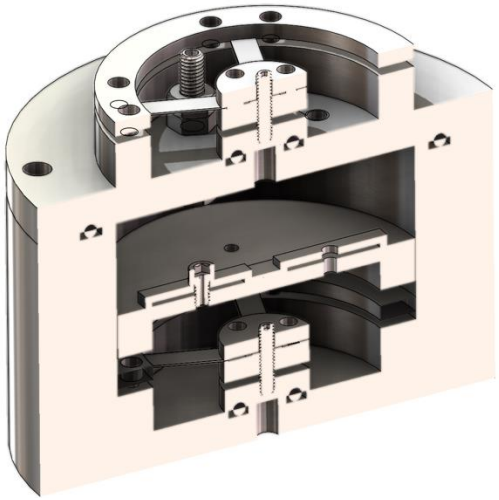


System Overview (Hardware Integration)

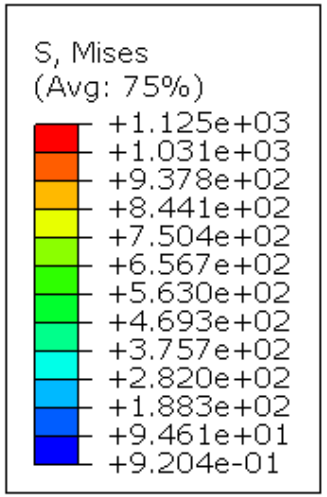


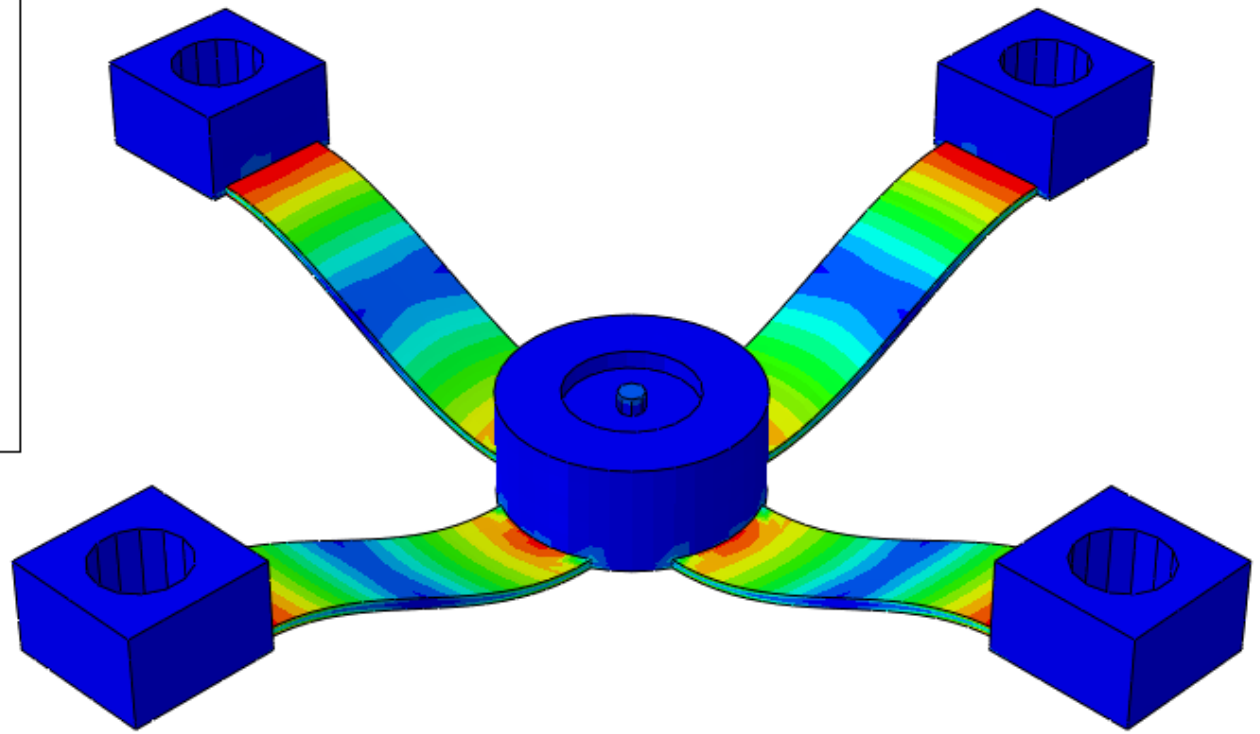
Sensing & DAQ (LabVIEW Integration)

Project – High-Pressure Test Chamber (300 MPa) with Pressure-Driven Actuation Module

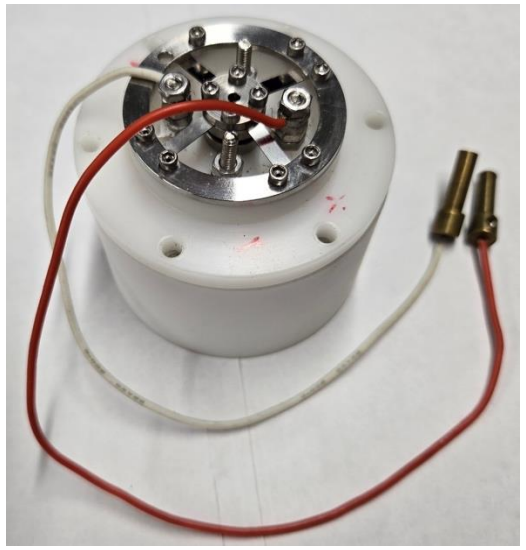


CAD Design (SolidWorks Cutaway)





FEA: Pressure-Driven Actuation Module (Switch for Pump/Vent Control)



Prototype Hardware

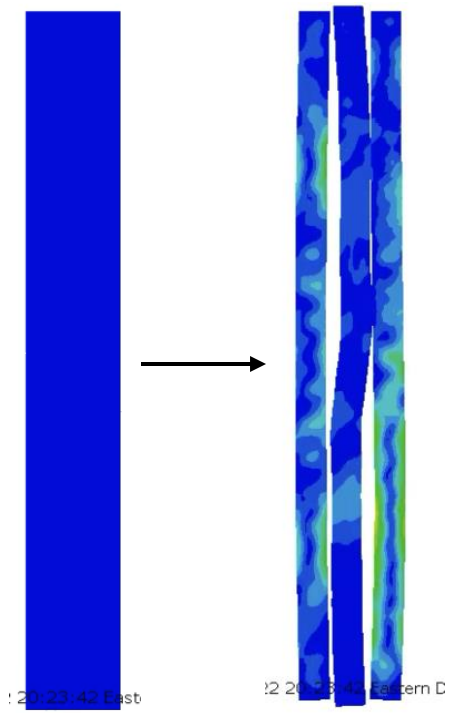
Key Contributions

- Designed a sealed 300-MPa chamber and verified structural/thermal stability via Abaqus FEA.
- Built and pressure-tested prototype; resolved leakage through iterative redesign.
- Implemented a pressure-driven actuation switch enabling pump/vent control.

Project – Digital Twin of Pressure-Shear Plate Impact Experiment

Finite Element Analysis

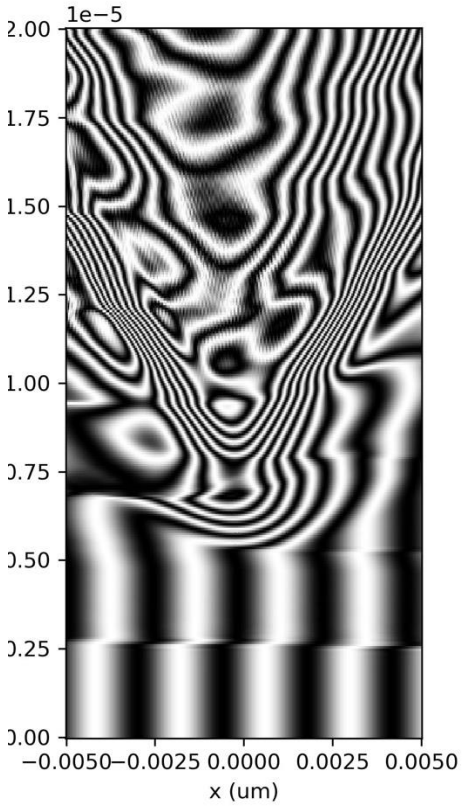
Modeled pressure–shear plate impact in Abaqus/Explicit with custom VUMAT + VUINTER, capturing mixed-mode crack evolution.



Initial Final

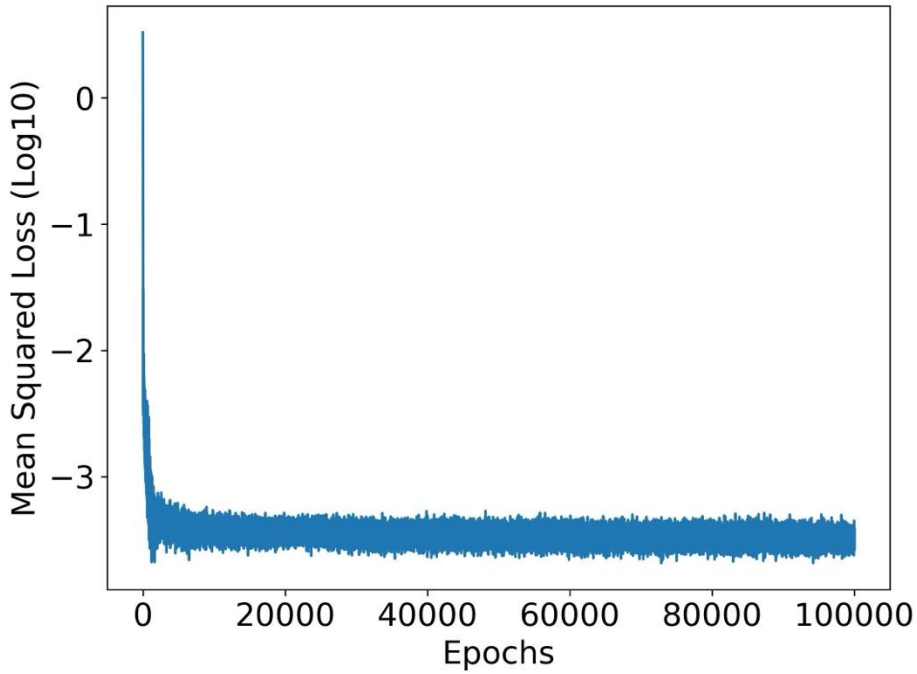
Python Post-processing

Converted simulated stress/velocity fields into synthetic interferometric sensor signals for experiment-matching.



Machine Learning

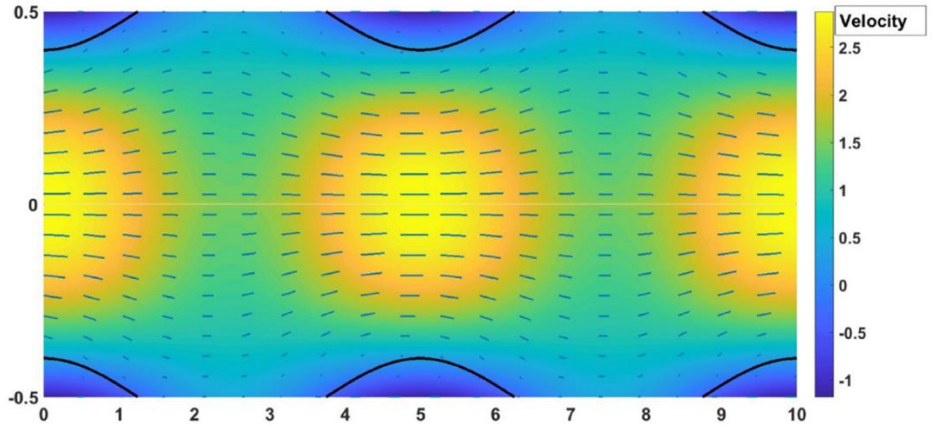
Trained neural network to map material properties → sensor response using Abaqus-generated data.



Project – Multi-Physics Simulation of Rough Microchannels (Fluent + COMSOL)

Fluent CFD — Rough-Channel Flow

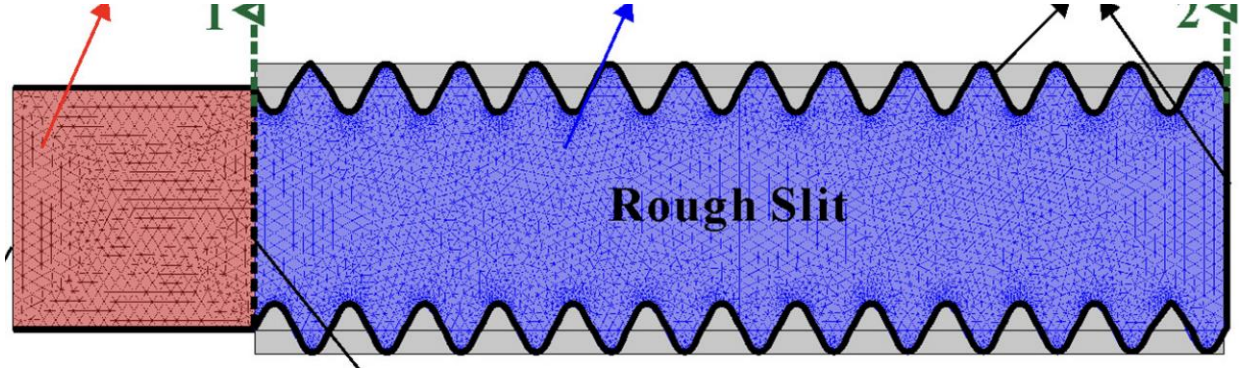
- Simulated laminar/Stokes flow through periodic rough geometries.
- Extracted velocity field and wall shear distribution.
- Quantified drag increase due to roughness amplitude.



Simulation of Stokes Flow in Rough Channels (Fluent-Ansys)
(velocity magnitude + in-plane streamlines)

COMSOL — ThermoAcoustic Wave Propagation

- Simulated pressure-acoustic propagation with thermal–viscous losses.
- Analyzed impedance, wave attenuation, and boundary-layer effects.
- Studied geometry-dependent absorption in rough slits.



Simulation of Acoustic Wave Propagation in Rough Slits (COMSOL-Multiphysics)
(mesh + boundary constraints from simulation export)