



# OPTICAL METHODS FOR SOLID AND FLUID MECHANICS

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**PRE-REQUISITES :** Not required, but background in fluid and solid mechanics and optics can be helpful.

**INTENDED AUDIENCE :** Final year undergraduate students in engineering; PG & PHD students wanting to specialize in experimental methods in fluid and solid mechanics

**INDUSTRY SUPPORT :** Industries requiring experimental work specially those involved in aviation,

### COURSE OUTLINE :

Course dealing with use of optical methods for quantification of fluid and solid mechanics phenomena. On the fluid mechanics front, the course will focus primarily on fluid flow visualization and quantification. Techniques discussed will include shadowgraphy, particle tracking velocimetry (PTV) and particle imaging velocimetry (PIV). The section on solid mechanics will cover a range of methods, including strain field visualization using Digital Image Correlation (DIC), stress measurements using photoelasticity and volumetric imaging using tomography.

### ABOUT INSTRUCTOR :

Prof. Alope Kumar received his Bachelors and Masters degrees from the Indian Institute of Technology, Kharagpur, India in 2005 and his Ph.D in Mechanical Engineering from Purdue University, West Lafayette, USA in 2010. After completing his doctoral work, Prof. Kumar joined the Oak Ridge National Laboratory (ORNL) as a Eugene Wigner Fellow. In this role, Prof. Kumar established a research program focused on understanding bacterial biofilms. After his post-doctoral work, Prof. Kumar joined University of Alberta's Mechanical Engineering Department, where he was the Canada Research Chair in Microfluidics for Biological Systems. He moved to the Indian Institute of Science in 2017. Prof. Kumar has almost two decades of experience in the field of fluid flow visualization and quantification. Prof. Koushik Viswanathan is an assistant professor at the Indian Institute of Science, Bangalore. He obtained B-Tech and M-Tech degrees in mechanical engineering from IIT Madras, followed by MS and PhD degrees from Purdue University. At IISc, he heads the Laboratory for Advanced Manufacturing and Finishing Processes (LAMFiP) and is interested in problems at the intersection of solid mechanics and materials science.

### COURSE PLAN :

**Week 1:** Introduction and Historical Context.

**Week 2:** Vector and Tensor fields in Mechanics.

**Week 3:** Imaging and Optics.

**Week 4:** Fluid Flow Visualization (Basics, Shadowgraphy, PIV/PTV).

**Week 5:** Solid deformation visualization (comparison with fluids, DIC methods).

**Week 6:** Stress-optic law and photoelasticity for plane stress problems.

**Week 7:** Tomography methods for volumetric imaging (optical, X-ray).

**Week 8:** Lab demo and discussion.