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ME 260 (AUG) 3:0

Structural Optimization: Size, Shape, and Topology

Instructor(s): G. K. Ananthasuresh

Course description:

A quick overview of finite-variable optimization and calculus of variations. Analytical size optimization of bars and beams for stiffness, flexibility, strength, and stability criteria in the framework of variational calculus. Gradient-based computational optimization of trusses, frames, and continuum structures. Sensitivity analysis for parameter, shape, and topology variables. Shape optimization. Topology optimization. Design parameterization for topology optimization of coupled structural problems involving thermal, electro-thermal, electrostatic, fluid, and other multiphysics domains.

Prerequisites:

Multivariable calculus and programming experience in MATLAB are preferred. Familiarity with finite element analysis is recommended.

Resources:

1. NPTEL MOOC: <https://nptel.ac.in/courses/112/108/112108201/>
2. Haftka, R. T. and Gurdal, Z., "Elements of Structural Optimization," Kluwer Academic Publishers, 1992.
3. Bendsoe, M. P. and Sigmund, O., "Topology Optimization: Theory, Methods, and Applications," Springer, 2003.
4. Haug, E. J., Choi, K. K., and Komkov, V., "Design Sensitivity Analysis of Structural Systems," Academic Press, 1986.

Outcomes:

After taking this course, the student will be able to:

1. Formulate structural optimization problems in the framework of calculus of variations as well as finite-variable optimization.
2. Become familiar with principles of structural optimization and be able to solve them analytically when it is possible and computationally in most cases.
3. Read and understand the contemporary literature on structural optimization in general and topology optimization in particular.

Additional information:

This course is open to doctoral and master's students interested in structural mechanics and optimization. Undergraduate students with sufficient background can approach the instructor for permission.

Course website: <https://mecheng.iisc.ac.in/suresh/me256/>