ASEN 5519 Topology Optimization

Spring 2018

Instructor: Kurt Maute
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Office Hours: W/F 1:00-2:00 pm in ECAE 183

Lectures: T/Th: 12:30- 1:45 pm, ECCR 131.

Class Web Site: log on to https://learn.colorado.edu/ to find ASEN5519 Design Optimization.

Class e-mail list: This is automatically done through D2L.

Texts:

Topology Optimization

1. *Optimization of structural topology, shape, and material* by Martin P. Bendsøe and O. Sigmund (available online: https://link.springer.com/book/10.1007%2F978-3-662-05086-6)
2. Topology Optimization in Structural and Continuum Mechanics by Rozvany, Eds (available online: https://link.springer.com/book/10.1007%2F978-3-7091-1643-2)

General textbooks on design optimization (mostly in the context of solid mechanics):

1. *Introduction to Optimum Design* by J.S. Arora
2. *Structural Optimization : Fundamentals and Applications* by U. Kirsch
3. *Elements of Structural Optimization* by R.T. Haftka, Z. Gurdal
4. *Foundations of Structural Optimization : A Unified Approach* by A. J. Morris
5. *Introduction to Optimization of Structures* by N.V. Banichuk
6. *Numerical Optimization Techniques for Engineering Design* G.N. Vanderplaats

Useful books on special topics

3. *Parameter Sensitivity in Nonlinear Mechanics* by M. Kleiber, et al.
4. *Design Sensitivity Analysis of Structural Systems* by E.J. Haug, et al.

Course Objectives: Introduce the fundamentals of topology optimization of problems in solid and fluid mechanics and heat transfer with a focus on problems in aerospace engineering. Topics include PDE constrained optimization, nonlinear programming, sensitivity analysis, shape optimization.

Major Course Topics:

1. Introduction into Optimization
    (a) Overview and terminology
    (b) Formulation of optimization problems

2. Topology Optimization of Discrete Systems - I
    (a) Ground structure method
    (b) Review of finite element analysis of trusses
    (c) Global search Methods:
        a. Integer and mixed-integer problems
        b. Genetic Algorithms and Evolutionary Strategies
        c. Particle swarm methods
    (d) Multi-objective and min-max problems

3. Topology Optimization of Discrete Systems - II
    (a) Relaxation of Integer Problems
    (b) Parameter sensitivity analysis of truss systems
    (c) Nonlinear programming methods
    (d) Optimality criteria methods

4. Topology Optimization of Continuous Systems Fundamentals
    (a) Maxwell and Michell Design Theories
    (b) Review of finite element analysis of continuous systems in solid and fluid mechanics and heat transfer
    (c) Parameter sensitivity analysis of continuous systems

5. Density Methods
    (a) Regularization methods and geometry control
    (b) Optimization with stress constraints
    (c) Optimization of heat transfer problems
    (d) Optimization of low problems

6. Level-Set Methods
    (a) Parametric level-set methods
    (b) Hamilton-Jacobi approach
    (c) Topological Derivatives

Grading Guideline:

Group work:	Projects	Group effort	50%
Individual:	1 Midterm Exam		20%
	Projects	Individual effort	30%
			100%

Note: We reserve the right to make minor changes to this distribution of weights based on variations in assignments.

Course Policies and Procedures:

1. The instructor reserves the right to reply to email questions only in business hours, i.e. Monday through Friday, 8:00 am 5:00 pm. Emails received 24 hours or less before the exams are not guaranteed to be responded to.
2. The instructor reserves the right to make changes to the weekly course schedule based on occurring events that require different dispositions. The instructors will give sufficient advanced notice through announcements in class and posting on D2L. Changes to this syllabus and assignments may be announced at any time during class periods. The instructors will post the current syllabus and assignments on D2L. Both are dated in the footnote.
3. This course exclusively uses D2L to send out announcements, to provide comments to students daily on class activities, and to provide general information about course assignments. It is strongly recommended that all students setup their D2L account such that they receive automatically a notification about new postings and updates to the D2L course page.
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