Robust and Reliability in Mechanical Design

Uncertainty in engineering design results in adverse product performances and variations. In this course we will study how to evaluate these impacts and how to systematically integrate these analysis approaches in design processes in mechanical design.

Course Objectives

1. Understand mathematical backgrounds of optimization theories.
2. Facilitate standard algorithms in solving continuous and discrete problems.
3. Establish the ability of generating Pareto set of a multi-objective problem.
4. Develop fundamental robust design backgrounds for mechanical engineers.
5. Provide examples to show the significance of engineering impacts on various sources of uncertainty models.
6. Determine uncertainty models based on existing data.
7. Understand various uncertainty analysis techniques.
8. Integrate uncertainty models in standard design optimization process.
9. Expand the concept of deterministic optimization to design for six sigma.
10. Review the state-of-the-art techniques in design under uncertainty.

Lecturer Information：

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Room : 603 Engineering Building
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Office Hour : 0900-1200 Tuesdays (or by appointment)

Course Information :

Time : 0910-1210, Wednesdays
Classroom : B04 Engineering Building
CEIBA course webpage : https://ceiba.ntu.edu.tw/1022ME5021_
Textbook : Course Handouts
References :

- "*Principles of Optimal Design: Modeling and Computation*" 2nd ed. by P. Papalambros and D. Wilde, Cambridge University Press, 2000
- "*Quality Engineering Using Robust Design*" by M. Phadke, Prentice Hall, 1989.
- "*Probability, Reliability, and Statistical Methods in Engineering Design*" by A. Haldar and S. Mahadevan, John Wiley & Sons, 2000.

Credits : 3
Grades (100%):

Attendance and participation	10%
Homework	30% (5% each)
Midterm Exam	20%
Individual Term Project	40%

Honor Code :

I have neither given nor received any unauthorized aid on any exam or assignment, nor have I concealed any violations of the Honor Code.

Schedule : (subject to changes**)**

Wk.	Date	Lecture	Assignment
1	2/19	Course Introduction, Design Concepts	
2	2/26	Optimization:Basics	
3	3/5	Optimization:Algorithms	Project Proposal Due
4	3/12	Multiobjective Optimization:Examples and Pareto Set	HW1. Bin packing problem
5	3/19	Multiobjective Optimization:Pareto Set Generation	
6	3/26	Multiobjective Optimization:Algorithm Uncertainty Model:Interval, Fuzzy, Random	HW2. Racing line
7	4/2	NO CLASS	
8	4/9	Midterm Exam Text	
9	4/16	Robust Optimization:Review and Comparisons	Project Progress Report Due
10	4/23	Robust Optimization:Algorithms and Applications	HW3. Comparisons of robustness formulations
11	4/30	Reliability-Based Optimization:FORM/SORM/MCS	
12	5/7	Reliability-Based Optimization:Algorithms	HW4. FOSM/FORM/MCS
13	5/14	Reliability-Based Optimization:Maximal Reliability	
14	5/21	Design for Six Sigma (DFSS):Concept and Theories	HW5. Ten-bar truss
15	5/28	Design for Six Sigma (DFSS):Applications	
16	6/4	Surrogate Modeling in Design:Regression, Neural Network, Kriging	HW6. DFSS
17	6/11	Project presentation	
18	6/18	Project presentation	Term project report