Indian Institute of Technology
Course Details Report

Course No: OE5031

Course Name: Optimization applied to ocean engineering problems

Course Type:

Theory

Description:

This course aims to provide an understanding of engineering design optimization using Artificial Intelligence (AI) techniques and to demonstrate their application in ocean engineering problems. Emphasizing strategies for minimizing time costs associated with computationally expensive problems, the course will cover coding-based optimization approaches applicable to engineering problems.

Course Content:

- Introduction to design optimization; formulation of optimum design problems, graphical optimization and fundamental concepts.
- Artificial intelligence and machine learning in engineering optimization, Overview, surrogate approximation, training of surrogates; optimization examples related to fluid and structural problems.
- Single objective optimization, constrained and unconstrained optimizations, objective functions, variables, and design space, sampling methods, factorial design, Latin hypercube sampling.
- Different surrogate models, response surface approximation model, neural network model, neurons, weights, and biases, training and cross-validation; other surrogate models; variable sensitivity; multi-surrogate modeling; example problems illustrating single-objective optimization.
- Optimizers, local and global search methods: genetic algorithms, population; local search, sequential quadratic programming.
- Multi-objective optimization, multi-disciplinary optimization, Pareto optimal front; other optimization techniques; automated optimization; examples illustrating multiple variables and multiple objectives optimization and Pareto optimal front.

Text Books:

- Arora J.S., ‘Introduction to Optimization Design’ – Elsevier Academic Press, New Delhi, 3e.
- Martins, J., & Ning, A. (2021). Engineering Design Optimization. Cambridge University Press. doi:10.1017/9781108980647
- Kim, K.Y., Samad, A., and Benini, E., Design Optimization of Fluid Machinery: Applying Computational Fluid Dynamics and Numerical Optimization, 2019, ISBN:9781119188292, John Wiley & Sons Singapore Pte. Ltd

Reference Books:

- Rao S. S., ‘Engineering Optimization, Theory and Practice’ – New Age International Publishers, 2012, 4th Edition
- Forrester, A., Sobester, A., and Keane, A., Engineering Design via Surrogate Modelling: A Practical Guide, Wiley (2008)
- Montgomery, D. C., Design and Analysis of Experiments, 8th ed., John Wiley (2012).