TEQIP-III Sponsored One week Workshop on

Engineering Design Optimization Including Multi-Disciplinary Optimization.

June 4-8, 2018

Course Coordinator

Dr. Vilas Kalamkar
&
Dr. M. S. Kotambkar

Organized By:

Department of Mechanical Engineering

Visvesvaraya National Institute of Technology,

Nagpur (INDIA)

Introduction:

Rapid prototyping and automation of engineering designs are the two keywords for future industrial revolution. There is a lot of awareness on Rapid prototyping; however there is hardly any awareness on automation of engineering design. It is clearly seen that as of now designing an engineering product consumes a lot of talent and other resources. The existing conventional design process is an iterative procedure. It starts with a baseline design derived from the user specifications. This baseline design is changed till its performance is acceptable. The conventional design method is characterized by three features: (a) The analysis methods for evaluation of performance are analytical formulae, computer simulations on software, i.e. CAD models, or experimental data obtained using hard models, i.e. prototypes. (b) If the performance is not satisfactory, the design is changed by trial-and-error based on the designer's intuition, experience or trade studies till a satisfactory design is found out. (c) Whether the design is "most optimal or not" remains unanswered in conventional design process. Engineering design optimization (EDO) / Multi-disciplinary design optimization replaces ad-hoc trial-and-error based conventional design method by the well formulated computational methods and algorithms based on mathematical theories. To start with EDO/MDO considers design of a product as a mathematical statement of minimization or maximization of a function that represents the performance of the product. The important features of EDO/MDO are as follows: (a) It casts user requirements as a mathematical function called objective function, howsoever complex it may be. It also identifies variables called design variables with constraints on them which are available for optimizing the performance of the product. (b) The EDO/MDO methods use computational tools which mostly involve regression or interpolation of legacy data, experimental or computational data. (c) Unlike in the conventional design, design variables are changed automatically by optimization algorithms, without any intervention from the designer. The optimization algorithms also specifically inform the designer, if the design is optimal (i.e. not only acceptable, but the best possible). The optimization algorithms in EDO/MDO also have responsibility to identify infeasible designs quickly. (d) Interestingly, EDO/MDO may not execute high fidelity analysis tools such as CFD or FEM directly, though it should have ability to process large data generated by such tools for extracting useful information that matters for performance of the product. EDO/MDO emerged in aerospace community as aerospace vehicles are complex multidisciplinary systems. It emerged in the 1980s following the success of the application of numerical optimization techniques to structural design in the 1970s. However, other than in automotive and aerospace industry, where is it is being tried EDO/MDO remains underused. There were many reasons: (a) the absence of EDO/MDO in undergraduate and graduate curricula (b) limited computing power did not permit analysis of large number of designs 3 | P a g e (c) resistance to accept the absence of the designer form design process. However, slowly the EDO/MDO is catching up in academic institutes, R&D organizations and also in industry. There are research papers describing intuitive tools that define, evaluate and optimize the performance issues in several industries such as aerospace, automotive, construction, defense, power, etc. Issues such as optimization of acquisition cost, operational cost, performance, operational effectiveness, and environment issues such noise, vibration etc. are being addressed. Off-the shelf products are not very common, but some proprietary software's, and open domain codes available for EDO and MDO. The aim of the course was to create awareness to a large cross section of faculty/scientists and engineers to work in this new direction

Coordinators

Dr. V. R. Kalamkar

Dr. M. S. Kotambkar

Objectives of the Workshop

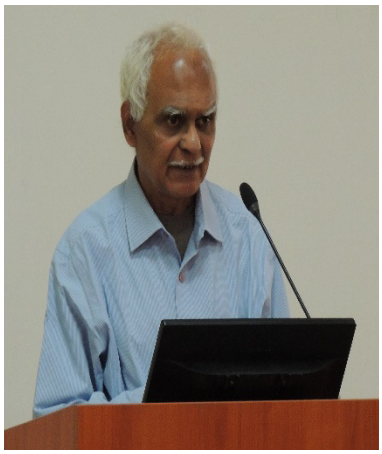
The course had multiple aims leading to training of participant in Engineering Design Optimization (EDO) including Multidisciplinary Optimization MDO) as follows.

1. Gradient and Non-gradient based algorithms
2. Optimisation and Multi-disciplinary optimisation
3. Tools for approximating the data
4. Demonstration of EDO and MDO for a couple of problems

Total participants: **72**

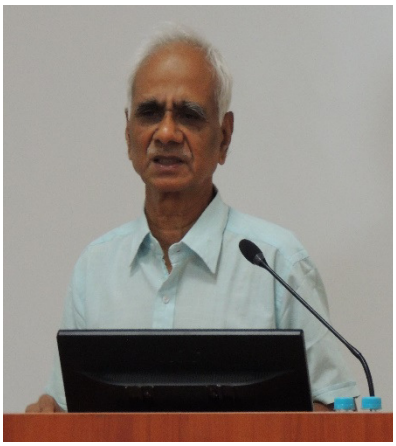
Prominent Speakers

Mr. Avinash Thakre
(VNIT-Nagpur)



Prof. RPRC Aiyar
(IIT Bombay)

Prof. R. P. Shimpi
(IIT Bombay)



Prof. Gopal Shevare
(IIT Bombay)

Mr. Basant Kumar Gupta
(Zeus Numerix)

Prof. Mangesh Kotambkar
(VNIT-Nagpur)

Mr. Suman Mohandas
(Zeus Numerix)

A group photo with all the participants