



Graduate course

***Structural optimization:
algorithms and applications***

May 25 and 26, 2023

**Delft University of Technology
Eindhoven University of Technology
University of Twente**

Location: Delft

General

The two-day course provides an overview of several popular optimization techniques, with particular focus on optimization methods for structural optimization applications. The first day of the course presents the general techniques of gradient-based optimization and Bayesian optimization using surrogate models. The second day considers finite-element-based optimization, with particular focus on the calculation of design sensitivities and structural topology optimization. The course has an informal character with ample opportunity for discussions with the lecturers and other participants.

Organization

The course is hosted by Delft University of Technology. The local organizing committee is composed of S. Koppen, D.P. Munro and M. Langelaar. Due to limitations regarding assistance with exercises, the maximum number of participants is 30.

Lecturers

- Dr. L.F.P. Etman (Eindhoven University of Technology)
- Dr. J. Havinga (University of Twente)
- Dr. S. Koppen (Delft University of Technology)
- Dr. D.P. Munro (Delft University of Technology)
- Dr. M. Langelaar (Delft University of Technology)

Lecture notes

Lecture notes and course material will be distributed digitally at the start of the course.

Prerequisites

Participation in the course is facilitated by basic familiarity with:

- Calculus and linear algebra;
- Continuum mechanics;
- Numerical techniques (notably, finite-element methods);
- Matlab (for exercises).

Contents

The course consists of lectures and some computer-practical sessions, and covers the following topics:

- 1) *Basic principles and gradient-based optimization*
Introduction, optimization problem formulation, conditions for optimality, concepts of gradient-based optimization methods, line search methods, trust region methods, methods in structural optimization.
- 2) *Bayesian optimization*
Concepts of surrogate modeling, kriging, radial basis functions, sequential improvement, with applications to optimization.
- 3) *Structural sensitivity analysis*
Approaches, finite difference gradients, semi-analytic derivatives, adjoint formulation, continuum derivatives.
- 4) *Structural topology optimization*
Sensitivity analysis, topology optimization concepts, SIMP method, level set method, applications of topology optimization.

Assessment

The course is concluded with a short assessment, based on the presented content. In order to complete the course, participants must pass this assessment.

Fee/Registration

The course is free for registered members of the graduate school Engineering Mechanics and for the research members of the contributing research groups. Participants need to register by completing the registration form, which can be found at:

<https://engineeringmechanics.nl/courses/#upcoming> . Please register **ultimately May 14, 2023**. Members of the Graduate School Engineering Mechanics receive priority in case of over-subscription.

Further information

Both course days start at 10.15 hour and end around 17.00 hour, and include a lunch break.

Please make sure you have Matlab installed on your computer.

For more information about the contents of the course, feel free to contact:
Matthijs Langelaar, TU Delft (m.langelaar@tudelft.nl)

Further information about the educational programme and other activities of the Graduate School on Engineering Mechanics can be found at: <https://engineeringmechanics.nl/>.