Graduate course

Mechanics of Large Deformations

December 16th – 18th 2020

Nonlinear Solid Mechanics
Faculty of Engineering Technology
University of Twente

General

Equilibrium of forces and moments—or the equations of motion in dynamics—must be considered in the deformed configuration—the current state. Even for materials with linear stress–strain relations, the equilibrium equations are fundamentally nonlinear. In many practical cases only small errors are made if these equations are linearized, but for large deformations this is not valid. For large displacements and rotations and especially for large deformations, concepts like strain and stress, known from small deformation mechanics must be redefined to remain meaningful.

This course provides the mathematical and physical basis for a proper analysis of large deformation problems. Equilibrium conditions and stress and strain measures are derived with respect to the deformed and undeformed configuration. Special consideration is given to the formulation in finite element technology with a total or updated Lagrangian approach or with an Arbitrary Lagrangian–Eulerian (ALE) formulation.

Local organization

The course is organized by the Nonlinear Solid Mechanics group of the Faculty Engineering Technology at the University of Twente. The local organizing committee is composed of

- Prof. dr. ir. Ton van den Boogaard
- Dr. Javad Hazrati

Lecturers

- Prof. dr. ir. Ton van den Boogaard
- Dr. Semih Perdahcıoğlu
- Dr. Javad Hazrati

Lecture notes

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

Prerequisites

Participants are expected to have basic familiarity with:
- linear continuum mechanics;
- linear finite element analysis;
- nonlinear solution techniques.

Contents

The course covers the following topics:

1) *An introduction to geometrical nonlinearity*
   a. Limitations of geometrical linear theory
   b. Geometrically nonlinear equations for a simple truss structure
   c. Nonlinear solution techniques (refresher)

2) *Kinematics*
   a. Position vectors and coordinate systems
   b. Deformation tensor
   c. Strain tensors
   d. Deformation rates

3) *Stresses and balance laws*
   a. Equilibrium in deformed and undeformed configuration
   b. Energy conjugated stress definitions
   c. Objectivity requirements
   d. Incremental objectivity and corotational formulations

4) *Finite element formulations*
   a. Total Lagrange
   b. Updated Lagrange
   c. Arbitrary Lagrangian–Eulerian

Fee/Registration

Participants need to register by completing the online registration form, which can be found at http://wwwhttps://engineeringmechanics.nl/courses/ and returning it **before Dec 7rd, 2020** to the Secretariat of the Graduate School Engineering Mechanics, Eindhoven University of Technology.

Location/date

Owing to the COVID19 outbreak, the university campus will be closed until further notice. For this reason, this edition of the Engineering Mechanics course "Mechanics of large Deformations" will be provided online. Further details about the online setup of this course will be communicated to the registered participants in due time before the start of the course.

Course assessment

Credits for this EM courses will be awarded on the basis of successful completion of a course assessment. Details regarding the assessment procedure will follow.

For more information on the contents of the course, contact:

Dr. Javad Hazrati, UT
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Further information about the educational programme and other activities of the Graduate School on Engineering Mechanics can be found at: http://www.engineeringmechanics.nl.