

# 5R14 - Nonlinear Solid Mechanics

<b>Lecturer:</b>	Dr F Cirak
<b>Timing:</b>	Lent term
<b>Prerequisites:</b>	This module is available to first year research students (PhD or MPhil)
<b>Structure:</b>	14 afternoon lectures, two per week
<b>Assessment:</b>	Coursework

## Aims and Scope

The main objective of this module is to introduce students to aspects of nonlinear mechanical behaviour of solids and structures. The focus is on formulations that are of interest in application of finite elements to solid and structural mechanics. The module includes a hands-on component based on a commercial software for introducing students into the complexities and pitfalls of nonlinear analysis. The target audience are new students who will develop or use nonlinear finite elements as part of their research.

## Syllabus

### Nonlinear truss mechanics (4 Lectures)

- Governing equations
- One-dimensional nonlinear strain measures
- Finite element discretization
- Elasto-plastic behavior

### Continuum mechanics (6 Lectures)

- Vector and tensor algebra
- Kinematics of deformation
- Stress and equilibrium
- Equilibrium equations in weak form
- Hyperelastic material models

### Finite Elements (4 Lectures)

- Review of the basic finite element method
- Discretization of the nonlinear equilibrium equations in weak form
- Linearization and Newton-Raphson iteration

## **Coursework**

- During the term, three sets of homework assignments; one of which will be on computational analysis of a selected nonlinear mechanics problem
- At the end of the term, a presentation on a research paper relevant to the course content (15 minutes talk + 5 minutes discussion)