

PX920-10 Micromechanics of Materials

26/27

Department

Physics

Level

Taught Postgraduate Level

Module leader

Lukasz Figiel

Credit value

10

Module duration

10 weeks

Assessment

60% coursework, 40% exam

Study location

University of Warwick main campus, Coventry

Description

Introductory description

N/A.

[Module web page](#)

Module aims

Provide students with understanding and practical aspects of homogenisation methods for predicting overall macroscopic response of heterogeneous solids with nonlinear material constituents through lectures, case studies and computer-lab (workshop) activities.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

Topic 1: Fundamentals of Nonlinear Solid Mechanics

- a. Theory of finite deformations - brief recap
- b. Nonlinear constitutive equations (e.g. hyperelasticity, plasticity, viscoplasticity)
 - i) Phenomenological

ii) Physically-based

iii) Data-driven

Topic 2: Methods for predicting macroscopic properties of nonlinear heterogeneous solids

a. Mean-field approaches

i) Self-consistent methods

ii) Mori-Tanaka methods

b. Homogenisation

i) Homogenisation for linear periodic heterogeneous materials

ii) Homogenisation for nonlinear periodic heterogeneous materials

Topic 3: Extensions to multi-physics problems in nonlinear heterogeneous solids

a. Mean-field approaches

b. Homogenisation

Learning outcomes

By the end of the module, students should be able to:

- Understand sources of material nonlinearity.
- Be familiar with common constitutive models.
- Be able to implement nonlinear constitutive models into nonlinear solution process.
- Understand the concept of homogenisation.
- Apply a nonlinear mean-field approach to a simple problem.
- Be able to design and implement a simple two-scale nonlinear simulation process.

Indicative reading list

[Reading lists can be found in Talis](#)

Subject specific skills

Understand sources of material nonlinearity

Be familiar with common constitutive models

Be able to implement nonlinear constitutive models into nonlinear solution process

Understand the concept of homogenisation

Apply a nonlinear mean-field approach to a simple problem

Be able to design and implement a simple two-scale nonlinear simulation process

Transferable skills

Programming, data analysis, problem-solving

Study

Study time

Type	Required
Lectures	6 sessions of 2 hours (14%)
Practical classes	2 sessions of 2 hours (5%)
Private study	69 hours (81%)
Total	85 hours

Private study description

Reading etc

Costs

No further costs have been identified for this module.

Assessment

You do not need to pass all assessment components to pass the module.

Assessment group D1

	Weighting	Study time	Eligible for self-certification
Assessment component			
Computational Project	60%	10 hours	No
One piece of assessed work based on the numerical implementation of homogenisation procedure.			

Reassessment component is the same

Assessment component

Viva voce Exam	40%	5 hours	No
30 minutes.			

Reassessment component is the same

Feedback on assessment

Written annotations to submitted computational notebooks \r\nVerbal discussion during viva voce exam \r\nWritten summary of viva performance

[Past exam papers for PX920](#)

Availability

There is currently no information about the courses for which this module is core or optional.