Modal Analysis

VU 325.100

Florian TOTH

2020S

Course Information

Aims & Scope

Organisation

Team Learning

Lab

Grades

Aims & Scope



- Introduction to modal analysis and model order reduction
- Theoretical background explained by the example of mechanical, linear multi degree of freedom systems
- Experimental application demonstrated by lab experiments

understand the concept of a modal basis, apply it to achieve model order reduction, and be familiar with experimental modal analysis techniques

Reduce 10.000 to 10 degrees of freedom!

Learning Objectives



Upon successful completion of the course students

- are familiar with the concept of time and frequency domain analyses of linear multi-degree-of-freedom systems,
- can derive the free oscillation EV problem and interpret its solution,
- can use a modal basis for model order reduction,
- can describe the working principles of measurement equipment for experimental modal analysis,
- can extract natural frequencies and mode shapes from measurement data by using various identification techniques.

Additionally, the course offers a possibility to

- work efficiently in teams,
- · learn with and from other students, and
- improve presentation and communication skills.

Organisation



The course uses a team-learning approach, consisting of

- lectures, exercises, presentations, lab demonstrations and exercises, and is
- graded by participation, group exercises, and an individual exam.
- Details in the course manual in TUWEL.

Please sign up to the TUWEL course!

Dates



all events at Wednesday, 09:00-11:00 in BA 05

- 04/03/2019 Introduction & course information, overview lecture 1 11/03/2019 First team meeting (attendance for team distribution)
- 18/03/2019 Team learning
- 25/03/2019 Workshop 1 (attendance), overview lecture 2
- 01/04/2019 Team learning
- 22/04/2019 Workshop 2 (attendance), overview lecture 3
- 29/04/2019 Team learning
- 06/05/2019 Workshop 3 (attendance), overview lecture 4
- 13/05/2019 Team learning
- 20/05/2019 Team learning
- 27/05/2019 Workshop 4 (attendance), overview lecture 5
- 03/06/2019 Team learning
- 10/06/2019 Team learning
- 17/06/2019 Workshop 5
- 24/06/2019 Final test

Course Content



The course is structured in 5 modules:

- 1 The free oscillation Eigenvalue problem
- Time and frequency domain
- Model order reduction
- Measurement techniques for modal testing
- 6 Identification Methods for modal analysis

Team Learning Approach



- Participants will be working in teams of 3-4 students
- Team members are encouraged to learn from each other and to work together to achieve the learning objectives
- Work can be shared freely, but every team member must be able to account for work done by others in a meaningful way (e.g. explain the basics)
- Each course module constitutes a learning cycle (lecture, teamwork, workshop)

teaching others is learning twice!

The team learning approach is optional. If students decide to work on their own they are required to complete all tasks individually!

The Learning Cycle



The course will be split into

- 5 learning cycles lasting 2-3 weeks
- each covering one module of the course.

One cycle consists of

- overview lecture (week 1)
- exercise phase including one team meeting (week 2)
- 3 workshop (week 3) concluding the topic.

Overview lecture



- Held by Florian Toth
- Introduction to the topic of the module
- Presentation of the exercise problems

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Exercise phase



The exercise phase is intended to

- review the material presented at the overview lecture
- work on exercise problems / perform lab measurements

Each exercise phase must contain one team meeting to

- discuss the exercise problems
- prepare for the workshop

Each meeting needs a chairperson and a secretary. See the *course manual* for details.

You must upload the *minutes of the meeting* immediately after the meeting to the *Team Logbook* in TUWEL.

Team Meetings



Some tips for efficient meetings:

- come prepared
- decide on an agenda at the start
- appoint a chairperson (which is responsible for following the agenda)

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Workshop



The workshop concludes each learning cycle and will be chaired by FT

It is intended to

- summarize the topic
- discuss difficulties and insights
- provide solutions for exercise problems

During the workshop the teams will be asked to

- present their solution for homework problems
- shortly present their team's main difficulty and main insight

Please sit down together with your team during the workshop.

Lab



Parts of the courses team learning activities consist on working in the lab. You will

- investigate an oscillating plate,
- obtain measurement data for modal analysis,
- do hands-on measurements.

Requirements / Grading Criteria



To complete the course you must participate in the teamwork activities by working on exercise problems, take part in discussions, and sharing your team's responsibilities.

Grading is based on

- Presentations during workshops
- Submissions of solutions to selected exercise problems
- Individual written exam

See the course manual for details regarding the weighting of the different parts.

Final Grade



Computed from the sum of points obtained in the individual parts

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p > 50\% genügend
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p > 60% befriedigend

p > 80% gut

p > 90% sehr gut

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