A Study Guide

Topics

The content of this 3rd cycle course given at the division of Machine Elements, Luleå University of technology, is related to following topics:

i. Computational contact mechanics (CM)
ii. Modelling and simulation of flows in thin films (TFF)
iii. Multiphysics problem(s) in lubrication (MPH)

Instead of doing the predefined multiphysics problem (iii.), there's a possibility to formulate and carry out a project you think would be useful for your own PhD-project. The examination of this project will then involve:

- A Description of the mathematical model, including approximations and assumptions
- Presentation of numerical solution method
- Limitations / range of applicability
- Verification of the implemented solution procedure
- Justification of the validity

Course flow / teaching

The theory behind each topic will be introduced during lectures and video tutorials. The course material will be based on hand-outs, complemented by recommendations for further reading.

The majority of the course will be student's independent work on the course assignments. There will also be computer labs with teaching assistance for each topic.

Assignments

For each topic, there will be one assignment. The assignments can with advantage be carried out in groups, but this is the student's own choice. Each assignment will involve:

- Theory and modelling
- Discretization and pseudo coding
- Implementation and numerical solution
- Peer-review & discussion
- Written report

The work on all assignments should be documented in one technical report. The report should be a self-contained technical report and a comprehensive summary of the numerical implementations. The detail level of the report should be such that it can be handed over to another student, with similar background but who have not taken the course, and they should be able to use the numerical simulation procedures you have implemented in order to reproduce what you have done.

The solution procedures implemented in MATLAB should be well-structured and richly commented. The MATLAB code should follow the structure below:

Input
Physical properties such as speed, elastic modulus etc.
Numerical specifics such as number of nodes, tolerances on residuals for convergence, etc
Pre-processing
Computing dimensionless parameters, generating discrete solution domain
Solver
Routine for solving the problem at hand
Post processing
Computing output parameters such as friction, real area of contact, etc
Visualization

The peer-review procedure will commence as follows:

i) Each student's numerical implementations will be assessed by other peers, who summarise their assessments in review reports.
ii) The responding student should then revise the numerical implementations, by means of the review reports and they should also write (very condensed) rebuttals indicating how the reviewers' comments was considered and which changes that was made.
iii) The technical report should be handed in to the responsible teacher. The report should comprise the work in all assignments and include appendices with the revised numerical implementations, the original review reports with associated (very condensed) rebuttals indicating how the reviewers' comments was considered.

Examination

Assessment and evaluation of the assignments will involve the student peer-review procedure described in the following. The numerical implementations of each peer will be evaluated by other peers, who will comment and report back on the quality and completion of the assignment. The review reports should be uploaded in CANVAS as well as handed over to the evaluated peer who should update the MATLAB code with consideration to the review. The technical report comprising all assignments, including appendices with the revised MATLAB codes, the review reports and rebuttals, should then be uploaded in CANVAS for final evaluation and marking by the responsible teachers. An oral exam (online if necessary) will be held in order to test the students learning individually.

Responsible teacher (examinator)

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