

Final report Engineering Optimization – Concepts & Applications (ME46060)

Aim: demonstrate obtained skills and knowledge (material discussed in lectures and techniques practiced in the exercises) by application of the techniques considered in the course to a practical problem, or by the critical study of certain algorithms.

Recommended report contents

(not all points may apply in all cases)

- Statement of contribution (obligatory when working in pairs: see below for more)
- Introduction, background, motivation
- Problem formulation
 - Optimization problem (also present mathematical problem statement)
 - Modelling aspects (incl. discussion of simplification choices)
- Initial problem investigation
 - E.g. boundedness, monotonicity, convexity
 - Numerical noise
 - Sensitivity analysis
- Initial optimization on simplified problem (e.g. 2 variables)
 - Motivation of optimization approach, choices
 - Investigation of obtained optimum
 - Observations, interpretation of results, conclusions
- Optimization of actual problem
 - (Same points as above)
 - (possibly including different variations of model, problem formulation, optimization approach)
 - Observations, interpretation of results, conclusions
- Overall conclusions and recommendations
- References
- Appendices
 - Matlab code used (preferably, *include this digitally*)
 - Additional graphs/data, when applicable

Typical length of report: about 12-15 pages (individual) or 16-20 pages (pairs), excluding Statement of Contribution and Appendices. The fontsize should be such that a maximum 45 lines fit on a page (11pt), or larger. A penalty method will be applied to this constraint.

Statement of contribution: indicate your individual contributions to the work in the following format:

Topic	Involvement <name student 1>	Involvement <name student 2>
Problem definition	(together)	(together)
Topic 2	Performed the calculations	Checked the result
Topic 3	(together)	(together)
Etc. (list all topics relevant to ME46060 that are addressed in the report)		

If this statement is missing, your report cannot be graded.

General guidelines

- Include at least 2 continuous design variables.
- *Avoid spending most of your effort on the modelling.* This course is not about modelling, but about optimization. Focus on demonstrating your optimization skills and knowledge. Rather crude models and big simplifications are allowed in this course (but mention clearly where simplifications are made!).
- Use at least 1 optimization algorithm that you have (partly) implemented yourself. For inspiration, see e.g. Exercise 4 or 7.
- When making optimization-related statements or observations, also include the material (numbers, figures) they are based on. Whenever possible, allow the reader to verify your findings.
- *Experiment!* Investigate different approaches (e.g. formulations, algorithms), and also report on things that did not work well. Try to explain why something did or did not work.
- *Show what you know!* This remains a 3.0 ECTS course, so time and report pages are constrained. Within these constraints, choose your report content such that it optimally illustrates your level of knowledge and understanding of the course topics.
- *Cite your sources.* If you present material copied from others as your own, this is plagiarism. This is a form of fraud which can have serious consequences. Avoid confusion and cite your sources. This also applies if the source is your own work for another course.

Guideline for topology optimization projects

Topology optimization is increasingly popular as a project topic. However, it is often difficult to include sufficient aspects of the course in this type of project. Specifically for topology optimization projects, minimal demands are to include {individual: 3; pair: 5} out of the following aspects, next to your project case study itself:

1. Study of optimization behavior in terms of various problem parameters, e.g.:
 - a. Effect of mesh resolution, filter size
 - b. Effect of allowed volume
 - c. Effect of starting design
 - d. Effect of physical problem parameters
2. Study of the effect of modification of boundary conditions

3. Study of the effect of modification of problem formulation (same problem, different mathematical structure, e.g. exchanging objective and constraint, or transforming into unconstrained problem)
4. Discussion of sensitivity analysis including numerical study
5. Study of the use of different optimizers
6. Implementation and study of an approach found in literature
7. Consideration of multiple loadcases
8. Consideration of an eigenvalue optimization problem
9. Consideration of a multi-material problem

Please indicate clearly in the report which aspects you have chosen.

Grading criteria

The following criteria play a role in determining the optimization project report grade:

- Level of difficulty
- Modelling choices & motivation
- Problem formulation choices & motivation
- Proper use of relevant techniques
- Critical investigation
- Algorithm choices , motivation and implementation
- Algorithm usage and evaluation
- Study & interpretation of results
- Conclusions & recommendations
- General report readability, clarity, completeness

Good luck with your project!