

# Numerical Libraries

Seminar

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## Contents

This *Seminar* aims to reinforce the participants' ability to conduct academic research. For the given topic participants are required to

- find and read related material giving an overview of the field,
- set the research agenda, e.g. by focussing on a subtopic, and write and defend a corresponding research proposal,
- conduct in-depth research into the chosen (sub)topic,
- author a manuscript to be published,
- present the manuscript to the audience.

The following topics shall be covered:

1. Roots of One or More Transcendental Equations
2. Fourier Transforms
3. Wavelet Transforms

4. Quadrature
5. Ordinary Differential Equations
6. Partial Differential Equations
7. Integral Equations
8. Mesh Generation
9. Interpolation
10. Curve and Surface Fitting
11. Minimizing or Maximizing a Function
12. Global Optimization of a Function
13. Simultaneous Linear Equations
14. Least Squares and Eigenvalue Problems
15. Correlation and Regression Analysis
16. Analysis of Variance
17. Time Series Analysis

## Approach

A topic is assigned to each participant at the first meeting on **April 21, 2017** at 10:00 in room **2.31** of the ITC building. The NAG Library<sup>1</sup> can serve as a possible *entry point* to the topic. Following the first meeting literature and online research is required to produce a written **research proposal** to be submitted by **May 19, 2017**. The proposal needs to be accompanied by a signed **Declaration of Compliance** with the *Ethical Guidelines for the Authoring of Academic Work*. It is defended during a 10 minute oral presentation on **dates to be specified**. Each participant produces a written report (10-15 pages) covering both theoretical and practical (algorithms, applications, reference implementation) aspects of the topic. The reports need to be submitted by **July 14, 2017**. 30 minute final oral presentations will be scheduled for **dates to be specified**.

## Proposal and its Presentation (MOTIVATE)

Your written proposal's aim is to get first and early feedback on your research plan. It serves as the starting point for the final report. Its oral presentation is supposed to **MOTIVATE** the planned work. Imagine that your next semester's salary depends on the quality of this presentation.

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<sup>1</sup>[http://www.nag.co.uk/numeric/numerical\\_libraries.asp](http://www.nag.co.uk/numeric/numerical_libraries.asp)

### Specific Hints

1. Use the provided L<sup>A</sup>T<sub>E</sub>X frame as the basis of your 2-3 pages written proposal covering
  - problem description
  - state of the art and literature survey
  - work plan including milestones, deliverables, and risk management
2. Stay within the allocated 10 minutes.
3. Use the provided L<sup>A</sup>T<sub>E</sub>X frame for slides.

### Final Presentation (SELL)

**SELL** your final report. Your report is a publication. Publications are supposed to be read by other people. You need to generate interest in your work if you want it to become a *best seller*.

1. Provide an overview of your report's contents.
2. Summarize problems, theoretical results, and algorithmic solutions.
3. Discuss the state of the art and provide examples for relevant applications and ongoing related R&D projects.
4. Give an outlook to potential follow-up projects.
5. Use the provided L<sup>A</sup>T<sub>E</sub>X frame for slides.
6. Stay within the allocated 30 minutes.

### Report (PUBLISH)

1. Give a detailed description of the problem.
2. Present a survey of the problem's history and present activities including literature about the problem, applications, and methods for its solution as well as related software. You should provide an *extensive bibliography*. Your research proposal should be based on this literature research phase.
3. Discuss the selected subtopics in detail. Use *self-made examples* for illustration.
4. Develop three *tutorial exercises* covering different aspects of your topic. Present the *solutions* in the appendix of your report.

## General Guidelines

1. Stay within the allocated time.
2. Have extra material available in case you finish early.
3. Practice your presentation.
4. Never copy and paste.
5. Design your own examples.
6. Use a spell checker.
7. Check the hardware prior to your presentation.