Semester Project Description

Empirical modeling of the dynamic behaviour of a non-homogeneous cylinder

J.M. Fürbringer
Modeling and Design of Experiments – SPH EPFL

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Project Description

The project focuses on the study of a non-homogeneous cylinder rolling down inclined rails. Students will investigate the effect of weight distribution on the dynamic behaviour of the system. The objective is to model the motion using Taylor polynomials and determine the optimal distribution of four weights placed on four axes, such that the transit time between the start and the end of the rails is minimized.

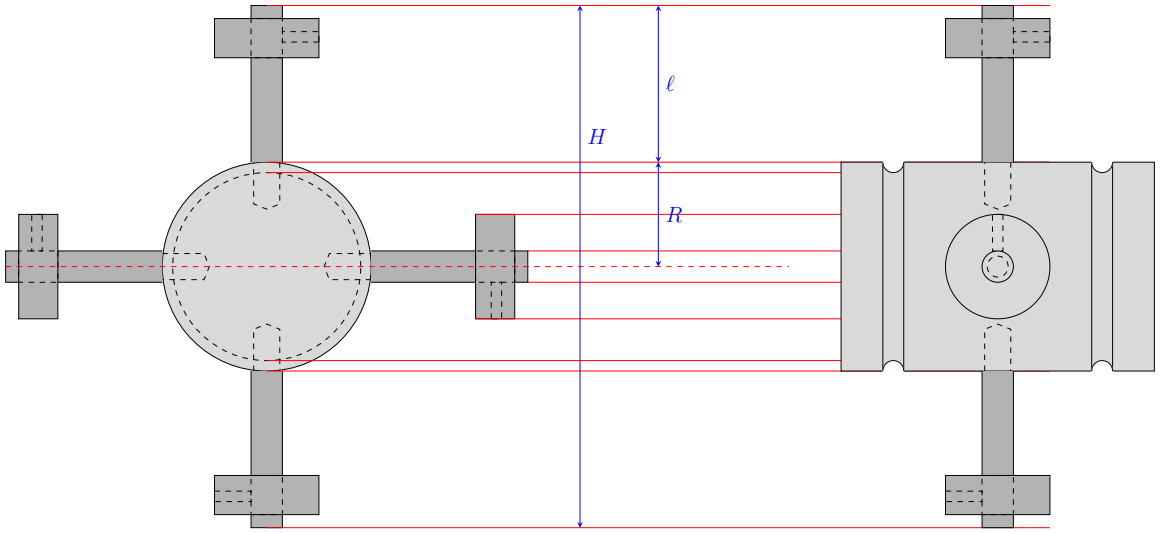

Figure 1: Monge projection of a non-homogeneous cylinder.

Objectives

- Develop an empirical model of the cylinder's dynamics using Taylor series approximations.
- Experimentally evaluate how the distribution of masses affects rolling behaviour.
- Optimize the weight configuration to minimize transit time.
- Practice the methodology of experimental design, data collection, and model validation.

Timeline and Deliverables

Intermediary Report (due October 17, 2025) A PDF document of 4–8 pages (excluding annexes). The report should include the problem statement, experimental objectives, chosen design, and initial data collection plans. The document must follow technical reporting standards: clear structure, page numbering, readable graphics, and properly labelled axes with units.

Peer Review (between October 17 and November 3, 2025) Each group will review another team's intermediary report. A short feedback report should be prepared, providing constructive comments in a fair and collegial manner.

Final Report (due January 6, 2026) A PDF document not exceeding 20 pages (excluding annexes). The report should include methodology, data analysis, results, and conclusions. Annexes may include Matlab or Python codes. The same standards for technical reporting apply.

Oral Examination Each group will present their results in an oral session followed by a Q&A with the instructor.

Team Work

Students will work in teams of three. Each team member is expected to contribute equally. Collaboration is required across all aspects of the project, even if specific roles are assigned internally.

Evaluation Criteria

The project will be graded as follows:

- Intermediary Report: 20%

- Peer Review: 10%
- Final Report: 30%
- Oral Examination: 40%

Resources Provided

The experimental setup (non-homogeneous cylinder system and rails) is available in the lecturer's office. Teams will be scheduled in turns to ensure fair access. Additional resources include Matlab and Python for analysis, and guidance from the instructor.

Use of AI Tools

In accordance with EPFL guidelines, students are allowed to use Artificial Intelligence (AI) tools as support for this project, under the following conditions:

- **Permitted uses:** assistance in coding (with mandatory testing and verification), and improvement of written text form (clarity, structure, grammar).
- **Not permitted uses:** searching for new knowledge or concepts, generating unverifiable technical content, or entering confidential/sensitive data.
- **Transparency:** Any use of AI must be explicitly acknowledged in the reports. Students should describe how AI was used (e.g., for code debugging, improving English phrasing) and remain critical of the outputs.

The philosophy is that AI can assist with form and efficiency but cannot replace understanding. Students are fully responsible for the correctness and originality of their work.

Important Information

- Deadlines are strict. Late submissions will be penalized unless justified by extenuating circumstances.
- All work must be original and properly cited. Plagiarism will result in severe academic penalties.
- Teams are encouraged to communicate regularly with the instructor for guidance and clarifications.

Conclusion

This semester project is a critical component of the course. It provides students with the opportunity to apply theoretical knowledge in a practical context. Successful completion will enhance understanding of experimental design and prepare students for future professional and research challenges.