

Exercise 11: Your Own Project for Modelling and System Identification
(to be returned on February 2nd, 2015, 8:15 in HS 26, or before in building 102, 1st floor, 'Anbau')

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The last two exercises come in form of a small project. The aim is to model a self chosen system. Ideally, one selects a real-world dynamic system for which input and output data can be generated and measured in form of time series. The objective is to develop and identify a system model, using these measurements and an appropriate method, as in one of the exercise sheets. One might use white box or black box modelling techniques, in discrete or in continuous time, with linear or nonlinear models, with linear-in-the-parameters models or not. One modelling technique is enough. The final identified model can be used to predict the system response for a previously unknown input. This prediction might be compared with new measurements. Also, one might want to give the confidence bounds of the parameter estimates.

The project will be valid 20 points plus 10 bonus points, which are added to the total points of the other exercise sheets. The project will not have an immediate influence on the final course grade, but, like the other sheets, some exam questions will be easier to answer if one has worked on it.

Some guidelines for the projects

1. A project can be done by one, two or three people.
2. The main result is a short written report of at least one page, maximum 2 pages, as a PDF.
3. The report must be a new and self-written document and may not contain any copy of other text or figures. Not a single one. The report must be solely written by the author(s).
4. The report should have a short interesting title, the name of the author(s), and be structured like a short report with section titles and only full sentences in the text. It should start with a clear introduction and conclude with a short summary and critical discussion of the results (examples of some good reports from the previous year are shown on the course webpage).
5. The report should contain at least one sketch or a photo of the modelled system, a mathematical description of the chosen or developed system model, possibly a plot of the measurement data and simulated system response.
6. Figures or tables shall have a short caption and be referenced in the text like e.g. “the result of this simulation is shown in Fig. 1”.
7. The report must cite all used external sources as references at the end, and other people’s contributions must be acknowledged. Using other people’s ideas and help is allowed, even encouraged. But not citing or acknowledging them properly is a crime.
8. Mathematical or physical variables shall consist of one letter only and be printed in italics. This is automatic in Latex, e.g. a_i as `$a_i$`. Physical units and sub- or superscripts that mean words are in normal roman letters (use `\mathrm` when in Latex `mathmode`, e.g. x_{initial} as `$x_{\mathrm{initial}}$` or $\frac{\text{kg}}{\text{m}^3}$ as `$(\mathrm{kg})/(\mathrm{m}^3)$`. Write e.g. $m = 5 \text{ kg}$ (and not $m = 5kg$ or $m= 5kg$).
9. Measurements and graphs must contain physical units and axis descriptions.
10. On February 4, 2015, from 8-10, a short presentation of 2-5 minutes (with maximum 3 powerpoint or PDF slides) shall be given by the author(s) to the teacher and the class. The slides can be partially based on material copied from the report, but also contain other material like movies. It is also allowed to base the presentation entirely on the PDF of the report.
11. The project mark is based on the form and content of the report, the originality and quality of the results, the quality of the slides and the oral presentation, and the answers to the questions.
12. As a special offer for help, you can send your two page minireport two days prior to the presentation (February 2nd, at 10:00) to giovanni@ampyxpower.com to get feedback on the same day to improve the result.
13. **Deadline** for final submission of the written two page report (PDF): ideally on February 3 at 8:15 before the lecture, as usual, but extensible upon request to

February 3, 23:00, 2015, sent by email to diehl@imtek.uni-freiburg.de