IDENTIFICATION

2022/23

Instructions for the preparation of the seminar

The task is to identify the process given in the form of a Simulink s-function. Each student will be given a `mexw64` file with the compiled s-function. The file can be downloaded from the student information system. The use of the s-function:

- A new model is created in Simulink. A block `S-Function` is constructed, the name of the s-function without extension (with lowercase letters) is defined via the form, and no other parameters are specified.
- The model represents a continuous system. To enable digital processing, a model of D/A converter is used at the input (`Zero-Order Hold` block with a proper sampling time), and the model of A/D at the system output (realised by the block `To Workspace`; sampling time synchronised with the input). Sampling time should be chosen based on the process dynamics and the identification method (for some continuous-time methods short sampling times are advisable).

The tasks of the seminar work:

- The process is nonlinear but can be approximated with the linear one in the vicinity of the operating point. The first task is therefore to measure the static curve of the process. To minimise the effect of noise, the steady state can be obtained by long-time averaging.
- Then the operating interval for the identification should be chosen where a linear approximation is valid (the interval should be wide enough to improve the signal-to-noise ratio).
- A parametric model of the process should be identified in the form of a discrete transfer function. The least squares parameter estimation should be used. Standard deviations of the parameters should also be provided. The obtained model should be appropriately validated (see the instructions for the last lab exercise).
- The frequency response of the process should be determined by empirical transfer function estimation (Fourier analysis). Based on the estimated standard deviation of the amplitude response error, a confidence band should be plotted around the absolute value of the identified frequency response. This model should also be validated by orthogonal correlation (see the instructions for the last lab exercise).
- An arbitrary identification method treated during this subject should also be used to identify the process again. (Note: simple identification methods from the introductory chapters – until slide 80 – are not sufficient). The error of the obtained model should be estimated.
- For the excellent grade (10), it is necessary (but not sufficient) to also identify the process using one of the following methods: maximum likelihood, instrumental variables, stochastic approximation.
- The seminar should be prepared as a document (PDF – preferably – or Word documents can be submitted) that includes the description of the solutions with technical details, and also some discussion and conclusions. The Matlab code that enables the results to be recreated should also be submitted as a ZIP file (the main script should be `main.m` while only m files and Simulink schemes can be submitted additionally). The report and the ZIP file should be e-mailed to saso.blazic@fe.uni-lj.si.

Mandatory interim consultations will take place on 25 April at 13:15 and 5 May at 11:00. The deadline for submission of the seminar paper is Thursday, 11 May 2023 by 09:00. Presentations of the seminar papers with projection (PDF or Powerpoint) and defence will take place on 15 May at 9:15 and 16 May at 13:15.