Integration Project (SC42035)

Learning Objectives

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Main objective: make operational and apply in practice the theoretical knowledge gained in the courses 'Control Theory' (SC42015), 'Modeling and Nonlinear Systems Theory' (SC42060) and 'Filtering and Identification' (SC42025), which are compulsory within the M.Sc. program 'Systems and Control.'

After successfully completing the course, the student is able to:

1. Develop a dynamic mathematical model (based on 'first principles' like mass balances and Lagrange equations) for a given real-world process. Estimate unknown parameters in the model by using experimental data measured on the process.
2. Implement the model in Matlab / Simulink and validate it against measured process data. Linearize the model around an operating point. Assess the accuracy of the linearized model with respect to the nonlinear one and with respect to the real process. Identify limitations of the linearized model.
3. Choose a suitable sampling period, discretize the linearized model.
4. Define meaningful performance specifications for a control system to be designed for the given process. Selected a suitable type of controller. Compute the controller's parameters such that the above specifications are met. Verify the closed-loop performance in simulations.
5. Design a linear state observer for the system (i.e., a Kalman filter or a deterministic Luenberger observer). Verify the performance of the observer in simulations.
6. Apply the observer and controller to the process in real-time experiments. Evaluate the performance of the entire control system. Identify reasons for possible discrepancies between simulations and real-time results. Suggest possible improvements.
7. Demonstrate proficiency in using Matlab and Simulink as the primary tool for the achievement of the above objectives.
8. Document the design steps, considerations, choices and the achieved control results effectively in a written report. Explain and defend the report in an in-depth discussion with peers.