Course Control and System Theory of Rational Systems Motivated by the Life Sciences

Homeworkset 9

Date issued: 25 October 2018.
Date due: 1 November 2018.

1. Take either the rational system or the polynomial system which you have used for your solution of Homework Set 1 or take a simplified version of that system of state-space dimension two or three. This restriction is imposed to have a system of a small state-space dimension. Described the inputs, the states, and the output of the system. This proposed system you will then use for this homework set and the homework sets of the next two lectures on system identification.

2. Make a simulation of the rational system which you have proposed in Problem 1 of this homework set. The simulation should contain and display the output of the system and, if present, the input trajectory. A simulation can be of only the initial-state response or of a simulation of the output in reaction to a particular piecewise-constant input function. Store the values of the input and output data for later use.

   The advice is to take a time interval in which the most relevant dynamics of the output is displayed and to choose the sampling time so that you have about 100 samples for this interval. The computation time for the simulation can be smaller than the sampling interval. For example, if the time interval has a duration of 20 minutes then take a sampling time of 0.2 minutes, which is 12 seconds. You then obtain 100 samples. The computation time of the simulation can be 12 seconds or smaller.

3. How would you approximate a diagonal matrix of the form,

$$H = \begin{pmatrix} 0.9 & 0 & 0 & 0 & 0 \\ 0 & 0.6 & 0 & 0 & 0 \\ 0 & 0 & 0.3 & 0 & 0 \\ 0 & 0 & 0 & 0.1 & 0 \\ 0 & 0 & 0 & 0 & 0.07 \end{pmatrix} \in \mathbb{R}^{5\times 5}.$$

   See for this problem Section 11.7 of the lecture notes. Provide arguments for your choice.

Reading advice for Lecture 9

Please read Chapter 11.

Reading advice for the future Lecture 10

On Thursday 1 November, Lecture 11 will be presented. Please read of the lecture notes for that day, Chapter 12. As mentioned before, this advice is a recommendation only.