

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

Homeworkset 8

Date issued: 23 October 2018.

Date due: 1 November 2018.

1. *Observability of a rational system.* Consider the following systems. Though the system is polynomial, it will be regarded as a rational system to simplify the calculations.

$$\begin{aligned}\frac{dx_1(t)}{dt} &= c_1 - c_2x_1(t)x_2(t), \\ \frac{dx_2(t)}{dt} &= c_2x_1(t)x_2(t) - c_3x_2(t), \\ y(t) &= c_3x_2(t), \\ n_x &= 2, X = \mathbb{R}^{n_x}, c_1, c_2, c_3 \in \mathbb{R}_{s+}.\end{aligned}$$

Check whether this system is an observable system when it is regarded as a rational system.

2. Consider the system,

$$\begin{aligned}\frac{dx_1(t)}{dt} &= x_2(t), \\ \frac{dx_2(t)}{dt} &= x_1(t) - x_2(t)^2, \\ y(t) &= x_1(t), \\ n_x &= 2, X = \mathbb{R}^{n_x}.\end{aligned}$$

Consider the birational map,

$$\begin{aligned}(x_1, x_2) &\mapsto \left(x_1, \frac{1}{x_2}\right), \\ s(x) &= (s_1(x), s_2(x)), s_1(x) = x_1, s_2(x) = 1/x_2.\end{aligned}$$

Calculate the transformed system.

The initial system is in the observable canonical form of a rational system. The transformation shows in which way it can be further transformed within that observable canonical form.

Reading advice for Lecture 8

Please read partly the three papers submitted at the day of the lecture. It is not necessary to read the proofs which are based on algebraic geometry.

Reading advice for the future Lecture 9

On Thursday 25 October, Lecture 9 will be presented. Please read of the lecture notes Chapter 11. As mentioned before, this advice is a recommendation only.