Session 7

Polynomial Matrix Descriptions, Poles and Zeros of MIMO systems

Reading Assignment

Rugh, Ch. 16-17.

Exercises

Exercise 7.1 Make sure you can handle the Maple routines Matrix, HermiteForm, SmithForm. Hint: ?MatrixPolynomialAlgebra[HermiteForm] gives some help text.

Exercise 7.2 = Rugh 16.1

Exercise 7.3 = Rugh 16.2

Exercise 7.4 Determine the Smith form, i.e. the invariant polynomials, for the three matrices

$$\begin{pmatrix} s & s & 0 \\ s & s & s \\ 0 & s & s \end{pmatrix}, \quad \begin{pmatrix} s+1 & s & 0 \\ s & s & s \\ 0 & s & s \end{pmatrix}, \quad \begin{pmatrix} s+1 & s & 0 \\ s & s+1 & s \\ 0 & s+1 & s \end{pmatrix}$$

either by calculating the determinantal divisors or using Maple.

Exercise 7.5 = Rugh 16.3

Exercise 7.6 = Rugh 16.4

Exercise 7.7 = Rugh 17.4

Exercise 7.8 = Rugh 17.7

Hand in problems

Exercise 7.9 Compute the poles and zeros (including multiplicities) for

$$H(s) = \begin{pmatrix} \dfrac{s+2}{s+1} & \dfrac{s-1}{s+2} \\ 0 & \dfrac{s+2}{s+3} \end{pmatrix}$$

Exercise 7.10 Assume that the square system $G(s)$ is invertible with a proper inverse $G^{-1}(s)$. Show that the poles (with multiplicities) of $G^{-1}(s)$ equal the zeros of $G(s)$ and vice versa (Hint: How are the Smith McMillan forms of $G(s)$ and $G^{-1}(s)$ related?)