AE353 (Spring ZOZI)

Day 18. Acker

T. Bretl. Controllability

Controllable Canonical Form (CCF)

$$A = \begin{bmatrix} I - a_1 & \cdots & -a_n \end{bmatrix} \quad B = \begin{bmatrix} I & I & I \\ I & I & I \\ I & I & I \end{bmatrix}$$

Facts

$$det(sI - A) = s^{M} + a_1 s^{M-1} + \cdots + a_{M-1} s + a_M$$

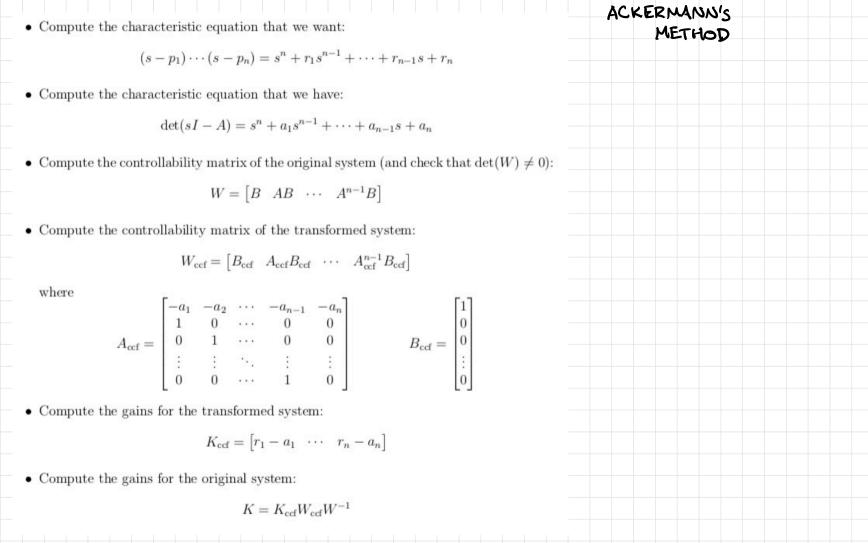
$$A - BK = \begin{bmatrix} I - a_1 - k_1 & \cdots & -a_M - k_M \end{bmatrix}$$

$$det(sI - (A - BK)) = s^{M} + (a_1 + k_1) s^{M-1} + \cdots + (a_{M-1} + k_{M-1}) s + (a_M + k_M)$$

Consequence

if you want
$$s^{M} + \Gamma_1 s^{M-1} + \cdots + \Gamma_{M-1} s +$$

solve for V (that's what we need to find K How? given Kax) ACCF = VAV BCCF = VB Bccf = AUFBUF = AUF BUF = Accf Bccf = [BOOF ACCEBUF AUFBOUF -- ACCE BOOF] = VI[WCCF is invertible - works as long as



States X) The system x = Ax+ Bu is controllable if A"-1B] W = [B AB ··· has full rank. in python this means "np. linalg. matrix_rank (w)" is the same as "n" if there is only one input, W is square, and so "full rank" and "invertible" mean the same thing - so, for a system with only one input, you can simply check if det(w) 70