

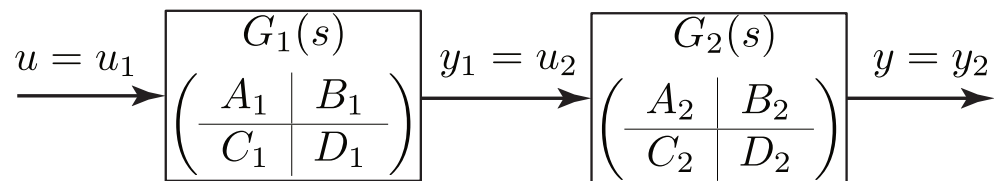
Lecture 16

*Lecturer: Asst. Prof. M. Mert Ankarali***16.1 Minimality of Interconnected Systems**

In this section we shall examine the conditions under which minimality is lost when minimal subsystems are interconnected in various configurations,

16.2 Series - Cascade Connection

Consider the following system structure where two sub systems, with transfer functions $G_1(s)$ and $G_2(s)$ and associated minimal representations $\left(\begin{array}{c|c} A_1 & B_1 \\ \hline C_1 & D_1 \end{array} \right)$ and $\left(\begin{array}{c|c} A_2 & B_2 \\ \hline C_2 & D_2 \end{array} \right)$, connected in series/cascade configuration.



The transfer function of the connection is simply equal to $G(s) = G_2(s)G_1(s)$. Let x_1 and x_2 state-variables of the sub-systems, then natural choice of the state variable for the series connection is $x = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$. Under this definition the state-space representation for the whole system can be found as

$$A = \left[\begin{array}{c|c} A_1 & 0 \\ \hline B_2 C_1 & A_2 \end{array} \right], B = \left[\begin{array}{c} B_1 \\ B_2 D_1 \end{array} \right], C = [D_2 C_1 \mid C_2], D = [D_2 D_2]$$

Let's analyze the observability of the connection via PBH test.