

From State-Space to Transfer Function

Now we take the Laplace transform:

$$\dot{x}_i = \sum_{j=1}^n a_{ij}x_j + \sum_{k=1}^m b_{ik}u_k$$

$\downarrow \mathcal{L}$

$$sX_i(s) - x_i(0) = \sum_{j=1}^n a_{ij}X_j(s) + \sum_{k=1}^m b_{ik}U_k(s), \quad i = 1, \dots, n$$

Write down in matrix-vector form:

$$sX(s) - x(0) = AX(s) + BU(s)$$

$$(Is - A)X(s) = x(0) + BU(s) \quad (I \text{ is the } n \times n \text{ identity matrix})$$

$$X(s) = (Is - A)^{-1}x(0) + (Is - A)^{-1}BU(s)$$