Transfer Functions of Multivariable ODEs

Teng-Jui Lin
Department of Chemical Engineering, University of Washington
Process Dynamics and Control

Transfer functions of multivariable ODEs show linearity

Seborg Ex. 4.4a Given constant liquid density ρ, volume V, mass flow rates w_1, w_2, and w, the governing equation for a continuous blending process is

$$\rho V \frac{dx}{dt} = w_1 x_1 + w_2 x_2 - wx$$

where x are compositions. Determine the transfer function for output x and varying input x_1 while x_2 is held constant.

Transfer functions of multivariable ODEs show linearity

Seborg Ex. 4.4a (cont.)

Transfer functions of multivariable ODEs show linearity

Seborg Ex. 4.4a (cont.)

Transfer functions of multivariable ODEs show linearity

Seborg Ex. 4.4b Given constant liquid density ρ, volume V, mass flow rates w_1, w_2, and w, the governing equation for a continuous blending process is

$$\rho V \frac{dx}{dt} = w_1 x_1 + w_2 x_2 - wx$$

where x are compositions. Determine the transfer function for output x and varying inputs x_1 and x_2.

Transfer functions of multivariable ODEs show linearity

Seborg Ex. 4.4b (cont.)

Transfer functions of multivariable ODEs show linearity

Seborg Ex. 4.4b (cont.)

Linearity and input-output relationship

$$X'(s) = G_1(s)X_1'(s) + G_2(s)X_2'(s)$$