Model Documentation of the 'Binary distillation tower with pressure variation'

1 Nomenclature

1.1 Nomenclature for Model Equations

x	state vector
u	control input vector
w	noise vector
z	regulated output vector
y	measurement vector

2 Model Equations

State Vector and Input Vector:

$$x \in \mathbb{R}^1 1u \qquad \in \mathbb{R}^3 w \in \mathbb{R}^1 z \qquad \in \mathbb{R}^6 y \in \mathbb{R}^3$$

System Equations:

$$\dot{x}(t) = Ax(t) + B_1 w(t) + Bu(t) \tag{1a}$$
$$z(t) = C_1 x(t) + D_{11} w(t) + D12u(t) \tag{1b}$$
$$y(t) = Cx(t) + D21w(t) \tag{1c}$$

Outputs: z

2.1 Exemplary parameter values

Symbol	Value
A	$\begin{bmatrix} -0.014 & 0.0043 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.0095 & -0.0138 & 0.0046 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0.0095 & -0.0141 & 0.0063 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0.0095 & -0.0158 & 0.011 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.0095 & -0.0312 & 0.015 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.0202 & -0.0352 & 0.022 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.0202 & -0.0422 & 0.028 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.0202 & -0.0482 & 0.037 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.0202 & -0.0572 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.0202 \\ 0.0255 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$
B	$\begin{bmatrix} 0 & 0 & 0 \\ 5.0 \cdot 10^{-6} & -4.0 \cdot 10^{-5} & 0.0025 \\ 2.0 \cdot 10^{-6} & -2.0 \cdot 10^{-5} & 0.005 \\ 1.0 \cdot 10^{-6} & -1.0 \cdot 10^{-5} & 0.005 \\ 0 & 0 & 0.005 \\ 0 & 0 & 0.005 \\ -5.0 \cdot 10^{-6} & 1.0 \cdot 10^{-5} & 0.005 \\ -1.0 \cdot 10^{-5} & 3.0 \cdot 10^{-5} & 0.005 \\ -4.0 \cdot 10^{-5} & 5.0 \cdot 10^{-6} & 0.0025 \\ -2.0 \cdot 10^{-5} & 2.0 \cdot 10^{-6} & 0.0025 \\ 0.00046 & 0.00046 & 0 \end{bmatrix}$
B_1	$\begin{bmatrix} 0 & 0 & 0 \\ 5.0 \cdot 10^{-6} & -4.0 \cdot 10^{-5} & 0.0025 \\ 2.0 \cdot 10^{-6} & -2.0 \cdot 10^{-5} & 0.005 \\ 1.0 \cdot 10^{-6} & -1.0 \cdot 10^{-5} & 0.005 \\ 0 & 0 & 0.005 \\ 0 & 0 & 0.005 \\ -5.0 \cdot 10^{-6} & 1.0 \cdot 10^{-5} & 0.005 \\ -1.0 \cdot 10^{-5} & 3.0 \cdot 10^{-5} & 0.005 \\ -4.0 \cdot 10^{-5} & 5.0 \cdot 10^{-6} & 0.0025 \\ -2.0 \cdot 10^{-5} & 2.0 \cdot 10^{-6} & 0.0025 \\ 0.00046 & 0.00046 & 0 \end{bmatrix}$
C_1	$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0 & 0 \\ 1.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$
C	$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0 & 0 \\ 1.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0 \end{bmatrix}$
D_{11}	$\begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$
D_{12}	$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 1.0 & 0 & 0 \\ 0 & 1.0 & 0 \\ 0 & 0 & 1.0 \end{bmatrix}$
D_{21}	$\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$

3 Derivation and Explanation

This model is part of the "'COMPleib"' - library and wasautomatically imported into ACKREP.
The original description was:
BDT1 Binary distillation tower with pressure variation E. J. Davison, "Benchmark Problems for Control System Design", "Report of the IFAC Theory Comittee", 1990

4 Simulation

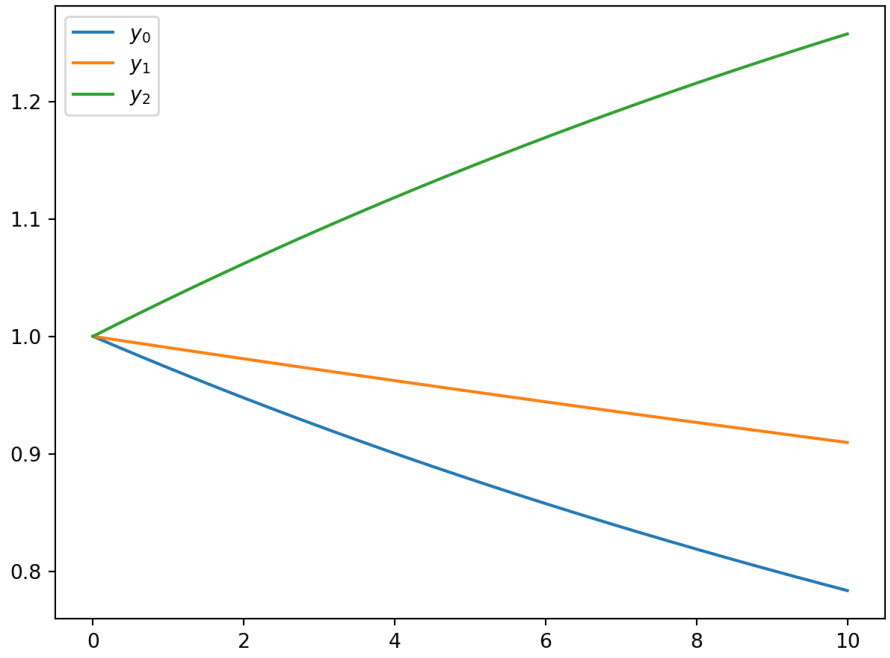

Figure 1: Simulation of the Binary distillation tower with pressure variation.

References

[1] . J. Davison, "Benchmark Problems for Control System Design", "Report of the IFAC Theory Comittee", 1990