Model Documentation of the ’Nuclear reactor model,’

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:

$$x \in \mathbb{R}^1 2u \qquad \in \mathbb{R}^1 w \in \mathbb{R}^1 2z \qquad \in \mathbb{R}^1 2y \in \mathbb{R}^3$$

System Equations:

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

Outputs: z

2.1 Exemplary parameter values

Symbol	Value
A	$\begin{bmatrix} -0.4044 & 0 & 0 & 0.4044 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -0.4044 & 0 & 0 & 0.4044 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -0.4044 & 0 & 0 & 0.4044 & 0 & 0 & 0 & 0 \\ 0.01818 & 0 & 0 & -0.5363 & 0 & 0 & 0.4045 & 0 & 0 & 0 \\ 0 & 0.0818 & 0 & 0.4545 & -0.5363 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0.0818 & 0 & 0.4545 & -0.5363 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.15 & 0 & -0.15 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -7.5 & 0 & 0 & 75.0 & 0 & 0 & 600.0 & -74.995 & 0.03 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 2.475 & -0.0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 25.95 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 46.57 & 0 \end{bmatrix}$
B	$\begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 1.0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$
B_1	$\begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 1.0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$
C_1	$\begin{bmatrix} 1.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1.0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1.0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0 \end{bmatrix}$
C	$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 1.0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0 & 0 & 0 & 0 \end{bmatrix}$
D_{11}	$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$

3 Derivation and Explanation

This model is part of the ”‘COMPleib”’ - library and wasautomatically imported into ACKREP.
The original description was:
REA3 Nuclear reactor model, L. F. Miller, R. G. Cochran, J. W. Howze ”Computation of Optimal Output Feedback Gains for Linear Multivariable Systems”, TOAC, Vol. 19, pp. 257–258, 1974

4 Simulation

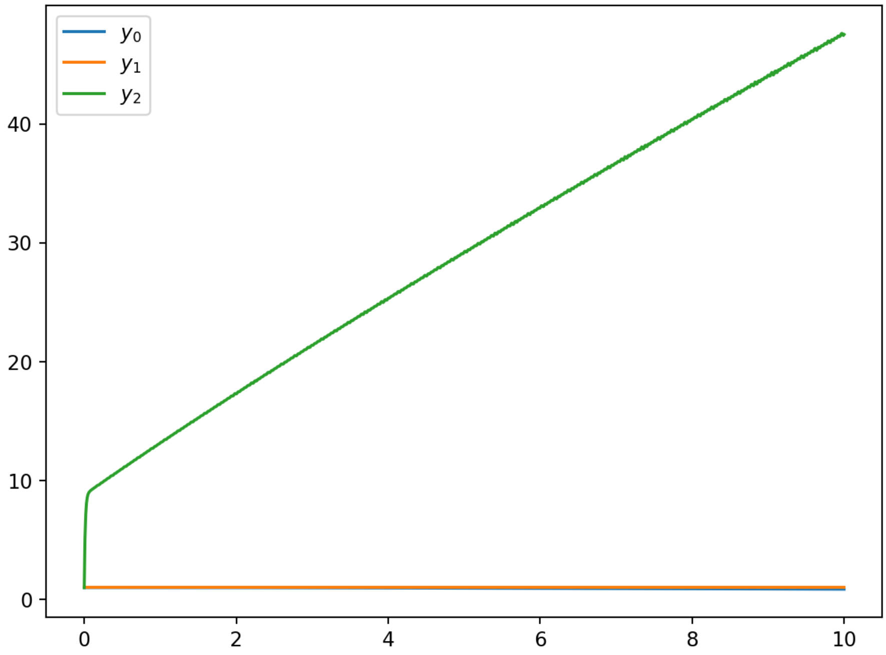

Figure 1: Simulation of the Nuclear reactor model,.

References

[1] . F. Miller, R. G. Cochran, J. W. Howze ”Computation of Optimal Output Feedback Gains for Linear Multivariable Systems”, TOAC, Vol. 19, pp. 257–258, 1974