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:

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

System Equations:

$$\dot{x}(t) = Ax(t) + B_1 w(t) + Bu(t) \tag{1a}$$

$$z(t) = C_1 x(t) + D_{11} w(t) + D_{12} u(t)$$
(1b)

$$y(t) = Cx(t) + D21w(t) \tag{1c}$$

Outputs: z



2.1 Exemplary parameter values

| Symbol | Value | | | | | | | | | |
|----------|---|--|---|--|--|--|----------|----------|---------|----------|
| | -0.4044 | 0 | 0 | 0.4044 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 0 | -0.4044 | 0 | 0 | 0.4044 | 0 4044 | $0 \\ 0$ | 0 | 0 | 0 |
| | 0.01818 | $0 \\ 0$ | -0.4044 | -0.5363 | 0 | 0.4044 | 0.4045 | $0 \\ 0$ | 0 | $0 \\ 0$ |
| | 0.01010 | 0.0818 | 0 | -0.5505 0.4545 | -0.5363 | 0 | 0.4045 | 0 | 0 | 0 |
| | 0 | 0.0010 | 0.0818 | 0.1910 | 0.4545 | -0.5363 | 0 | 0 | 0 | 0 |
| A | 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 | $0 \\ 0$ | $0 \\ 0$ | $0 \\ 0$ | 0 | 0 | 25.95 | 0 |
| В | | U | 0 | U | U | U | 0 | 0 | 46.57 | 0 |
| B_1 | 0 0 0 0 0 0 1.0 0 0 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 0 0 | 1 | | | |
| | $\begin{array}{c cc} 0 & 1.0 \\ 0 & 0 \\ 0 & 0 \end{array}$ | $ \begin{array}{ccc} 0 & 0 \\ 1.0 & 0 \\ 0 & 1.0 \end{array} $ | $egin{array}{ccc} 0 & 0 \\ 0 & 0 \\ 0 & 0 \\ \end{array}$ | $ \begin{array}{ccc} 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{array} $ | $ \begin{array}{ccc} 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{array} $ | $ \begin{array}{ccc} 0 & 0 \\ 0 & 0 \\ 0 & 0 \end{array} $ | | | | |
| | $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ | $\begin{array}{cc} 0 & 0 \\ 0 & 0 \end{array}$ | $ \begin{array}{ccc} 1.0 & 0 \\ 0 & 1.0 \end{array} $ | $\begin{array}{cc} 0 & 0 \\ 0 & 0 \end{array}$ | $\begin{array}{cc} 0 & 0 \\ 0 & 0 \end{array}$ | $egin{pmatrix} 0 & 0 \\ 0 & 0 \end{matrix}$ | | | | |
| C_1 | $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ | $\begin{array}{ccc} 0 & 0 \\ 0 & 0 \end{array}$ | 0 1.0 | $\begin{array}{ccc} 0 & 0 \\ 1.0 & 0 \end{array}$ | $\begin{array}{ccc} 0 & 0 \\ 0 & 0 \end{array}$ | $\begin{array}{ccc} 0 & 0 \\ 0 & 0 \end{array}$ | | | | |
| | 0 0 | $\begin{array}{ccc} 0 & 0 \\ 0 & 0 \end{array}$ | $\begin{array}{ccc} 0 & 0 \\ 0 & 0 \end{array}$ | 0 1.0 | $\begin{array}{ccc} 0 & 0 \\ 0 & 0 \end{array}$ | 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 | | | | |
| | $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ | $egin{pmatrix} 0 & 0 \\ 0 & 0 \end{matrix}$ | $\begin{array}{ccc} 0 & 0 \\ 0 & 0 \end{array}$ | $\begin{array}{ccc} 0 & 0 \\ 0 & 0 \end{array}$ | $\begin{array}{ccc} 0 & 0 \\ 0 & 0 \end{array}$ | 1.0 0 | | | | |
| | $\begin{bmatrix} 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$ | $\begin{array}{cccc} 0 & 0 \\ 0 & 0 & 0 \end{array}$ | $\begin{array}{cc} 0 & 0 \\ 1.0 & 0 \end{array}$ | $\begin{array}{cccc} 0 & 0 \\ 0 & 0 & 0 \end{array}$ | | 0 1.0 | Т | | | |
| C | 0 0 0 | 0 0 0 | 0 31.0 | 0 0 0 | | | | | | |
| | 0 0 0 | $0 \ 0 \ 0$ | 0 0 | 1.0 0 0 | | | | | | |
| | $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$ | 0 0 0 | 0 0 0 | 0 0 0 | _ | | | | | |
| | $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$ | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | $\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$ | $\begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$ | | | | | | |
| | $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$ | $\begin{array}{cccc} 0 & 0 & 0 \\ 0 & 0 & 0 \end{array}$ | $\begin{array}{cccc} 0 & 0 & 0 \\ 0 & 0 & 0 \end{array}$ | $\begin{array}{cccc} 0 & 0 & 0 \\ 0 & 0 & 0 \end{array}$ | | | | | | |
| | $\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$ | 0 0 0 | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | $\begin{array}{cccccccccccccccccccccccccccccccccccc$ | | | | | | |
| Б. | 0 0 0 | 0 0 0 | 0 0 0 | 0 0 0 | | | | | | |
| D_{11} | | | <u>:</u> | <u> </u> | <u> </u> | | | | | |

3 Derivation and Explanation

This model is part of the "'COMPleib"' - library and was automatically 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

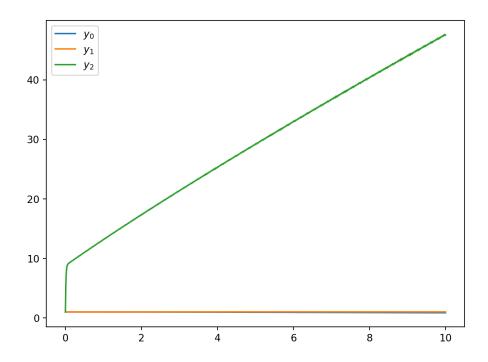


Figure 1: Simulation of the Nuclear reactor model,.

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