Model Documentation of the 'Helicopter control'

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:

$$x \in \mathbb{R}^8 u \qquad \in \mathbb{R}^4 w \in \mathbb{R}^3 z \qquad \in \mathbb{R}^4 y \in \mathbb{R}^2$$

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	$\begin{bmatrix} 0 & 0 & 0 & 0.99857378 & 0.0533842742 & 0 \\ 0 & 0 & 1.0 & -0.00318221934 & 0.0595246553 & 0 \\ 0 & 0 & -11.5704956 & -2.54463768 & -0.0636026263 & 0.106780529 \\ 0 & 0 & 0.439356565 & -1.9981823 & 0 & 0.016651883 \\ 0 & 0 & -2.04089546 & -0.458999157 & -0.73502779 & 0.019255757 \\ -32.1036072 & 0 & -0.503355026 & 2.29785919 & 0 & -0.02121581 \\ 0.102161169 & 32.0578308 & -2.34721756 & -0.503611565 & 0.834947586 & 0.02122657 \\ -1.9109726 & 1.71382904 & -0.00400543213 & -0.0574111938 & 0 & 0.013989634 \end{bmatrix}$
B	$\begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0.124335051 & 0.0827858448 & -2.75247765 & -0.0178887695 \\ -0.0363589227 & 0.475095272 & 0.0142907426 & 0 \\ 0.30449152 & 0.0149580166 & -0.496518373 & -0.206741929 \\ 0.287735462 & -0.544506073 & -0.0163793564 & 0 \\ -0.0190734863 & 0.0163674355 & -0.544536114 & 0.2348423 \\ -4.82063293 & -0.000381469727 & 0 & 0 \end{bmatrix}$
B_1	$\begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0.124335051 & 0.0827858448 & -2.75247765 & -0.0178887695 \\ -0.0363589227 & 0.475095272 & 0.0142907426 & 0 \\ 0.30449152 & 0.0149580166 & -0.496518373 & -0.206741929 \\ 0.287735462 & -0.544506073 & -0.0163793564 & 0 \\ -0.0190734863 & 0.0163674355 & -0.544536114 & 0.2348423 \\ -4.82063293 & -0.000381469727 & 0 & 0 \end{bmatrix}$
C_1	$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0.0595 & 0.05329 & -0.9968 \\ 1.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1.0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & -0.05348 & 1.0 & 0 & 0 & 0 \end{bmatrix}$
C	$\begin{bmatrix} 0 & 0 & 1.0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1.0 & 0 & 0 & 0 & 0 \end{bmatrix}$
D_{11}	$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$
D_{12}	$\begin{bmatrix} 1.0 & 0 & 0 & 0 \\ 0 & 1.0 & 0 & 0 \\ 0 & 0 & 1.0 & 0 \\ 0 & 0 & 0 & 1.0 \end{bmatrix}$
D_{21}	$\begin{bmatrix} 0.01 & 0 & 0 \\ 0 & 0.01 & 0 \end{bmatrix}$

3 Derivation and Explanation

This model is part of the "'COMPleib"' - library and wasautomatically imported into ACKREP.
The original description was:

HE5 A variation of the system above with eight state, two measurement and four control variables. The matrices A and B are the same as in HE4.

4 Simulation

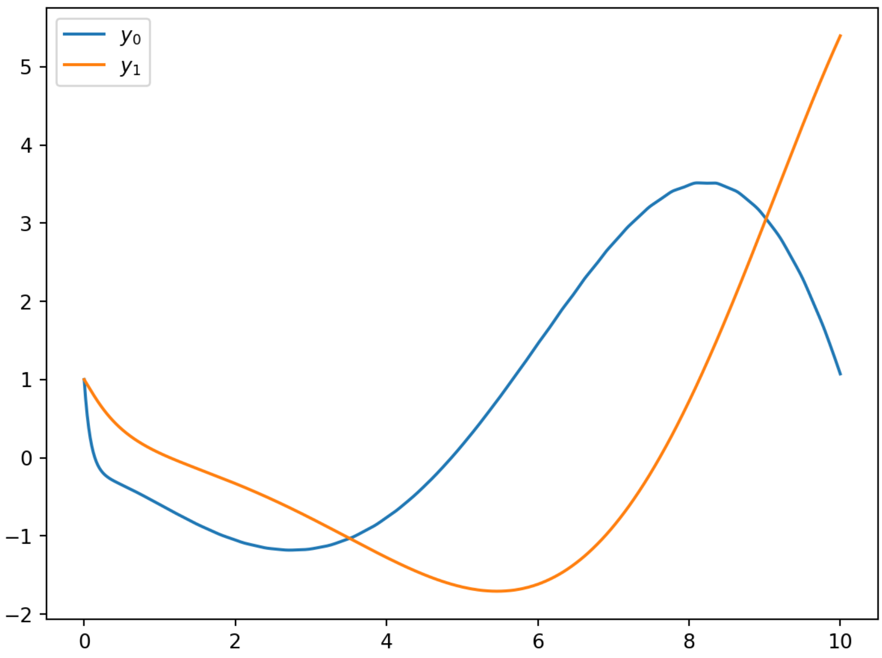

Figure 1: Simulation of the Helicopter control.

References

[1] Multivariable feedback control Analysis and design" S. Skogestad and I. Postlethwaite John Wiley and Sons, 1996, Section 12.2