Model Documentation of the 'Wind energy conversion system'

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:

$$x \in \mathbb{R}^1 0 u \qquad \in \mathbb{R}^3 w \in \mathbb{R}^1 0 z \qquad \in \mathbb{R}^1 0 y \in \mathbb{R}^4$$

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	$\begin{bmatrix} -5.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1.0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -33.69 & -1479.1 & -3.3531 & -0.089802 & 0 & 0 & 169.68 & 36.137 & 36.137 \\ 0 & 1416.4 & 3.125 & 0 & 0 & 0 & -169.68 & -36.137 & -36.137 \\ 0 & 0 & 0 & 0.095493 & -10.0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -10.0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 7.8416 & 0 & 0.11552 & -1257.1 & 1015.1 & 1011.1 \\ 0 & 0 & 0 & 4.6042 & 0 & 2.096 & -693.13 & 559.33 & 631.31 \\ 0 & 0 & 0 & 5.7968 & 0 & -1.8671 & -976.81 & 788.51 & 708.25 \\ 0 & 0 & 0 & -2.8663 & 0 & -0.047856 & 413.58 & -343.35 & -341.63 \end{bmatrix}$
B	$\begin{bmatrix} 5.0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 10.0 & 0 \\ 0 & 0 & -305.65 \\ 0 & 0 & -166.27 \\ 0 & 0 & -239.88 \\ 0 & 0 & 96.02 \end{bmatrix}$
B_1	$\begin{bmatrix} 5.0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 10.0 & 0 \\ 0 & 0 & -305.65 \\ 0 & 0 & -166.27 \\ 0 & 0 & -239.88 \\ 0 & 0 & 96.02 \end{bmatrix}$
C_1	$\begin{bmatrix} 1.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1.0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1.0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1.0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1.0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0 \end{bmatrix}$
C	$\begin{bmatrix} 0 & 0 & 0 & 0 & 1.0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1.0 & 0 & 0 & 0 \\ 0 & 0 & 0.045455 & 0.045455 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 12.249 & 0.027025 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$
D_{11}	$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 3 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$
	$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$

3 Derivation and Explanation

This model is part of the "'COMPleib"' - library and wasautomatically imported into ACKREP.
The original description was:
WEC2 like WEC1 at an operation point of v=16m/s v wind speed

4 Simulation

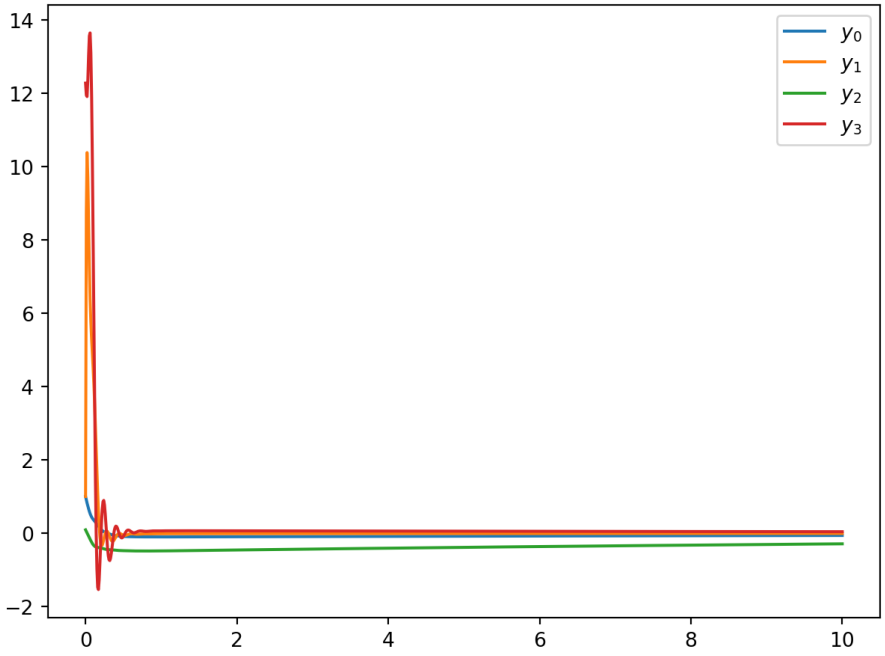

Figure 1: Simulation of the Wind energy conversion system.

References

[1] Dynamic modelling and robust control of a wind energy conversion system" Maarten Steinbuch, 1989, PHD-Thesis University of Delft Appendix A.5 Linear models operation point v=12 m/s v wind speed