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:

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

System Equations:

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

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

$$y(t) = Cx(t) + D21w(t)$$
(1c)

Outputs: z



2.1 Exemplary parameter values

Symbol	Value								
	-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
4	0	0	0	0.095493	-10.0	0	0	0	0
A	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
	5.0 0	0]						
	0 0	0							
	0 0	0							
	0 0	0							
B	0 0	0							
D	0 10.0	0							
	0 0	-305.68	5						
	0 0	-166.2'	7						
	0 0	-239.88	3						
	$\begin{bmatrix} 0 & 0 \end{bmatrix}$	96.02							
	[5.0 0]	0]						
	0 0	0							
	0 0	0							
	0 0	0							
B_1	0 0	0							
D_1	0 10.0								
	0 0	-305.68							
	0 0	-166.2'							
	0 0	-239.88	3						
	0 0	96.02				-			
	$\begin{bmatrix} 1.0 & 0 \end{bmatrix}$	0 0	0 0	0 0	0 0				
	0 1.0	0 0	0 0	0 0	0 0				
	$\begin{bmatrix} 0 & 0 \\ 0 & 1 \end{bmatrix}$	1.0 0	0 0	0 0	0 0				
	$\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$	0 1.0	0 0	0 0	0 0				
C_1	$\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$	0 0	1.0 0	0 0	0 0				
- 1	0 0	0 0	0 1.0	0 0	0 0				
	$\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$	0 0	0 0	1.0 0	0 0				
	$\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$	0 0	0 0	0 1.0	0 0				
	$\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$	$\begin{array}{ccc} 0 & 0 \\ 0 & 0 \end{array}$	$\begin{array}{ccc} 0 & 0 \\ 0 & 0 \end{array}$		1.0 0	.]			
	$\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$	0 0		0 0	$\begin{pmatrix} 0 & 1.0 \\ 0 & 0 \end{pmatrix}$				
	$\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$	$0 \\ 0$	0	$ \begin{array}{ccc} 1.0 & 0 \\ 0 & 0 \end{array} $	$\begin{array}{cc} 0 & 0 \\ 1.0 & 0 \end{array}$	$\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$			
C	$\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$	0.04545			0 0	$\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$			
	$\begin{bmatrix} 0 & 0 \\ 0 & 12.249 \end{bmatrix}$			0 0	0 0	l l			
	$\begin{bmatrix} 0 & 12.248 \\ 0 & 0 & 0 \end{bmatrix}$	0.02702	$\begin{bmatrix} 25 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	0 0	0 0	$\begin{bmatrix} 0 & 0 \end{bmatrix}$			
	$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0 0 0	0					
	$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0 0 0	0					
	$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0 0 0	0					
	$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0					
D_{11}	$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0 0 0	0					
	$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0 0 0	0					
	$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	0 0 0	0 0 0	0					
	$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	0 0 0	0 0 0	0					
	$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	0 0 0	0 0 0	0					
		0 7		٦,					
		0							

3 Derivation and Explanation

This model is part of the "'COMPleib"' - library and was automatically imported into ACKREP.

The original description was:

WEC2 like WEC1 at an operation point of v=16m/s v wind speed

4 Simulation

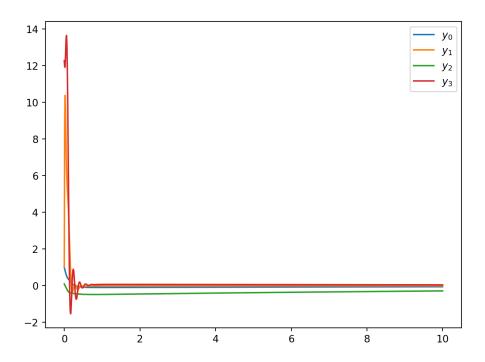


Figure 1: Simulation of the Wind energy conversion system.

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