

# Model Documentation of the 'Transport Aircraft model Boeing flight condition VMIN'

## 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:

$$x \in \mathbb{R}^{10} \quad u \in \mathbb{R}^4 \quad w \in \mathbb{R}^1 \quad z \in \mathbb{R}^2 \quad y \in \mathbb{R}^5$$

System Equations:

$$\dot{x}(t) = Ax(t) + B_1w(t) + Bu(t) \quad (1a)$$

$$z(t) = C_1x(t) + D_{11}w(t) + D_{12}u(t) \quad (1b)$$

$$y(t) = Cx(t) + D_{21}w(t) \quad (1c)$$

Outputs:  $z$

## 2.1 Exemplary parameter values

Symbol	Value				
$A$	$\begin{bmatrix} -0.01365 & 0.178 & 0.00017 & -0.561 & -0.03726 & 0 & 0.01365 & -0.01311 & 0 \\ -0.01516 & -0.752 & 1.001 & 0.00127 & -0.06311 & 0 & 0.01516 & 0.05536 & 0 \\ 0.00107 & 0.07896 & -0.8725 & 0 & -3.399 & 0 & -0.00107 & -0.00581 & 0 \\ 0 & 0 & 1.0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & -20.0 & 10.72 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & -50.0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -0.4447 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & -0.4447 & 0.0044 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & -0.0044 & -0.4447 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$				
	$B$	$\begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 50.0 & 0 & 0 & 0 \\ 0 & 0.9431 & 0 & 0 \\ 0 & 0 & 1.155 & 0 \\ 0 & 0 & -48.82 & 0 \\ 0 & 0 & 0 & 1.0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 50.0 & 0 & 0 & 0 \\ 0 & 0.9431 & 0 & 0 \\ 0 & 0 & 1.155 & 0 \\ 0 & 0 & -48.82 & 0 \\ 0 & 0 & 0 & 1.0 \end{bmatrix}$			
		$B_1$	$\begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 50.0 & 0 & 0 & 0 \\ 0 & 0.9431 & 0 & 0 \\ 0 & 0 & 1.155 & 0 \\ 0 & 0 & -48.82 & 0 \\ 0 & 0 & 0 & 1.0 \end{bmatrix}$		
			$C_1$	$\begin{bmatrix} 0.00646 & 0.3203 & -0.03358 & 0 & -0.1032 & 0 & -0.00646 & -0.02358 & 0 & 0 \\ 1.0 & 0 & 0 & 0 & 0 & 0 & -1.0 & 0 & 0 & 0 \end{bmatrix}$	
				$\begin{bmatrix} 0.00646 & 0.3203 & -0.03358 & 0 & -0.1032 & 0 & -0.00646 & -0.02358 & 0 & 0 \\ 1.0 & 0 & 0 & 0 & 0 & 0 & 0 & -1.0 & 0 & 0 \\ -0.01365 & 0.178 & 0.00017 & -0.561 & -0.03726 & 0 & 0.01365 & -0.01311 & 0 & 0 \\ 0 & -13.58 & 0 & 13.58 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$	
			$C$	$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$	
				$\begin{bmatrix} 1.0 & 1.0 & 1.0 & 1.0 \\ 1.0 & 1.0 & 1.0 & 1.0 \end{bmatrix}$	
			$D_{11}$	$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$	
				$D_{12}$	$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1.0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1.0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1.0 & 0 \end{bmatrix}$
					$D_{21}$

### 3 Derivation and Explanation

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

The original description was:

AC9 Transport Aircraft model Boeing flight condition CRUISE ehemals AC12 see AC7!

### 4 Simulation

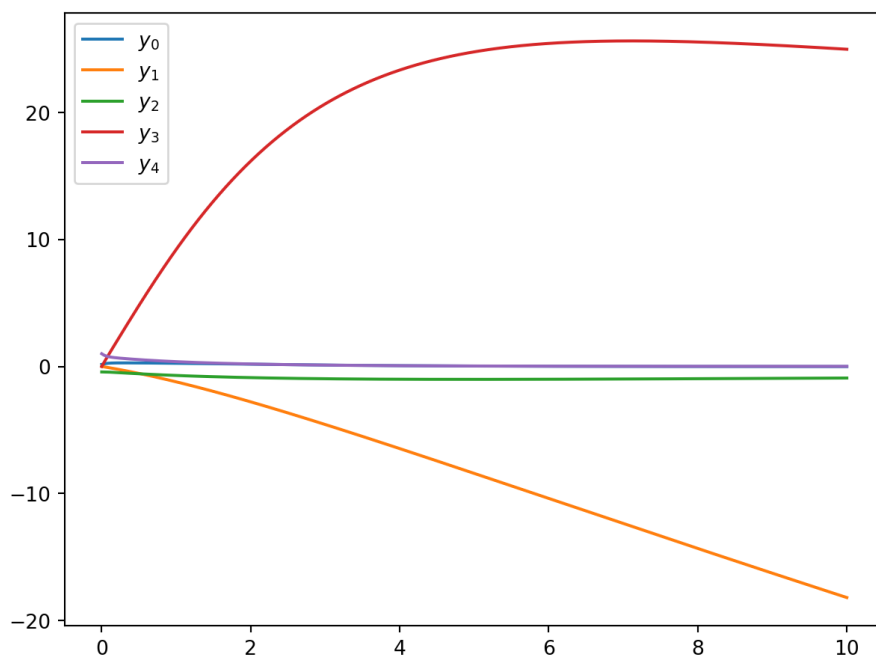


Figure 1: Simulation of the Transport Aircraft model Boeing flight condition VMIN.

### References

- [1] . Gangsaas, K. R. Bruce, J. D. Blight and U.-L. Ly, "Application of Modern Synthesis to Aircraft Control Three Case Studies", TOAC, Vol.31, Nr.11, pp.995-1014, 1986 Case study III 2