$$\dot{X} = f(x, u)$$

$$x_1 = x, \qquad x_2 = \dot{x}, \; x_3 = x, \qquad x_4 = \dot{z}, \qquad x_5 = \Theta, \qquad x_6 = \dot{\Theta},$$

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \\ \dot{x}_4 \\ \dot{x}_5 \\ \dot{x}_6 \end{bmatrix} = \begin{bmatrix} x_2 \\ U_1 \cos\Theta - D(V,\alpha) \cos\gamma - L(V,\alpha) \sin\gamma \\ x_4 \\ U_1 \sin\Theta - D(V,\alpha) \cos\gamma + L(V,\alpha) \sin\gamma \\ x_6 \\ U_2/J \end{bmatrix}$$

$$\alpha = x_5 - x_7$$

$$\dot{\alpha} = x_6 - x_8$$

$$T = u_1, \qquad M = u_2$$

$$V = \frac{X_2 + X_4}{cosX_7 - sinX_7}$$

$$\gamma = atan2(-\dot{z}, \dot{x})$$