$$
A = \begin{bmatrix}
-\frac{\rho C_d A V_0}{m} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\[4pt]
0 & \frac{-N_r C_\alpha - N_f C_\alpha}{V_0 m} & \frac{N_r l_r \cos(\gamma_r) C_\alpha - N_f l_f \cos(\gamma_f) C_\alpha}{V_0 m} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\[4pt]
0 & \frac{-aN_f C_\alpha + bN_r C_\alpha}{I_z V_0} & \frac{-aN_f l_f \cos(\gamma_f) C_\alpha + aN_r l_r \cos(\gamma_r) C_\alpha}{V_0 I_z} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\[4pt]
0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\[4pt]
0 & 0 & 0 & \frac{-2k_{sf}-2k_{sr}}{m} & \frac{-2c_f-2c_r}{m} & 0 & 0 & \frac{2ak_{sf}-2bk_{sr}}{m} & \frac{2ac_f-2bc_r}{m} & \frac{k_{sf}}{m} & \frac{c_f}{m} & \frac{k_{sf}}{m} & \frac{c_f}{m} & \frac{k_{sr}}{m} & \frac{c_r}{m} & \frac{k_{sr}}{m} & \frac{c_r}{m} \\[4pt]
0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\[4pt]
0 & h\frac{N_r C_\alpha + N_f C_\alpha}{V_0 I_x} & h\frac{-N_r l_r \cos(\gamma_r) C_\alpha + N_f l_f \cos(\gamma_f) C_\alpha}{V_0 I_x} & 0 & 0 & \frac{-0.5k_{sf}w^2 - 0.5k_{sr}w^2}{I_x} & \frac{-0.5c_f w^2 - 0.5c_r w^2}{I_x} & 0 & 0 & \frac{0.5wk_{sf}}{I_x} & \frac{0.5wc_f}{I_x} & \frac{-0.5wk_{sf}}{I_x} & \frac{-0.5wc_f}{I_x} & \frac{0.5wk_{sr}}{I_x} & \frac{0.5wc_r}{I_x} & \frac{-0.5wk_{sr}}{I_x} & \frac{-0.5wc_r}{I_x} \\[4pt]
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\[4pt]
\frac{\rho C_d A V_0}{m} & 0 & 0 & \frac{2ak_{sf}-2bk_{sr}}{I_y} & \frac{2ac_f-2bc_r}{I_y} & 0 & 0 & \frac{-2a^2k_{sf}-2b^2k_{sr}}{I_y} & \frac{-2a^2c_f-2b^2c_r}{I_y} & \frac{-ak_{sf}}{I_y} & \frac{-ac_f}{I_y} & \frac{-ak_{sf}}{I_y} & \frac{-ac_f}{I_y} & \frac{bk_{sr}}{I_y} & \frac{bc_r}{I_y} & \frac{bk_{sr}}{I_y} & \frac{bc_r}{I_y} \\[4pt]
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\[4pt]
0 & 0 & 0 & \frac{k_{sf}}{m_{uf}} & \frac{c_f}{m_{uf}} & \frac{0.5wk_{sf}}{m_{uf}} & \frac{0.5wc_f}{m_{uf}} & \frac{-ak_{sf}}{m_{uf}} & \frac{-ac_f}{m_{uf}} & \frac{-k_{sf}-k_{uf}}{m_{uf}} & \frac{-c_f}{m_{uf}} & 0 & 0 & 0 & 0 & 0 & 0 \\[4pt]
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\[4pt]
0 & 0 & 0 & \frac{k_{sf}}{m_{uf}} & \frac{c_f}{m_{uf}} & \frac{-0.5wk_{sf}}{m_{uf}} & \frac{-0.5wc_f}{m_{uf}} & \frac{-ak_{sf}}{m_{uf}} & \frac{-ac_f}{m_{uf}} & 0 & 0 & \frac{-k_{sf}-k_{uf}}{m_{uf}} & \frac{-c_f}{m_{uf}} & 0 & 0 & 0 & 0 \\[4pt]
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\[4pt]
0 & 0 & 0 & \frac{k_{sr}}{m_{ur}} & \frac{c_r}{m_{ur}} & \frac{0.5wk_{sr}}{m_{ur}} & \frac{0.5wc_r}{m_{ur}} & \frac{bk_{sr}}{m_{uf}} & \frac{bc_r}{m_{ur}} & 0 & 0 & 0 & 0 & \frac{-k_{sr}-k_{ur}}{m_{ur}} & \frac{-c_r}{m_{ur}} & 0 & 0 \\[4pt]
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 \\[4pt]
0 & 0 & 0 & \frac{k_{sr}}{m_{ur}} & \frac{c_r}{m_{ur}} & \frac{-0.5wk_{sr}}{m_{ur}} & \frac{-0.5wc_r}{m_{ur}} & \frac{bk_{sr}}{m_{uf}} & \frac{bc_r}{m_{ur}} & 0 & 0 & 0 & 0 & 0 & 0 & \frac{-k_{sr}-k_{ur}}{m_{ur}} & \frac{-c_r}{m_{ur}}
\end{bmatrix}
\tag{1}
$$

$$\mathbf{B_u}(t) = \begin{bmatrix}
0 & 0 & 0 & 0 & \frac{cos(\delta_{fl})}{m\ R} & \frac{cos(\delta_{f\tilde{r}})}{m\ R} & \frac{cos(\delta_{rl})}{m\ R} & \frac{cos(\delta_{r\tilde{r}})}{m\ R} & 0 & 0 & 0 & 0 \\[2mm]
\frac{N_{fl}C_\alpha cos(\delta_{fl})}{m} & \frac{N_{fr}C_\alpha cos(\delta_{f\tilde{r}})}{m} & \frac{N_{rl}C_\alpha cos(\delta_{rl})}{m} & \frac{N_{rr}C_\alpha cos(\delta_{r\tilde{r}})}{m} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\[2mm]
\frac{aN_{fl}C_\alpha cos(\delta_{fl})}{I_z} & \frac{aN_{fr}C_\alpha cos(\delta_{f\tilde{r}})}{I_z} & \frac{-bN_{rl}C_\alpha cos(\delta_{rl})}{I_z} & \frac{-bN_{rr}C_\alpha cos(\delta_{r\tilde{r}})}{I_z} & \frac{wcos(\delta_{fl})}{2I_z\ R} & \frac{-wcos(\delta_{f\tilde{r}})}{2I_z\ R} & \frac{wcos(\delta_{rl})}{2I_z\ R} & \frac{-wcos(\delta_{r\tilde{r}})}{2I_z\ R} & 0 & 0 & 0 & 0 \\[2mm]
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\[2mm]
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\[2mm]
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\[2mm]
\frac{-N_{fl}C_\alpha h cos(\delta_{fl})}{I_x} & \frac{-N_{fr}C_\alpha h cos(\delta_{f\tilde{r}})}{I_x} & \frac{-N_{rl}C_\alpha h cos(\delta_{rl})}{I_x} & \frac{-N_{rr}C_\alpha h cos(\delta_{r\tilde{r}})}{I_x} & 0 & 0 & 0 & 0 & -\frac{w}{2I_x} & \frac{w}{2I_x} & -\frac{w}{2I_x} & \frac{w}{2I_x} \\[2mm]
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\[2mm]
0 & 0 & 0 & 0 & \frac{cos(\delta_{fl})h}{I_y\ R} & \frac{cos(\delta_{f\tilde{r}})h}{I_y\ R} & \frac{cos(\delta_{rl})h}{I_y\ R} & \frac{cos(\delta_{r\tilde{r}})h}{I_y\ R} & -a/I_y & -a/I_y & b/I_y & b/I_y \\[2mm]
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\[2mm]
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\[2mm]
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\[2mm]
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\[2mm]
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\[2mm]
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\[2mm]
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\[2mm]
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\[2mm]
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{bmatrix} \tag{2}$$

$$\mathbf{D}^T = \begin{bmatrix} \frac{V_0^2 \rho C_d A}{2m} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \tag{3}$$