B priedas. Automobilio su slydimo sistema matematinio modelio apibendrintųjų jėgų vektoriaus nariai

Masių ir inercijos matricos:

$$\left[M_{auto}\right]=m_{auto}\begin{bmatrix}1 & 0 & 0\\ 0 & 1 & 0\\ 0 & 0 & 1\end{bmatrix}, \tag{P.B.1}$$

$$\left[I_{auto}\right]=\begin{bmatrix}I_x & 0 & 0\\ 0 & I_y & 0\\ 0 & 0 & I_z\end{bmatrix}, \tag{P.B.2}$$

$$\left[M_{auto,z}\right]=\begin{bmatrix}m_1 & 0 & 0 & 0\\ 0 & m_2 & 0 & 0\\ 0 & 0 & m_3 & 0\\ 0 & 0 & 0 & m_4\end{bmatrix}, \tag{P.B.3}$$

$$\left[I_{auto,z}\right]=\begin{bmatrix}I_{y_1} & 0 & 0 & 0\\ 0 & I_{y_2} & 0 & 0\\ 0 & 0 & I_{y_3} & 0\\ 0 & 0 & 0 & I_{y_4}\end{bmatrix}, \tag{P.B.4}$$

$$\left[I_{ASS,w}\right]=\begin{bmatrix}I_{y_{11}} & 0 & 0 & 0\\ 0 & I_{y_{22}} & 0 & 0\\ 0 & 0 & I_{y_{33}} & 0\\ 0 & 0 & 0 & I_{y_{44}}\end{bmatrix}, \tag{P.B.5}$$

$$\left[I_{ASS,\delta}\right]=\begin{bmatrix} I_{z_{11}} & 0 & 0 & 0 \\ 0 & I_{z_{22}} & 0 & 0 \\ 0 & 0 & I_{z_{33}} & 0 \\ 0 & 0 & 0 & I_{z_{44}} \end{bmatrix}, \qquad \text{(P.B.6)}$$

Jėgų ir momentų vektoriai:

$$\left\{F_{auto}(X)\right\}=\begin{Bmatrix} F_{x_1}\cos\delta_1 - F_{y_1}\sin\delta_1 + F_{x_2}\cos\delta_2 - F_{y_2}\sin\delta_2 \\ +F_{x_3} + F_{x_4} - F_{pasipr.} \\ \\ F_{x_1}\sin\delta_1 + F_{y_1}\cos\delta_1 + F_{x_2}\sin\delta_2 + F_{y_2}\cos\delta_2 \\ +F_{y_3} + F_{y_4} \\ \\ -c_1\left(\dot{z}-\dot{z}_1+a_1\dot{\varphi}-b_1\dot{\theta}\right)-c_2\left(\dot{z}-\dot{z}_2-a_2\dot{\varphi}-b_1\dot{\theta}\right) \\ -c_3\left(\dot{z}-\dot{z}_3+a_1\dot{\varphi}+b_2\dot{\theta}\right)-c_4\left(\dot{z}-\dot{z}_4-a_2\dot{\varphi}+b_2\dot{\theta}\right) \\ -k_1\left(z-z_1+a_1\varphi-b_1\theta\right)-k_2\left(z-z_2-a_2\varphi-b_1\theta\right) \\ -k_3\left(z-z_3+a_1\varphi+b_2\theta\right)-k_4\left(z-z_4-a_2\varphi+b_2\theta\right) \\ -c_{t11}\left(\dot{z}-\dot{z}_{011}+a_{11}\dot{\varphi}-b_{11}\dot{\theta}\right)-c_{t22}\left(\dot{z}-\dot{z}_{022}-a_{22}\dot{\varphi}-b_{11}\dot{\theta}\right) \\ -c_{t33}\left(\dot{z}-\dot{z}_{033}+a_{11}\dot{\varphi}+b_{22}\dot{\theta}\right)-c_{t44}\left(\dot{z}-\dot{z}_{044}-a_{22}\dot{\varphi}+b_{22}\dot{\theta}\right) \\ -k_{t11}\left(z-\left(z_{011}+\Delta z_{11}\right)+a_{11}\varphi-b_{11}\theta\right) \\ -k_{t22}\left(z-\left(z_{022}+\Delta z_{22}\right)-a_{22}\varphi-b_{11}\theta\right) \\ -k_{t33}\left(z-\left(z_{033}+\Delta z_{33}\right)+a_{11}\varphi+b_{22}\theta\right) \\ -k_{t44}\left(z-\left(z_{044}+\Delta z_{44}\right)-a_{22}\varphi+b_{22}\theta\right) \end{Bmatrix}, \qquad \text{(P.B.7)}$$

$$\left\{M_{auto}(X)\right\}=\begin{Bmatrix} Z \\ \Phi \\ \Theta \end{Bmatrix}, \qquad \text{(P.B.8)}$$

čia:

$$\{Z\}=\begin{Bmatrix}
-c_1a_1\left(\dot z-\dot z_1+a_1\dot\varphi-b_1\dot\theta\right)+c_2a_2\left(\dot z-\dot z_2-a_2\dot\varphi-b_1\dot\theta\right)\\
-c_3a_1\left(\dot z-\dot z_3+a_1\dot\varphi+b_2\dot\theta\right)+c_4a_2\left(\dot z-\dot z_4-a_2\dot\varphi+b_2\dot\theta\right)\\
-k_1a_1\left(z-z_1+a_1\varphi-b_1\theta\right)+k_2a_2\left(z-z_2-a_2\varphi-b_1\theta\right)\\
-k_3a_1\left(z-z_3+a_1\varphi+b_2\theta\right)+k_4a_2\left(z-z_4-a_2\varphi+b_2\theta\right)\\
-c_{t11}a_{11}\left(\dot z-\dot z_{011}+a_{11}\dot\varphi-b_{11}\dot\theta\right)+c_{t22}a_{22}\left(\dot z-\dot z_{022}-a_{22}\dot\varphi-b_{11}\dot\theta\right)\\
-c_{t33}a_{11}\left(\dot z-\dot z_{033}+a_{11}\dot\varphi+b_{22}\dot\theta\right)+c_{t44}a_{22}\left(\dot z-\dot z_{044}-a_{22}\dot\varphi+b_{22}\dot\theta\right)\\
-k_{t11}a_{11}\left(z-\left(z_{011}+\Delta z_{11}\right)+a_{11}\varphi-b_{11}\theta\right)\\
+k_{t22}a_{22}\left(z-\left(z_{022}+\Delta z_{22}\right)-a_{22}\varphi-b_{11}\theta\right)\\
-k_{t33}a_{11}\left(z-\left(z_{033}+\Delta z_{33}\right)+a_{11}\varphi+b_{22}\theta\right)\\
+k_{t44}a_{22}\left(z-\left(z_{044}+\Delta z_{44}\right)-a_{22}\varphi+b_{22}\theta\right)\\
-ma_y\cdot h_\varphi\cdot\cos\varphi+mg\cdot h_\varphi\cdot\sin\varphi
\end{Bmatrix}, \qquad \text{(P.B.9)}$$

$$\{\Phi\}=\begin{Bmatrix}
c_1b_1\left(\dot z-\dot z_1+a_1\dot\varphi-b_1\dot\theta\right)+c_2b_1\left(\dot z-\dot z_2-a_2\dot\varphi-b_1\dot\theta\right)\\
-c_3b_2\left(\dot z-\dot z_3+a_1\dot\varphi+b_2\dot\theta\right)-c_4b_2\left(\dot z-\dot z_4-a_2\dot\varphi+b_2\dot\theta\right)\\
+k_1b_1\left(z-z_1+a_1\varphi-b_1\theta\right)+k_2b_1\left(z-z_2-a_2\varphi-b_1\theta\right)\\
-k_3b_2\left(z-z_3+a_1\varphi+b_2\theta\right)-k_4b_2\left(z-z_4-a_2\varphi+b_2\theta\right)\\
+c_{t11}b_{11}\left(\dot z-\dot z_{011}+a_{11}\dot\varphi-b_{11}\dot\theta\right)+c_{t22}b_{11}\left(\dot z-\dot z_{022}-a_{22}\dot\varphi-b_{11}\dot\theta\right)\\
-c_{t33}b_{22}\left(\dot z-\dot z_{033}+a_{11}\dot\varphi+b_{22}\dot\theta\right)-c_{t44}b_{22}\left(\dot z-\dot z_{044}-a_{22}\dot\varphi+b_{22}\dot\theta\right)\\
+k_{t11}b_{11}\left(z-\left(z_{011}+\Delta z_{11}\right)+a_{11}\varphi-b_{11}\theta\right)\\
+k_{t22}b_{11}\left(z-\left(z_{022}+\Delta z_{22}\right)-a_{22}\varphi-b_{11}\theta\right)\\
-k_{t33}b_{22}\left(z-\left(z_{033}+\Delta z_{33}\right)+a_{11}\varphi+b_{22}\theta\right)\\
-k_{t44}b_{22}\left(z-\left(z_{044}+\Delta z_{44}\right)-a_{22}\varphi+b_{22}\theta\right)\\
-ma_x\cdot h_\theta\cdot\cos\theta-mg\cdot h_\theta\cdot\sin\theta
\end{Bmatrix}, \qquad \text{(P.B.10)}$$

$$\{\Theta\}=\begin{Bmatrix}
\left(F_{x_1}\sin\delta_1+F_{y_1}\cos\delta_1+F_{x_2}\sin\delta_2+F_{y_2}\cos\delta_2\right)b_1\\
-\left(F_{y_3}+F_{y_4}\right)b_2-\left(F_{x_1}\cos\delta_1-F_{y_1}\sin\delta_1\right)a_1\\
+\left(F_{x_2}\cos\delta_2-F_{y_2}\sin\delta_2\right)a_2-F_{x_3}a_1+F_{x_4}a_2+\sum_{i=1}^{4}M_{z_i}
\end{Bmatrix}. \qquad \text{(P.B.11)}$$

$$\left\{F_{auto,z}\left(X\right)\right\}=\begin{Bmatrix} c_1\left(\dot{z}-\dot{z}_1+a_1\dot{\varphi}-b_1\dot{\theta}\right)+k_1\left(z-z_1+a_1\varphi-b_1\theta\right) \\ -c_{t1}\left(\dot{z}_1-\dot{z}_{01}\right)-k_{t1}\left(z_1-z_{01}\right) \\ \\ c_2\left(\dot{z}-\dot{z}_2-a_2\dot{\varphi}-b_1\dot{\theta}\right)+k_2\left(z-z_2-a_2\varphi-b_1\theta\right) \\ -c_{t2}\left(\dot{z}_2-\dot{z}_{02}\right)-k_{t2}\left(z_2-z_{02}\right) \\ \\ c_3\left(\dot{z}-\dot{z}_3+a_1\dot{\varphi}+b_2\dot{\theta}\right)+k_3\left(z-z_3+a_1\varphi+b_2\theta\right) \\ -c_{t3}\left(\dot{z}_3-\dot{z}_{03}\right)-k_{t3}\left(z_3-z_{03}\right) \\ \\ c_4\left(\dot{z}-\dot{z}_4-a_2\dot{\varphi}+b_2\dot{\theta}\right)+k_4\left(z-z_4-a_2\varphi+b_2\theta\right) \\ -c_{t4}\left(\dot{z}_4-\dot{z}_{04}\right)-k_{t4}\left(z_4-z_{04}\right) \end{Bmatrix}, \quad \text{(P.B.11)}$$

$$\left\{M_{auto,w}\left(X\right)\right\}=\begin{Bmatrix} T_{v_1}i_{tr.}\eta_{tr.}-T_{st.1}-F_{x_1}r_{d_1}-F_{ried.1}r_{d_1} \\ T_{v_2}i_{tr.}\eta_{tr.}-T_{st.2}-F_{x_2}r_{d_2}-F_{ried.2}r_{d_2} \\ -T_{st.3}-F_{x_3}r_{d_3}-F_{ried.3}r_{d_3} \\ -T_{st.4}-F_{x_4}r_{d_4}-F_{ried.4}r_{d_4} \end{Bmatrix}, \quad \text{(P.B.12)}$$

$$\left\{M_{ASS,w}\left(X\right)\right\}=\begin{Bmatrix} -F_{x_{11}}r_{d_{11}}-F_{ried.11}r_{d_{11}} \\ -F_{x_{22}}r_{d_{22}}-F_{ried.22}r_{d_{22}} \\ -F_{x_{33}}r_{d_{33}}-F_{ried.33}r_{d_{33}} \\ -F_{x_{44}}r_{d_{44}}-F_{ried.44}r_{d_{44}} \end{Bmatrix}, \quad \text{(P.B.13)}$$

$$\left\{M_{ASS,\delta}\left(X\right)\right\}=\begin{Bmatrix} F_{y_{11}}d-M_{z_{11}} \\ F_{y_{22}}d-M_{z_{22}} \\ F_{y_{33}}d-M_{z_{33}} \\ F_{y_{44}}d-M_{z_{44}} \end{Bmatrix}. \quad \text{(P.B.14)}$$