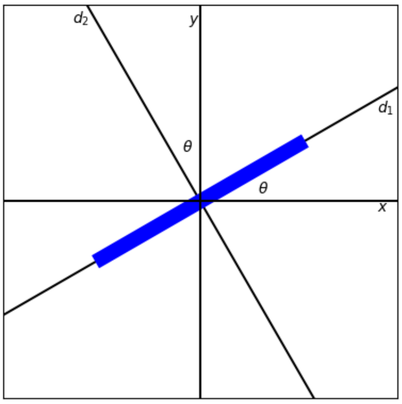
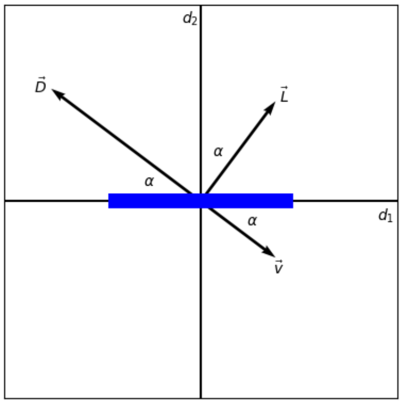
02-Airbounce: Ideje in rešitve

1 Stabilen frizbi

Frizbi zaradi vrtenja ohranja orientacijo.



Slika 1: Graf osi, koordinatni sistem N



Slika 2: Koordinatni sistem frizbija D

V sistemu frizbija (D):

$$L = \frac{1}{2} A\rho C_L v^2 \qquad D = \frac{1}{2} A\rho C_D v^2 \tag{1}$$

$$C_L = C_{L0} + C_{L\alpha}\alpha \qquad C_D = C_{D0} + C_{D\alpha}\alpha^2 \tag{2}$$

$$K = \frac{A\rho}{2m} \qquad \tan\alpha = \frac{-v_2}{v_1} \tag{3}$$

$$\boldsymbol{L} = mKv^2 C_L \begin{pmatrix} \sin\alpha \\ \cos\alpha \end{pmatrix} = mKv^2 C_L \begin{pmatrix} -v_2 \\ v_1 \end{pmatrix} \tag{4}$$

$$\boldsymbol{D} = mKv^2 C_D \begin{pmatrix} -\cos\alpha \\ \sin\alpha \end{pmatrix} = mKv^2 C_D \begin{pmatrix} -v_1 \\ -v_2 \end{pmatrix} \tag{5}$$

$$\boldsymbol{F_g} = -mg \begin{pmatrix} \sin\theta \\ \cos\theta \end{pmatrix} \tag{6}$$

$$m\boldsymbol{a} = \boldsymbol{L} + \boldsymbol{D} + \boldsymbol{F_g} \tag{7}$$

$$v = \sqrt{v_1^2 + v_2^2} \tag{8}$$

$$a_1 = -K(C_{L0} + C_{L\alpha}\alpha)vv_2 - K(C_{D0} + C_{D\alpha}\alpha^2)vv_1 - g\sin\theta \tag{9}$$

$$a_2 = K(C_{L0} + C_{L\alpha}\alpha)vv_1 - K(C_{D0} + C_{D\alpha}\alpha^2)vv_2 - g\cos\theta \tag{10}$$

Rešimo: d_1, d_2, v_1, v_2.
Zarotiramo v N sistem.

$$R = \begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix} \tag{11}$$

$$\begin{pmatrix} x \\ y \end{pmatrix}_N = R \begin{pmatrix} d_1 \\ d_2 \end{pmatrix}_D \tag{12}$$

$$\begin{pmatrix} v_x \\ v_y \end{pmatrix}_N = R \begin{pmatrix} v_1 \\ v_2 \end{pmatrix}_D \tag{13}$$