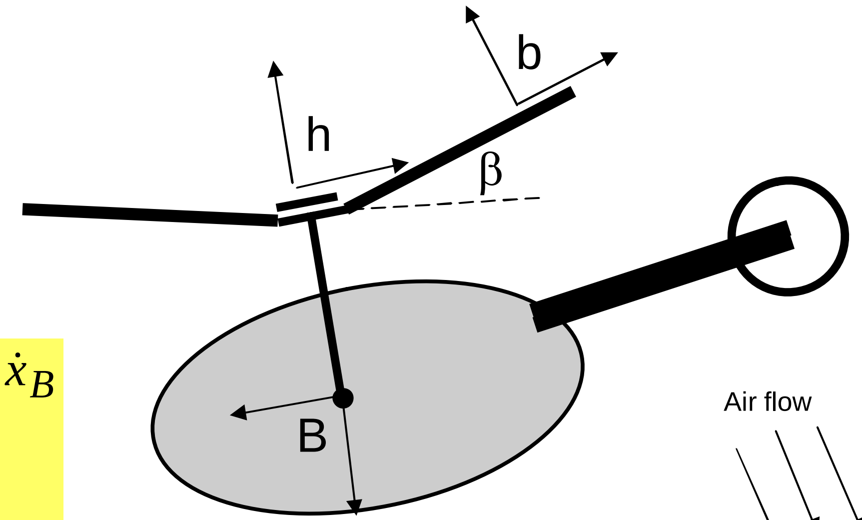
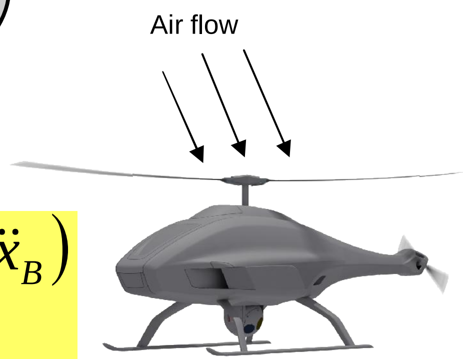
The helicopter (Skeldar) blade dynamics

General rigid body coordinate transformations

$$x_E = x_{B,0} + A_{B2E} x_B$$
$$x_B = x_{h,0} + A_{h2B} x_h$$
$$x_h = x_{b,0} + A_{b2h} x_b$$



$$\dot{x}_E = \dot{x}_{B,0} + A_{B2E}\left(\omega_B \times x_B\right) + A_{B2E}\dot{x}_B$$
$$\dot{x}_B = A_{h2B}\dot{x}_h$$
$$\dot{x}_h = \dot{x}_{b,0} + A_{b2h}\left(\omega_b \times x_b\right) + A_{b2h}\dot{x}_b$$



Skeldar

$$\ddot{x}_E = \ddot{x}_{B,0} + A_{B2E}\left(\omega_B \times \left(\omega_B \times x_B\right) + \dot{\omega}_B \times x_B + 2\omega_B \times \dot{x}_B + \ddot{x}_B\right)$$
$$\ddot{x}_B = A_{h2B}\ddot{x}_h$$
$$\ddot{x}_h = \ddot{x}_{b,0} + A_{b2h}\left(\omega_b \times \left(\omega_b \times x_b\right) + \dot{\omega}_b \times x_b\right)$$

E=Earth, B=Body, h=hub and b=blade