Equations for the sim

CIA Wanted

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We split horizontal and vertical dynamics.

1 Vertical dynamics

$$a_v = \frac{1}{m}(L - W), \tag{1}$$

where a_v is the vertical acceleration in ms^{-2}, m is the mass of the aircraft in Kg, and L and W are the lift and weight forces respectively in Newtons.

$$W = mg, \tag{2}$$

where $g = 9.8\,\mathrm{ms}^{-2}$ is the gravity acceleration.

$$L = c_l v_s^2, \tag{3}$$

where c_l is a coefficient to be determined experimentally, and v_s is the airspeed of the aircraft. We can assume that

$$v_s = c_{th}\,(t_h + \Delta t_h) + w_{bx}, \tag{4}$$

where $(t_h + \Delta_h) \in [0, 100]$ is the throttle signal and c_{th} is a coefficient to be determined experimentally, and w_{bx} is the component of the wind vector along the horizontal axis of the vehicle. We set t_h to a nominal value, let us say 50 and we use Δt_h to control the altitude of the aircrat with a P controller, i.e.,

$$\Delta t_h = k_p(h_d - h_c), \tag{5}$$

where k_p is a positive gain constant, and h_d is the desired altitude and h_c is the current altitude of the aircraft.

1.1 Euler integration

$$\begin{cases} h(k+1) & = h(k) + v_s(k)\Delta T \\ v_s(k+1) & = v_s(k) + a_v(k)\Delta T \end{cases} \tag{6}$$