## Equation of Motions already included

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These are the equations already included the 6DOF model.

$$C_{b/n} = \begin{bmatrix} cos(\theta)cos(\psi) & cos(\theta)sin(\psi) & -sin(\theta) \\ -cos(\phi)sin(\psi) + sin(\phi)sin(\theta)cos(\psi) & cos(\phi)cos(\psi) + sin(\phi)sin(\theta)sun(\psi) & sin(\phi)cos(\theta) \\ sin(\phi)sin(\psi) + cos(\phi)sin(\theta)cos(\psi) & -sin(\phi)cos(\psi) + cos(\phi)sin(\theta)sin(\psi) & cos(\phi)cos(\theta) \end{bmatrix}$$

Also represented as:  $C_{b/n} = fn(\Theta)$ 

$$\Omega = \begin{bmatrix} 0 & -R & Q \\ R & 0 & -P \\ -Q & P & 0 \end{bmatrix}$$

$$\begin{bmatrix} \dot{\phi} \\ \dot{\theta} \\ \dot{\psi} \end{bmatrix} = \begin{bmatrix} 1 & tan(\theta)sin(\phi) & tan(\theta)cos(\phi) \\ 0 & cos(\phi) & -sin(\phi) \\ 0 & sin(\phi)/cos(\theta) & cos(\phi)/cos(\theta) \end{bmatrix} \times \begin{bmatrix} P \\ Q \\ R \end{bmatrix}$$

Also represented as:  $\dot{\Phi} = H(\Phi)\omega_{b/e}^b$ 

$${}^b\dot{v}^b_{CM/e}=(\frac{1}{m})F^b_{A,T}+C_{b/n}\times g+\Omega^b_{b/e}\times v^b_{CM/e}$$

$$^e\dot{p}^n_{CM/T} = C_{n/b} \times v^b_{CM/e}$$

$${}^b\dot{\omega}^b_{b/e} = inv(J^b) \times [M^b_{A,T} - \Omega^b_{b/e} \times J^b \times \omega^b_{b/e}]$$

These are the equations in the force-moment model.

$$\alpha = tan^{-}1(w/u)$$
$$Q = 0.5 \times \rho \times ||V||^{2}$$

$$\begin{split} C_L &= C_{L0} + C_{L\alpha} \times \alpha + \left(\frac{C_{Lq} \times q \times c_{bar}}{2 \times \|V\|}\right) + C_{Lde} \times \delta_e \\ C_m &= C_{m0} + Cm\alpha \times \alpha + \left(\frac{C_{mq} * q * c_{bar}}{(2 \times \|V\|}\right) + C_{mde} \times \delta_e \\ C_D &= C_{D0} + K_{drag} \times C_L^2 \end{split}$$

$$L = C_L \times s \times Q$$

$$D = C_D \times s \times Q$$

$$Force = \begin{bmatrix} -D \times cos(\alpha) + L \times sin(\alpha) + thrust - mg \times sin(\theta) \\ 0 \\ -D \times sin(\alpha) - L \times cos(\alpha) + mg \times cos(\theta) \end{bmatrix}$$

$$Moment = \begin{bmatrix} 0 \\ C_m \times s \times c_{bar} \times Q \\ 0 \end{bmatrix}$$