

Acronyms

AOA Angle Of Attack. Also named *alpha*.

AOS Angle Of Sideslip. Also named *beta*.

FRD Coordinate system where the X-axis is pointing towards the Front of the vehicle, the Y-axis is pointing Right and the Z-axis is pointing Down, completing the right-hand rule.

FW Fixed-Wing.

MC MultiCopter.

MPC or MCPC MultiCopter Position Controller. MPC is also used for Model Predictive Control.

NED Coordinate system where the X-axis is pointing towards the true North, the Y-axis is pointing East and the Z-axis is pointing Down, completing the right-hand rule.

PID Controller with Proportional, Integral and Derivative actions.

Symbols

a Acceleration vector. $\mathbf{a} = \dot{\mathbf{v}} = \ddot{\mathbf{r}} = [a_x \quad a_y \quad a_z]^T$.

α Angle of attack (AOA).

AR Aspect ratio. $AR = b^2/S$.

b Wing span (from tip to tip).

β Angle of sideslip (AOS).

\bar{c} Mean aerodynamic chord (mac).

c Wing chord length.

$\delta_{a,e,r}$ Aerodynamic control surface angular deflection. Subscripts a , e and r stand for *aileron*, *elevator* and *rudder*, respectively. A positive deflection generates a negative moment.

Ψ Attitude vector. $\Psi = [\phi \quad \theta \quad \psi]^T$.

ϕ Roll euler angle. Also named *Bank angle* in aviation.

ψ Yaw euler angle. Also named *Heading*.

θ Pitch euler angle.

\mathbf{F} Force vector. $\mathbf{F} = [X \ Y \ Z]^T$.

\mathbf{F}_{Aero}^w Aerodynamic forces in wind frame. *Lift* L , *drag* D and *cross-wind force* C . $\mathbf{F}_{Aero}^w = [-D \ -C \ -L]^T$.

\mathbf{F}_T^b Thrust force in body frame. $\mathbf{F}_T^b = [X_T^b \ Y_T^b \ Z_T^b]^T$.

\mathbf{g} Gravity vector.

\mathbf{M}_{Aero}^b Body aerodynamic moments. $\mathbf{M}_{Aero}^b = [\ell \ m \ n]^T$.

\mathbf{M}_T^b Body thrust moments. $\mathbf{M}_T^b = [\ell_T \ m_T \ n_T]^T$.

M Mach number. Can be neglected for scale aircrafts.

$\tilde{\mathbf{q}}$ Hamiltonian attitude quaternion. $\tilde{\mathbf{q}} = (q_0, q_1, q_2, q_3) = (q_0, \mathbf{q})$
 A vector in the local NED frame ℓ can be represented in the body frame b using $\tilde{\mathbf{v}}^b = \tilde{\mathbf{q}} \tilde{\mathbf{v}}^\ell \tilde{\mathbf{q}}^*$ (or $\tilde{\mathbf{q}}^{-1}$ instead of $\tilde{\mathbf{q}}^*$ if $\tilde{\mathbf{q}}$ is not unitary).
 $\tilde{\mathbf{v}}$ represents a *quaternionized* vector: $\tilde{\mathbf{v}} = (0, \mathbf{v})$.

\mathbf{r} Position vector $\mathbf{r} = [x \ y \ z]^T$.

\mathbf{R}_a^b Rotation matrix. Rotates a vector from frame a to frame b . $\mathbf{v}^b = \mathbf{R}_a^b \mathbf{v}^a$.

Λ Leading-edge sweep angle.

λ Taper ratio $\lambda = c_{tip}/c_{root}$.

\mathbf{v} Velocity vector. $\mathbf{v} = \dot{\mathbf{r}} = [v_x \ v_y \ v_z]^T$.

\mathbf{v}^ℓ Velocity vector in local frame. $\mathbf{v}^\ell = \mathbf{v}_w^\ell + \mathbf{w}^\ell$.

\mathbf{v}_w^b Relative airspeed velocity vector in body frame. $\mathbf{v}_w^b = [u \ v \ w]^T$.

\mathbf{w}^ℓ Wind velocity vector in local frame. $\mathbf{w}^\ell = [w_N \ w_E \ w_D]^T$ Usually w_D is assumed to be null.

$\boldsymbol{\omega}^b$ Body rates vector. $\boldsymbol{\omega}^b = [p \ q \ r]^T$.

\mathbf{x} General state vector.

Decorators

$()^*$ Complex conjugate.

$\dot{()}$ Time derivative.

$()^b$ Resolved in the body FRD frame.

$()^\ell$ Resolved in the local NED frame.

$()^w$ Resolved in the wind frame.

$\hat{()}$ Estimate.

$()^{-1}$ Matrix inverse.

$()^T$ Matrix transpose.