Acronyms

AOA Angle Of Attack. Also named *alpha*.

AOS Angle Of Sideslip. Also named *beta*.

FRD Body frame centered on the CG where the X-axis is pointing towards the Front of the vehicle, the Y-axis towards Right and the Z-axis is Down, completing the right-hand rule.

FW Fixed-Wing.

MC MultiCopter.

MPC or MCPC?? MultiCopter Position Controller.

NED Local inertial frame where the X-axis is pointing towards the true North, the Y-axis towards the East and the Z-axis is Down, completing the right-hand rule. Its origin is defined when and where the drone arms.

PID Controller with Proportional, Integral and Derivative actions.

Symbols

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

α Angle of attack (AOA).

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

β Angle of sideslip (AOS).

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

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

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

$\mathbf{F}^b_T$ Thrust force in body frame. $\mathbf{F}^b_T = [X^b_T \quad Y^b_T \quad Z^b_T]^T$.

$\mathbf{g}$ Gravity vector in the local NED frame. $\mathbf{g} = [0 \quad 0 \quad g]^T$.

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

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

ψ Yaw euler angle. Also named *Heading*.

$\tilde{\mathbf{q}}$ 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 framae 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 $\mathbf{r} = [x \quad y \quad z]^T$.

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

$\mathbf{x}$ General state vector.

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

θ Pitch euler angle.

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

$\mathbf{v}^\ell$ 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. $\mathbf{v}_w^b = [u \quad v \quad w]^T$.

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

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

Decorators

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

$()^*$ Complex conjugate.

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

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

$\dot{()}$ Time derivative.

$\hat{()}$ Estimate.

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

$()^T$ Matrix transpose.