Nomenclature

Of the very large number of symbols required by the subject, many have more than one meaning. Usually the meaning is clear from the context in which the symbol is used.

a	Wing or wing–body lift curve slope: Acceleration. Local speed of sound
a'	Inertial or absolute acceleration
a_0	Speed of sound at sea level. Tailplane zero incidence lift coefficient
a_1	Tailplane lift curve slope
a_{1_f}	Canard foreplane lift curve slope
a_{1_F}	Fin lift curve slope
a_2	Elevator lift curve slope
a_{2_A}	Aileron lift curve slope
a_{2_R}	Rudder lift curve slope
a_3	Elevator tab lift curve slope
a_∞	Lift curve slope of an infinite span wing
a_h	Local lift curve slope at coordinate h
a_y	Local lift curve slope at spanwise coordinate y
ac	Aerodynamic centre
A	Aspect ratio
$\mathbf{A}$	State matrix
b	Wing span
b_1	Elevator hinge moment derivative with respect to α_T
b_2	Elevator hinge moment derivative with respect to η
b_3	Elevator hinge moment derivative with respect to β_η
$\mathbf{B}$	Input matrix
c	Chord: Viscous damping coefficient. Command input
$\overline{c}$	Standard mean chord (*smc*)
$\overline{\overline{c}}$	Mean aerodynamic chord (*mac*)
$\overline{\overline{c}}_\eta$	Mean elevator chord aft of hinge line
c_h	Local chord at coordinate h
c_y	Local chord at spanwise coordinate y
cg	Centre of gravity
cp	Centre of pressure
C	Command path transfer function
$\mathbf{C}$	Output matrix
C_D	Drag coefficient
C_{D_0}	Zero lift drag coefficient
C_l	Rolling moment coefficient
C_L	Lift coefficient

C_{L_w} Wing or wing–body lift coefficient
C_{L_T} Tailplane lift coefficient
C_H Elevator hinge moment coefficient
C_m Pitching moment coefficient
C_{m_0} Pitching moment coefficient about aerodynamic centre of wing
C_{m_α} Slope of C_m–α plot
C_n Yawing moment coefficient
C_x Axial force coefficicent
C_y Lateral force coefficient
C_z Normal force coefficient
C_τ Thrust coefficient
D Drag
D' Drag in a lateral–directional perturbation
$\mathbf{D}$ Direction cosine matrix: Direct matrix
D_c Drag due to camber
D_α Drag due to incidence
e The exponential function
e Oswald efficiency factor
F Aerodynamic force: Feed forward path transfer function
F_c Aerodynamic force due to camber
F_α Aerodynamic force due to incidence
F_η Elevator control force
g Acceleration due to gravity
g_η Elevator stick to surface mechanical gearing constant
G Controlled system transfer function
h Height: Centre of gravity position on reference chord: Spanwise coordinate along wing sweep line
h_0 Aerodynamic centre position on reference chord
h_F Fin height coordinate above roll axis
h_m Controls fixed manoeuvre point position on reference chord
h'_m Controls free manoeuvre point position on reference chord
h_n Controls fixed neutral point position on reference chord
h'_n Controls free neutral point position on reference chord
H Elevator hinge moment: Feedback path transfer function
H_F Fin span measured perpendicular to the roll axis
H_m Controls fixed manoeuvre margin
H'_m Controls free manoeuvre margin
i_x Dimensionless moment of inertia in roll
i_y Dimensionless moment of inertia in pitch
i_z Dimensionless moment of inertia in yaw
i_{xz} Dimensionless product of inertia about ox and oz axes
I' Normalised inertia
I_x Moment of inertia in roll
I_y Moment of inertia in pitch
I_z Moment of inertia in yaw
$\mathbf{I}$ Identity matrix
I_{xy} Product of inertia about ox and oy axes
I_{xz} Product of inertia about ox and oz axes

I_{yz}	Product of inertia about *oy* and *oz* axes
j	The complex variable ($\sqrt{-1}$)
k	General constant: Spring stiffness coefficient
k_q	Pitch rate transfer function gain constant
k_u	Axial velocity transfer function gain constant
k_w	Normal velocity transfer function gain constant
k_θ	Pitch attitude transfer function gain constant
k_τ	Turbo-jet engine gain constant
K	Feedback gain: Constant in drag polar
$\mathbf{K}$	Feedback gain matrix
K_n	Controls fixed static stability margin
K_n'	Controls free static stability margin
l_f	Fin arm measured between wing and fin quarter chord points
l_t	Tail arm measured between wing and tailplane quarter chord points
l_F	Fin arm measured between *cg* and fin quarter chord point
l_T	Tail arm measured between *cg* and tailplane quarter chord points
L	Lift: Rolling moment
L'	Lift in a lateral–directional perturbation
L_c	Lift due to camber
L_w	Wing or wing–body lift
L_F	Fin lift
L_T	Tailplane lift
L_α	Lift due to incidence
m	Mass
m'	Normalised mass
M	Local Mach number
M_0	Free stream Mach number
M_{crit}	Critical Mach number
M	Pitching moment
$\mathbf{M}$	"Mass" matrix
M_0	Wing–body pitching moment about wing aerodynamic centre
M_T	Tailplane pitching moment about tailplane aerodynamic centre
n	Total normal load factor
n_α	Normal load factor per unit angle of attack
n'	Inertial normal load factor
N	Yawing moment
o	Origin of axes
p	Roll rate perturbation: Trim reference point: System pole
q	Pitch rate perturbation
Q	Dynamic pressure
r	Yaw rate perturbation: General response variable
R	Radius of turn
s	Wing semi-span: Laplace operator
S	Wing reference area
S_B	Projected body side reference area
S_F	Fin reference area
S_T	Tailplane reference area
S_η	Elevator area aft of hinge line
t	Time: Maximum aerofoil section thickness

T Time constant
T_r Roll mode time constant
T_s Spiral mode time constant
T_u Numerator zero in axial velocity transfer function
T_w Numerator zero in normal velocity transfer function
T_θ Numerator zero in pitch rate and attitude transfer functions
T_τ Turbo-jet engine time constant
T_2 Time to double amplitude
u Axial velocity perturbation
$\mathbf{u}$ Input vector
U Total axial velocity
U_e Axial component of steady equilibrium velocity
U_E Axial velocity component referred to datum-path earth axes
v Lateral velocity perturbation
$\mathbf{v}$ Eigenvector
V Perturbed total velocity: Total lateral velocity
V_e Lateral component of steady equilibrium velocity
V_E Lateral velocity component referred to datum-path earth axes
V_0 Steady equilibrium velocity
$\overline{V}_f$ Canard foreplane volume ratio
$\overline{V}_F$ Fin volume ratio
$\overline{V}_T$ Tailplane volume ratio
$\mathbf{V}$ Eigenvector matrix
w Normal velocity perturbation
W Total normal velocity
W_e Normal component of steady equilibrium velocity
W_E Normal velocity component referred to datum-path earth axes
x Longitudinal coordinate in axis system
x_τ Axial coordinate of engine thrust line
$\mathbf{x}$ State vector
X Axial force component
y Lateral coordinate in axis system
y_B Lateral body "drag" coefficient
y_τ Lateral coordinate of engine thrust line
$\mathbf{y}$ Output vector
Y Lateral force component
z Normal coordinate in axis system: System zero
z_τ Normal coordinate of engine thrust line
$\mathbf{z}$ Transformed state vector
Z Normal force component

Greek letter

α Angle of attack or incidence perturbation
α' Incidence perturbation
α_e Equilibrium incidence

α_T Local tailplane incidence
α_{w_0} Zero lift incidence of wing
α_{wr} Wing rigging angle
β Sideslip angle perturbation
β_e Equilibrium sideslip angle
β_η Elevator trim tab angle
γ Flight path angle perturbation: Imaginary part of a complex number
γ_e Equilibrium flight path angle
Γ Wing dihedral angle
δ Control angle: Increment: Unit impulse function
δ_ξ Roll control stick angle
δ_η Pitch control stick angle
δ_ζ Rudder pedal control angle
δm Mass increment
Δ Characteristic polynomial: Transfer function denominator
ε Throttle lever angle: Downwash angle at tailplane: Closed loop system error
ε_0 Zero lift downwash angle at tail
ζ Rudder angle perturbation: Damping ratio
ζ_d Dutch roll damping ratio
ζ_p Phugoid damping ratio
ζ_s Short period pitching oscillation damping ratio
η Elevator angle perturbation
η_e Elevator trim angle
η_T Tailplane setting angle
θ Pitch angle perturbation: A general angle
θ_e Equilibrium pitch angle
κ Thrust line inclination to aircraft ox axis
λ Eigenvalue
Λ Wing sweep angle
$\mathbf{\Lambda}$ Eigenvalue matrix
μ_1 Longitudinal relative density factor
μ_2 Lateral relative density factor
ξ Aileron angle perturbation
ρ Air density
σ Aerodynamic time parameter: Real part of a complex number
τ Engine thrust perturbation: Time parameter
τ_e Trim thrust
$\hat{\tau}$ Dimensionless thrust
ϕ Roll angle perturbation: Phase angle: A general angle
$\mathbf{\Phi}$ State transition matrix
ψ Yaw angle perturbation
ω Undamped natural frequency
ω_b Bandwidth frequency
ω_d Dutch roll undamped natural frequency
ω_n Damped natural frequency
ω_p Phugoid undamped natural frequency
ω_s Short period pitching oscillation undamped natural frequency

Subscripts

0	Datum axes: Normal earth fixed axes: Wing or wing–body aerodynamic centre: Free stream flow conditions
1/4	Quarter chord
2	Double or twice
∞	Infinite span
a	Aerodynamic
A	Aileron
b	Aeroplane body axes: Bandwidth
B	Body or fuselage
c	Control: Chord: Compressible flow: Camber line
d	Atmospheric disturbance: Dutch roll
D	Drag
e	Equilibrium, steady or initial condition
E	Datum-path earth axes
f	Canard foreplane
F	Fin
g	Gravitational
H	Elevator hinge moment
i	Incompressible flow
l	Rolling moment
le	Leading edge
L	Lift
m	Pitching moment: Manoeuvre
n	Neutral point: Yawing moment
p	Power: Roll rate: Phugoid
q	Pitch rate
r	Yaw rate: Roll mode
R	Rudder
s	Short period pitching oscillation: Spiral mode
T	Tailplane
u	Axial velocity
v	Lateral velocity
w	Aeroplane wind or stability axes: Wing or wing–body: Normal velocity
x	ox axis
y	oy axis
z	oz axis
α	Angle of attack or incidence
ε	Throttle lever
ζ	Rudder
η	Elevator
θ	Pitch
ξ	Ailerons
τ	Thrust

Examples of other symbols and notation

x_u	A shorthand notation to denote the concise derivative, a dimensional derivative divided by the appropriate mass or inertia parameters
X_u	A shorthand notation to denote the American normalised dimensional derivative $\overset{\circ}{X}_u/m$
L'_v	A shorthand notation to denote a modified North American lateral–directional derivative
C_{x_u}	A shorthand coefficient notation to denote a North American dimensionless derivative
X_u	A shorthand notation to denote the dimensionless derivative $\partial\hat{X}/\partial\hat{u}$
$\overset{\circ}{X}_u$	A shorthand notation to denote the dimensional derivative $\partial X/\partial u$
$N_u^y(t)$	A shorthand notation to denote a transfer function numerator polynomial relating the output response y to the input u
$\hat{u}$	A shorthand notation to denote that the variable u is dimensionless
$(^*)$	A superscript to denote a complex conjugate: A superscript to denote that a derivative includes both aerodynamic and thrust effects in North American notation
$(^\circ)$	A dressing to denote a dimensional derivative in British notation
$(\hat{})$	A dressing to denote a dimensionaless parameter
$(^{\mathrm{T}})$	A superscript to denote a transposed matrix