

INTRODUCTION TO DATA ITEMS ON FLIGHT PATH OPTIMISATION

1. NOTATION AND UNITS

		SI	British
C_F	fuel cost coefficient in Performance Index function (Equation (4.20))		
C_L	lift coefficient, L/qS		
C_T	time cost coefficient in Performance Index function (Equation (4.20))		
D	airframe drag	N	lbf
D_M	intake momentum drag (per aircraft)	N	lbf
F_G	engine gross thrust (per aircraft)	N	lbf
f_k	denotes functional relationship of type f (.....)		
g	acceleration due to gravity	m/s ²	ft/s ²
g_0	standard sea-level value* of g	m/s ²	ft/s ²
H	geopotential height*	m	ft
H_p	pressure height*	m	ft
H^Σ	resultant angular momentum of aircraft	kg m ² /s	slug ft ² /s
I	Performance Index function		
i	number of variables		
j	number of control variables		
L	aerodynamic lift	N	lbf
M	Mach number		
M^Σ	resultant moment acting on aircraft	N m	lbf ft
m	mass of aircraft	kg	slug
n	normal load factor		
p	number of constraints in form of equalities		
Q	fuel-flow (weight-flow basis)	N/s	lbf/s
q	kinetic pressure, ($= \rho V^2/2$)	N/m ²	lbf/ft ²
R^Σ	resultant external force acting on aircraft	N	lbf
r	number of constraints (equalities and inequalities)		

For footnotes refer to end of Notation Section

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S	wing (reference) area	m^2	ft^2
T	temperature	K	K
t	time	s	s
U, u_1, u_2	general terms for control variables		
$u_{W_g}, v_{W_g}, w_{W_g}$	component of V_W in x_g -direction, y_g -direction, z_g -direction	m/s	ft/s
V	true airspeed (air-path velocity or resultant velocity with respect to air)	m/s	ft/s
V_{in}	velocity relative to an inertial frame of reference	m/s	ft/s
V_K	flight-path velocity (resultant velocity with respect to Earth)	m/s	ft/s
V_W	wind velocity	m/s	ft/s
W	aircraft weight, ($= mg$)	N	lbf
x_g, y_g	Earth-axis co-ordinates in horizontal plane	m	ft
Z	geometric height*, ($= -z_g$)	m	ft
z_g	Earth-axis co-ordinate in direction of local vertical, positive downwards	m	ft
α	angle of attack, <i>i.e.</i> angle between projection of true airspeed vector on to aircraft plane of symmetry and longitudinal datum or body axis	deg	deg
$\beta_1, \beta_2, \dots$	constraints on state and control variables		
γ	angle of climb (flight-path inclination angle), $\sin \gamma = (dZ/dt)/V_K$	deg	deg
γ_a	air-path angle of climb (air-path inclination angle), $\sin \gamma_a = (dZ/dt)/V$	deg	deg
η	throttle position parameter		
Θ	inclination angle [†] (elevation) of longitudinal datum or body axis	deg	deg
ρ	density of air	kg/m^3	$slug/ft^3$
τ	angle between projection of engine gross thrust vector on to aircraft plane of symmetry and longitudinal datum or body axis; positive when F_G contributes to lift	deg	deg
Φ	bank angle [†]	deg	deg
χ	flight-path azimuth angle (angle of track), taken as angle between x_g -axis and projection of V_K on to horizontal plane	deg	deg

For footnotes refer to end of Notation Section

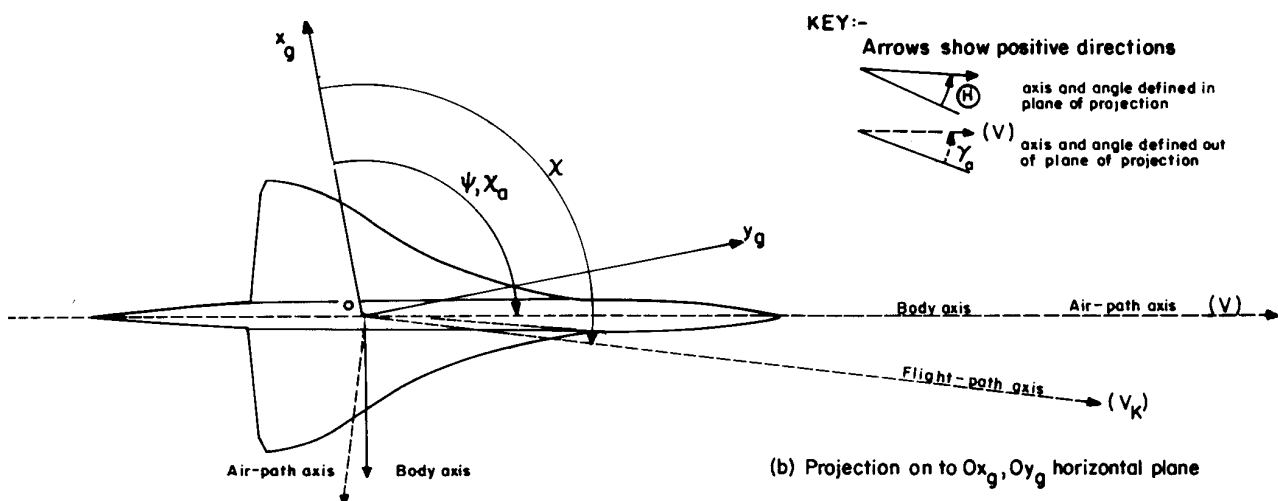
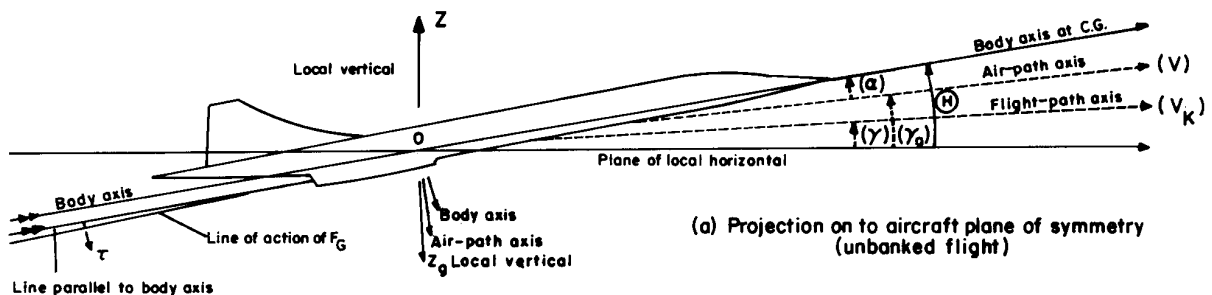
χ_a	air-path azimuth angle, taken as angle between x_g -axis and projection of V on to horizontal plane	deg	deg
Ψ	azimuth angle [†]	deg	deg

Subscripts

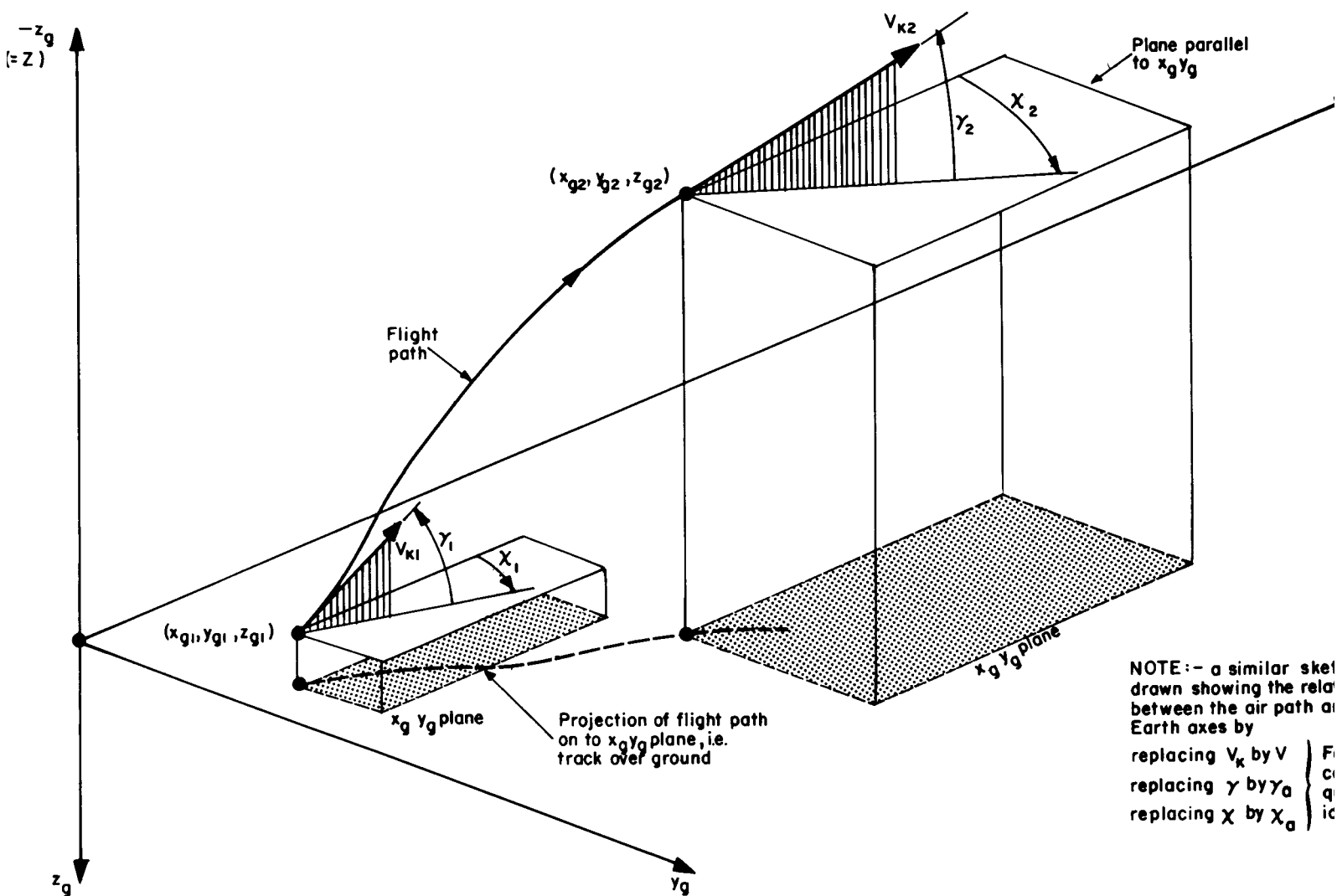
max	denotes maximum allowable value
min	denotes minimum allowable value
std	denotes conditions in International Standard Atmosphere, ISA
T	denotes value for terrain vertically below aircraft
1	denotes initial point of flight path to be optimised
2	denotes final point of flight path to be optimised

* See Data Item No. 77022 (Reference 3) for definitions.

† Transition from the Earth-axis system (x_g, y_g, z_g) to the body-axis system is effected by the rotation through the angles Ψ, Θ, Φ in that order. These angles define the orientation of the body axes with respect to the Earth axes and are called the attitude angles.



Sketch 1.1 Guide to axes and angles (unbanked flight, zero sideslip)



Sketch 1.2 Relationship of flight path to Earth axes