Unpowered Glide Analysis of a Baron 58 Light Aircraft

Introduction

This application presents an unpowered glide analysis of a Baron 58 aircraft.

An aircraft with no engine power will glide to the ground. The best glide angle is the flight angle at which the airplane will travel the greatest distance, and occurs at the maximum lift-to-drag ratio.

For the parameters used in this application, a Baron 58 aircraft has a maximum lift-to-drag ratio of about 12.2. This means an unpowered Baron will fall 1 m for every 12.2 m of flight. This application also calculates the best glide velocity, drag and lift coefficients, and the dynamic pressure.

Reference: "Performance of Light Aircraft", Lowry, J. T., 1999, American Institute of Aeronautics and Astronautics Inc

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restart :
with( Units[ Simple ] ) :
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Parameters

Weight of aircraft
$W := 5500\ \text{lbf}$:

Parasite drag coefficient/zero lift drag coefficient
$C_{D0} := 0.0255$:

Density of air at altitude h
$\rho := 1.155\ \text{kg}\,\text{m}^{-3}$:

Wing area
$S := 199.2\ \text{ft}^2$:

Oswald efficiency factor
$e := 0.67$:

Density of air at sea level
$\rho_0 := 1.225\ \text{kg}\,\text{m}^{-3}$:

Wing aspect ratio
$A := 7.19$:

Altitude
$h := 2000\ \text{ft}$:

Bank angle
$\phi := 0.\ \text{deg}$:

Best Glide Calculations

Best glide velocity (true air speed)

$$TAS_{bg} := \sqrt{\frac{2W}{\rho S}} \left(4 C_{D0}^{2} + C_{D0} \pi e A \cos(\phi)^{2}\right)^{-\frac{1}{4}} = 117.80 \text{ knot}$$

Best glide angle in radians (angle between the flight path and the ground that provides the highest lift-to-drag ratio)

$$\gamma_{bg} := \arcsin\left(-\sqrt{\frac{4 C_{D0}}{\pi e A \cos(\phi)^{2} + 4 C_{D0}}}\right) = -0.0819$$

Calibrated air speed

$$CAS_{bg} := TAS_{bg}\sqrt{\rho/\rho_0} = 114.39 \text{ knot}$$

Best glide angle in degrees

$$\gamma_{bg} \cdot 180/\pi = -4.69$$

Best glide drag

$$D_{bg} := -W \sin(\gamma_{bg}) = 2.00 \text{ kN}$$

Best glide lift

$$L_{bg} := W \cos(\gamma_{bg}) = 24.38 \text{ kN}$$

Maximum lift-drag ratio

$$\frac{L_{bg}}{D_{bg}} = 12.18$$

Dynamic pressure

$$q := \frac{\rho TAS_{bg}^{2}}{2} = 2.12 \text{ kPa}$$

Drag and lift coefficients

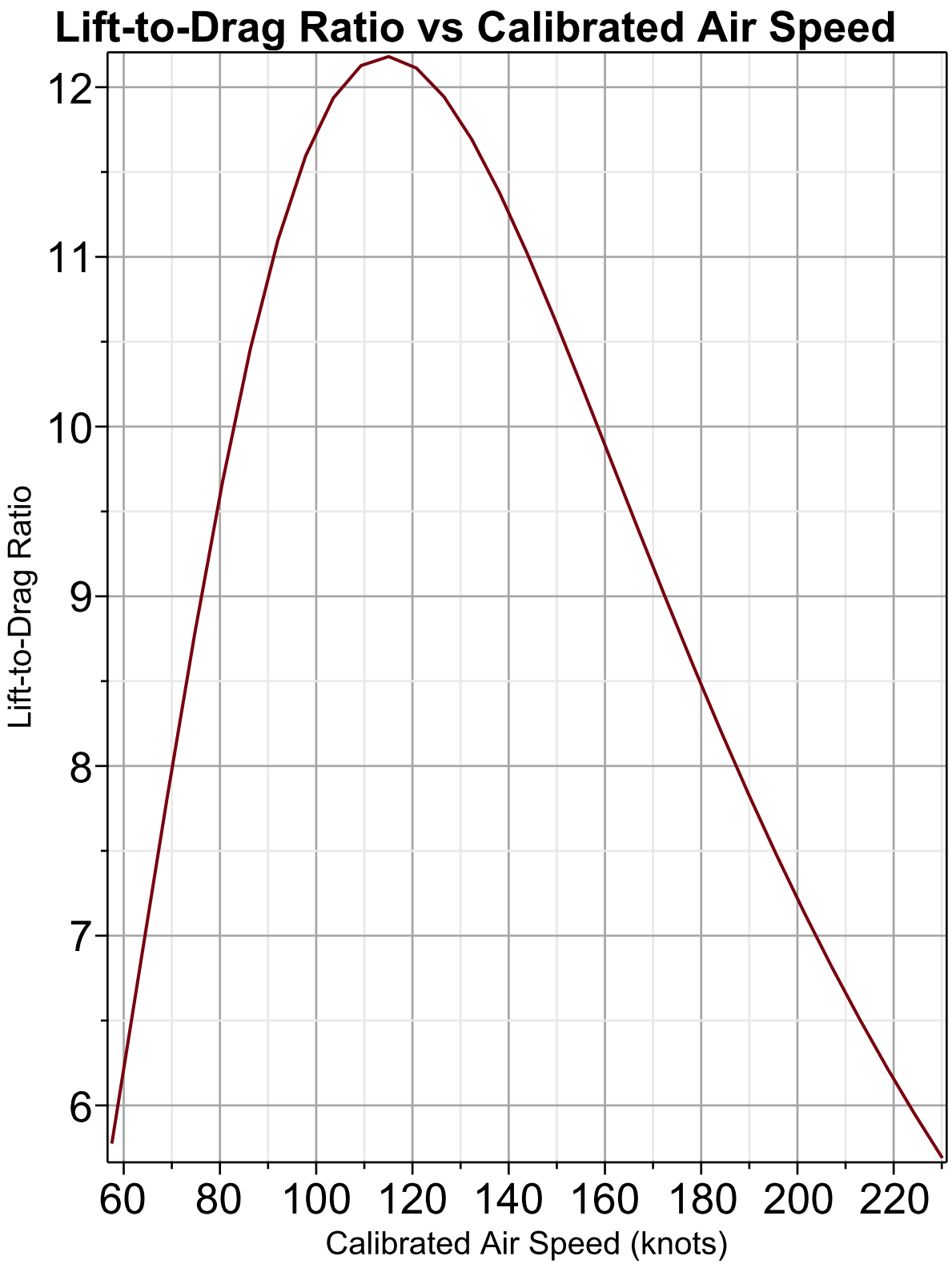
$$CD_{bg} := \frac{D_{bg}}{q S} = 0.0510$$

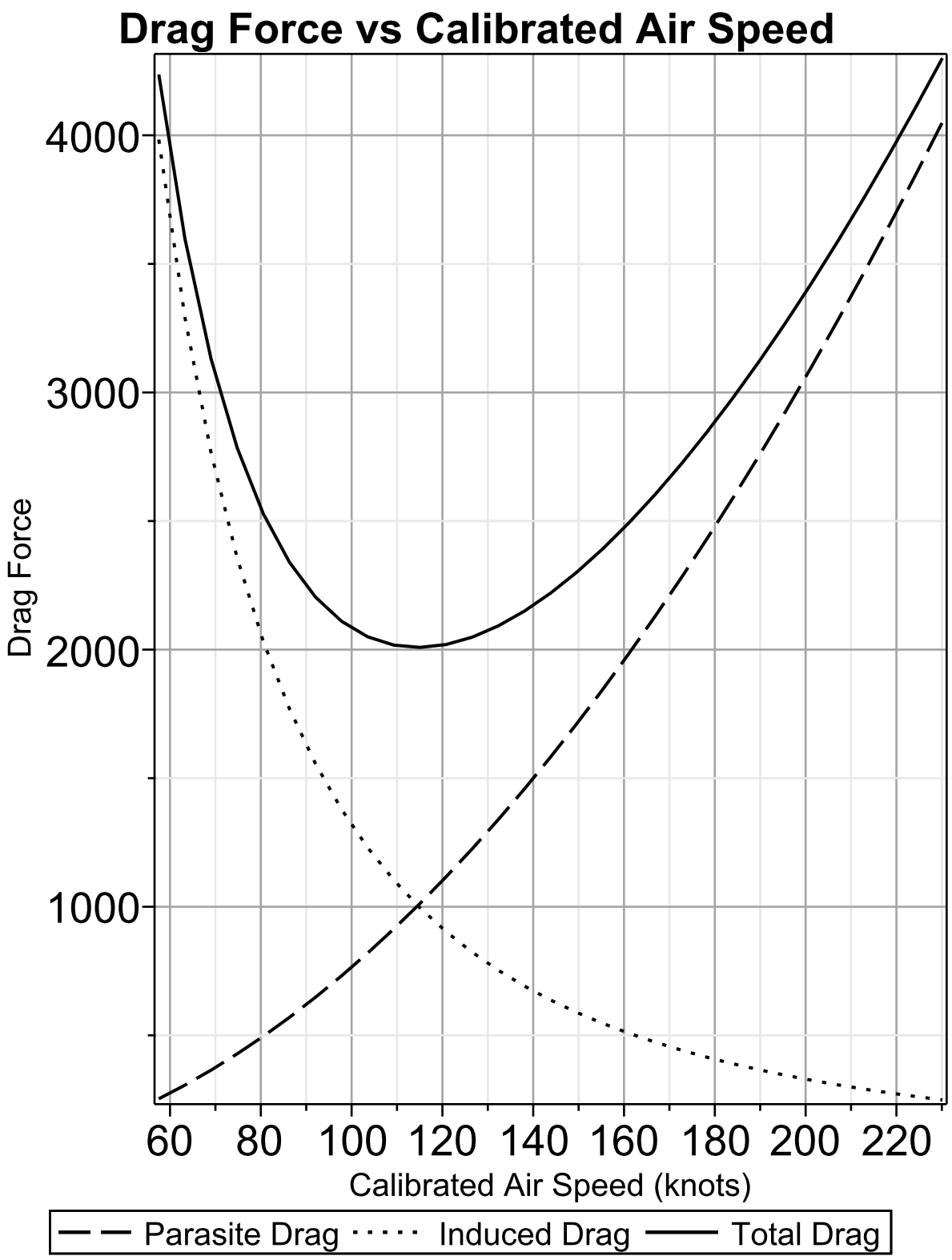
Lift coefficient

$$CL_{bg} := \frac{L_{bg}}{q S} = 0.6212$$

Plots

Plotting Code


Lift-to-Drag Ratio vs Calibrated Air Speed
Lift-to-Drag Ratio
12
11
10
9
8
7
6
60
80
100
120
140
160
180
200
220
Calibrated Air Speed (knots)


Drag Force vs Calibrated Air Speed
4000
3000
2000
1000
Drag Force
60
80
100
120
140
160
180
200
220
Calibrated Air Speed (knots)
Parasite Drag
Induced Drag
Total Drag