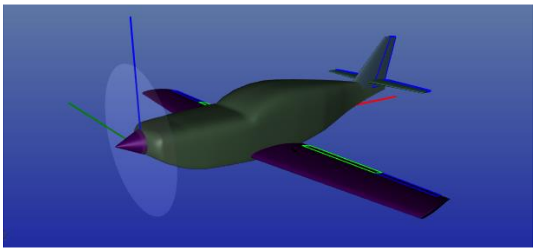
Airplane:
Glasair Aviation / Glasair III ADS V423

## Introduction

The goal of the validation process is to determine the accuracy of the ADS's algorithms to model an airplane of a given configuration. Validation consists in comparing the results of a series of measurements made during flight tests (FT) on a particular aircraft with the results of modelling carried out with the ADS software on the same aircraft (ADS).

Glasair III – long span (8.23 m)

## Methodology

The analysis takes place in 3 steps:

- Step 1: make the reverse engineering of the aircraft
- Step 2: calculate the performance of the aircraft for different flight conditions
- Step 3: present and comment the results

### List of assumptions

- CG position @ 20% MAC
- Constant Speed Propeller with Clark Y airfoil profile
- Parabolic drag estimation

### List of references

- 3View drawing
- Cafe Foundation, Aircraft Performance Report

### Reverse Engineering (ADS V423)

The reverse analysis consists to generate the 3D-Model of the aircraft and to specify its characteristics and performance. The aircraft will then be analyzed in detail in order to determine its mass efficiency and its aerodynamic efficiency for different flight conditions. A large number of statistics data will be generated. The reverse engineering report may be downloaded from here.

### Performance Analysis (ADS V423)

The performance analysis consists to compute the performance of the aircraft for a specific flight condition defined by the flight weight, the flight altitude, the power setting and the center of gravity position. One of the performance analysis reports may be downloaded from here.

**Results**

| Phase of flight | | FT | ADS | Δ (%) |
|---|---|---|---|---|
| Takeoff run | m | 427 | 420 | -1.6% |
| | | | | |
| Best rate of climb speed (Vy) | km/h | 209 | 220 | 5.3% |
| Rate of climb @ 256 km/h, 1028 kg, 914 m | m/s | 10.56 | 10.9 | 3.2% |
| Rate of climb @ 256 km/h, 1075 kg, 914 m | m/s | 9.13 | 10.3 | 12.8% |
| | | | | |
| Cruising speed @ 81%, 1045 kg, 2451 m | km/h | 453 | 443 | -2.2% |
| Cruising speed @ 68%, 1042 kg, 2433 m | km/h | 424 | 416 | -1.9% |
| Cruising speed @ 63%, 1039 kg, 2485 m | km/h | 415 | 406 | -2.2% |
| Cruising speed @ 51%, 1038 kg, 2446 m | km/h | 377 | 366 | -2.9% |
| | | | | |
| Stall (clean) @ 1070 kg, 2400 m | km/h | 132 | 139 | 5.3% |
| Stall (durty) @ 1070 kg, 2400 m | km/h | 124 | 128 | 3.2% |
| Stall (clean) @ 1022 kg, 2400 m | km/h | 127 | 136 | 7.1% |
| Stall (durty) @ 1022 kg, 2400 m | km/h | 119 | 125 | 5.0% |

**Comments**

The takeoff run is the distance between the brake release point and the point where the speed is equal to the liftoff speed and the plane lifts off. The mean acceleration is computed at several speeds, between these two limits, taking into account the engine thrust, the total drag, the wheel friction and the slope of the runway. The length of each segment is computed from the mean acceleration and the speed. The total distance is the sum of the distances travelled in each segment.

> The computed values are very close to the measured values

The rate of climb is computed at a given speed taking into account the engine thrust and the total drag of the airplane. The engine thrust is computed from the engine nominal power and takes into account the effects of altitude, the propeller efficiency and the installation efficiency. The total drag is the sum of the zero lift drag, induced drag and trim drag. The zero lift drag is computed by summing the drag of each component of the aircraft, including the interference drag

> The computed values are very close to the measured values for a given flight weight (1028 kg) but the accuracy seems to degrade as mass increases. There is no obvious reason, but it seems to us that the test value seems to be too different (Δ1.43 m) for just a small mass increase (Δ47 kg).

The cruising speed is computed for a given flight condition taking into account the power setting, the flight weight, the center of gravity position and the flight altitude.

> The computed values are very close to the measured values. The accuracy is about the same regardless of the power setting.

The stall speed is computed flaps up and flaps down taking into account the lift distribution on the lifting surface. The stall is reached when one local lift coefficient reaches its maximum value. The lift distribution is computed from the lifting line theory and takes into account the airfoil profiles and the planform of the lifting surface. The aerodynamic data of each airfoil profile have been computed with XFoil.

> The computed values are higher than the measured values. This lack of accuracy goes in direction of safety. Many reasons could be evocated to explain the difference, amongst other the use of theoretical aerodynamic data, the surface roughness… The lift increase due to the flap deflection is overestimated, maybe due to the lack of information about the exact geometry of the high lift device.