48 good reasons to adopt ADS

In addition to the common features an aircraft design software must have, ADS has the following specificities:

Foreword: Investing in Modeling Tools for Smarter Engineering Decisions

ADS-Suite

1. A set of modules designed to carry out the complete conceptual design of any type of aircraft

All-in-One: Module based software

2. Module: CAD → Unique toolset to generate exact geometry, quickly and efficiently
3. Module: Reverse Engineering → Perform a highly detailed analysis of existing aircraft
4. Module: Design Level 1 → To check, tune specifications
5. Module: Design Level 2 → To define the best configuration to fulfill the requirements
6. Module: Performance Analysis → To compute the performance for different flight conditions
7. Module: Dynamic Stability → To model the dynamic behavior of the aircraft
8. Module: Cost Analysis → To estimate R&D, manufacturing, operating costs, market price and breakeven point.
9. Module: Lift distribution → To optimize the wing planform for safety and performance
10. Module: Flight Data Analyzer → UAV/Aircraft Optimization and Flight Performance Analysis

Set of optimization tools

11. Aerodynamics → Set of tools to select the best airfoils and wing planform
12. Powerplant → List of engine candidates to fulfill the power requirement
13. Multiple Runs → Sequential computations performed to identify the optimal configuration
14. 3D Geometry → Unique set of features to optimize geometry
15. Design constraints → Automatically controls results to meet different types of constraints

Integrated expertise

16. Level of stability → Provides the user some tips to improve stability
17. Tracks changes → Displays only results that have changed from one run to the next
18. Analyzes the results → Displays qualitative analysis of results
19. Checks compliance with regulation → Checks and informs if out of the limits of regulation
20. Tire selection → Selects tire size in function of ground run operation
21. Airfoil selection → Selects the best airfoil for the specified flight condition
22. Comparative analysis → Compares the airplane with its competitors on different criteria
23. Aircraft Structure → Displays structural parts to check for interference between components
24. Occupants → Displays occupants to check cabin volume
25. Systems → Displays systems to check the available volume reserved for them
26. Checks interference between components → Checks and warns if there is interference
27. Checks CG Range → Checks the CG position for all load cases
28. Visual Competitor Analysis → Select and compare competitors graphically
29. Visual Version Analysis → Select and compare versions graphically

Toolbox

30. Digitizer → Digitizes any curve to retrieve the coordinates of the points that were used to draw it
31. Glide Polar Analyzer → Analyzes the drag polar of a (motor)glider

Tools

32. Aerodynamics / Zero Lift Drag → Sensitivity analysis in drag generation
33. Cost Analysis / Breakeven Point → Sensitivity analysis in breakeven point determination
34. Cost Analysis / RDTE & Manufacturing → Sensitivity analysis on RDTE & manufacturing costs
35. Mass → Sensitivity analysis on mass estimation
36. Standard Atmosphere → Lists the characteristics of the standard atmosphere at a given altitude
37. Unit Converter SI << >> FPSR

Database

38. Database → Airplanes, Engines, Airfoils, Fuels, Batteries, Tires, Materials

Export Functions

39. Airplane Report → Airplane report available in .doc, .txt, .csv file format
40. 3D-Geometry → 3D Geometry may be exported in .stl file format
41. Graphs → Graphs are saved in .bmp, .pdf, .png file format
42. Tables → Tables are saved in .csv file format

Customized software

43. Add new modules → Great flexibility of the software
44. Frequent new releases → Frequent new releases demonstrate OAD's high level of responsiveness

Technical assistance

45. Getting started with the software → OAD assists the customer getting started with ADS
46. Technical documentation → Technical notes and videos accessible directly from the software
47. Technical support → OAD may assist the customer at any time

References

48. ADS for everyone → Serving customers from all sectors, including small, medium, and large companies, as well as individuals and universities

Foreword: Investing in Modeling Tools for Smarter Engineering Decisions

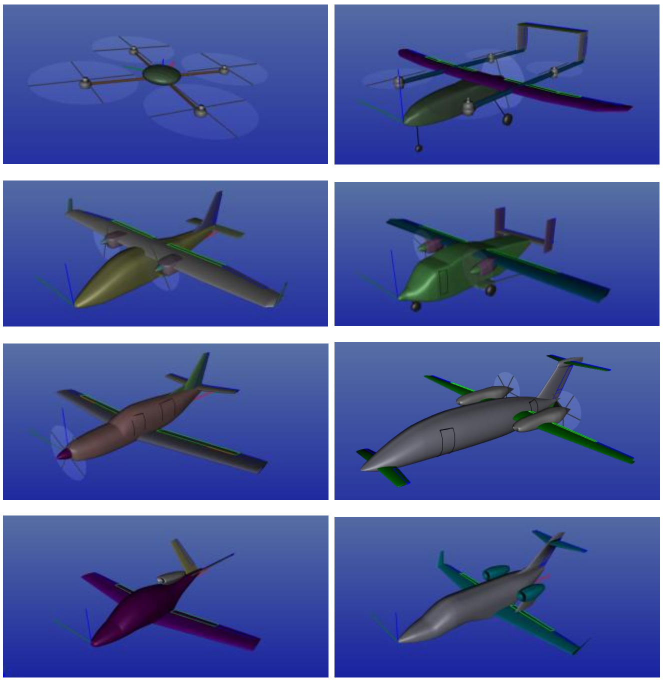
Modeling tools are essential assets for engineers aiming to make informed design decisions. In domains like aircraft design and other complex systems, these tools enable the creation of precise digital models that simulate real-world behavior.

By using modeling, engineers can analyze how systems perform, understand the interactions between components, and assess the impact of various inputs and modifications. This deep insight is crucial for identifying inefficiencies, weak points, and areas for potential improvement.

Moreover, modeling allows engineers to test and compare alternative scenarios without the need for costly real-world implementation. These simulations support better decision-making by enabling the exploration of multiple configurations, thus reducing risks and optimizing performance—while keeping costs under control.

ADS-Suite

1. A set of modules designed to carry out the complete conceptual design of any type of aircraft

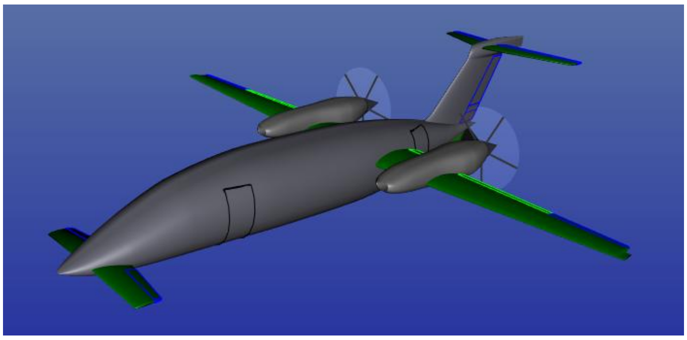


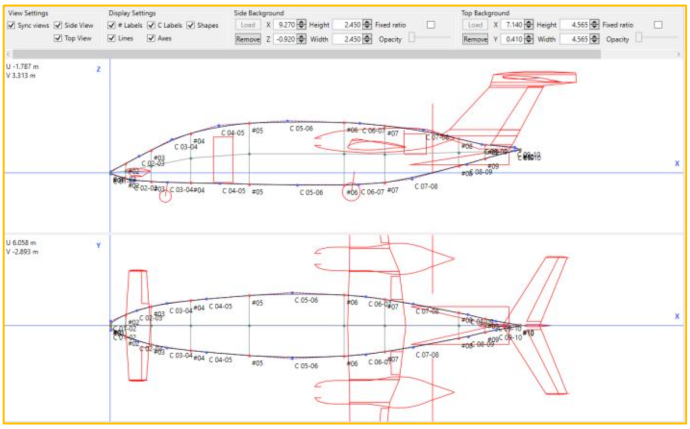
- From VTOL drones to commercial airliners
- Including their specific constraints such as regulatory requirements
- Including technological features such as distributed propulsion and blown control surfaces (STOL)
- Including various propulsion modes
- Including all types of systems and payloads (passengers, cargo containers, etc.)
- ...

There is an infinite number of possible solutions to meet a given set of requirements. If the user wishes to test a technical solution that is not yet supported by ADS, we encourage them to contact us. In most cases, such solutions are quickly integrated into future versions of the software.

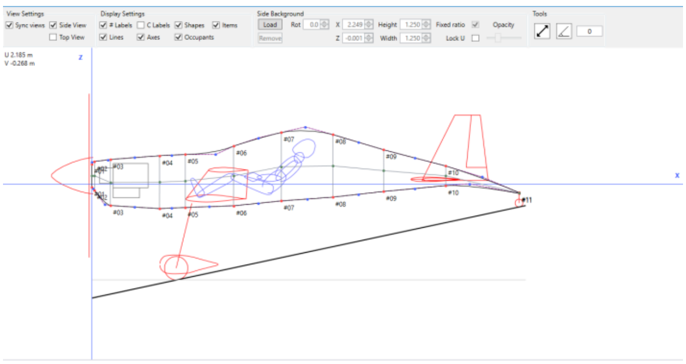
All-in-One: Module based software

2. Module: CAD → Unique toolset to generate exact geometry, quickly and efficiently



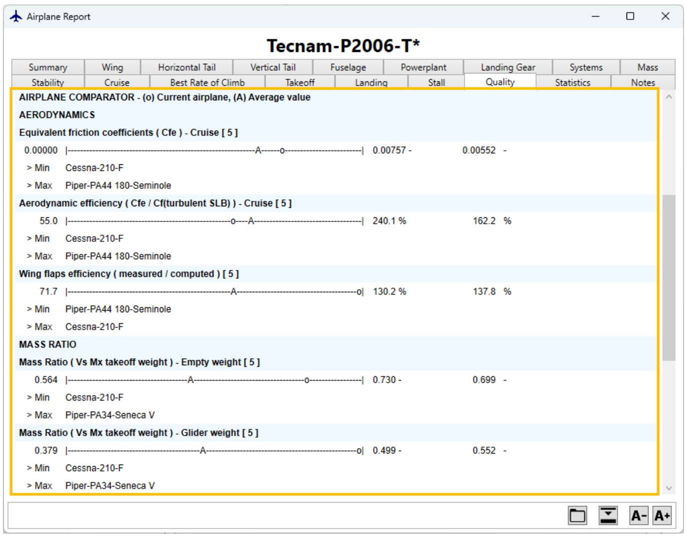


- To be used to generate a new design or reproduce an existing airplane
- **Bodies define from longitudinal control lines (LCLs) and control stations (CtS), based on conics**
- Lifting surfaces define from airfoil geometry
- Conics defined from Conic Shape Parameter (CSP)
- Operation on 3D-shapes:
  - Body lofting
  - Compute volume, wetted area
  - Stretch shapes
  - Align sections, force section to circular shape…
- Non-linear variation of control station offset and vertical position
- Non-linear variation of conic Shape Parameters
- Generate plots: volume, wetted area, cross section area (area rule)
- Geometry analysis and optimization (tangent continuity…)
- Representation of internal components:
  - Occupants
  - Payload
  - Systems
  - Tanks
  - Gears
- Export function (stl file)

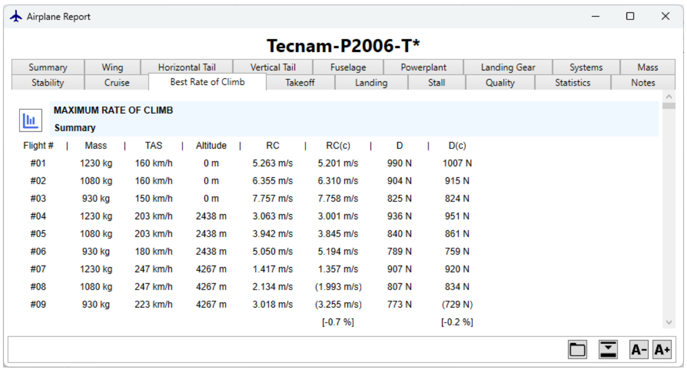


- The LCL line editor can also display: other geometric elements of the aircraft, a number of internal components such as occupants and the engine, as well as the ground position—both in-flight and on-ground.

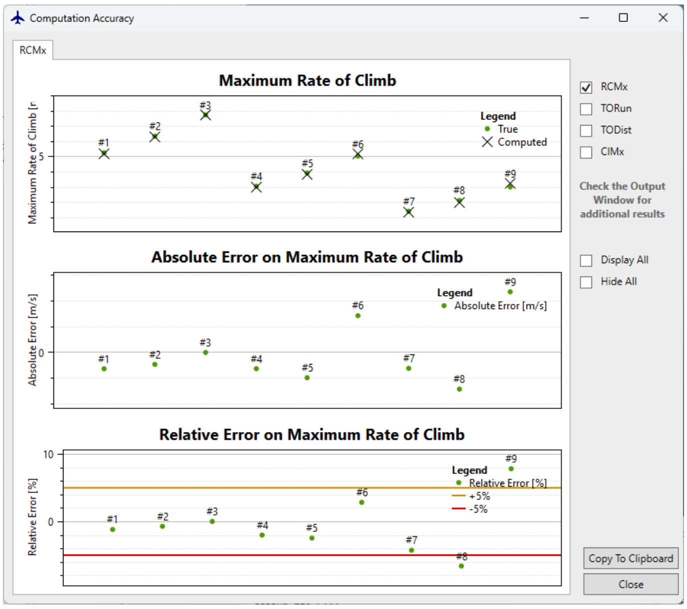
3. Module: Reverse Engineering → Perform a highly detailed analysis of existing aircraft



- Geometric analysis
- Performance analysis
- Weight breakdown
- Weight and balance
- Aerodynamic efficiency analysis
- Mass efficiency analysis
- Propulsion efficiency analysis
- **Comparative analysis with aircraft from the aircraft database**

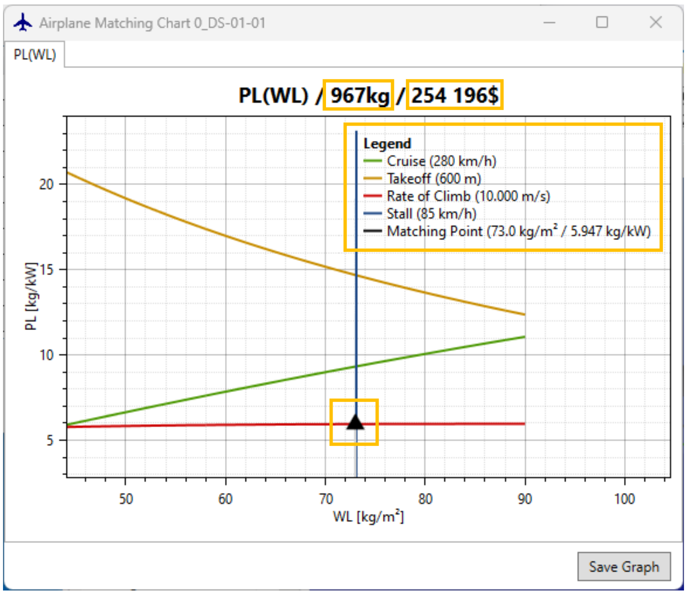


Flight #	Mass	TAS	Altitude	RC	RC(c)	D	D(c)
#01	1230 kg	160 km/h	0 m	5.263 m/s	5.201 m/s	990 N	1007 N
#02	1080 kg	160 km/h	0 m	6.355 m/s	6.310 m/s	904 N	915 N
#03	930 kg	150 km/h	0 m	7.757 m/s	7.758 m/s	825 N	824 N
#04	1230 kg	203 km/h	2438 m	3.063 m/s	3.001 m/s	936 N	951 N
#05	1080 kg	203 km/h	2438 m	3.942 m/s	3.845 m/s	840 N	861 N
#06	930 kg	180 km/h	2438 m	5.050 m/s	5.194 m/s	789 N	759 N
#07	1230 kg	247 km/h	4267 m	1.417 m/s	1.357 m/s	907 N	920 N
#08	1080 kg	247 km/h	4267 m	2.134 m/s	(1.993 m/s)	807 N	834 N
#09	930 kg	223 km/h	4267 m	3.018 m/s	(3.255 m/s)	773 N	(729 N)
					[-0.7 %]		[-0.2 %]



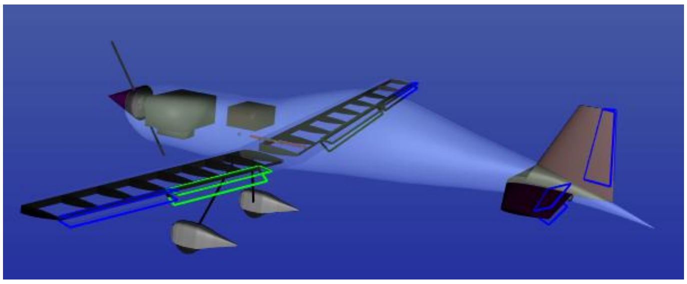
- Additionally, performance data provided by the manufacturer for specific flight conditions is compared to the values calculated by the ADS algorithms, in order to inform the user about the accuracy of ADS's computational algorithms when modeling an aircraft of this type
- A visual code using parenthesis symbols (), | |,)(immediately informs the user about the accuracy of the results
- The deviation between actual and calculated performance can be displayed as a chart, with different graph types available: actual values, absolute deviation, and relative deviation
- Charts can be copied to the clipboard and pasted into a report

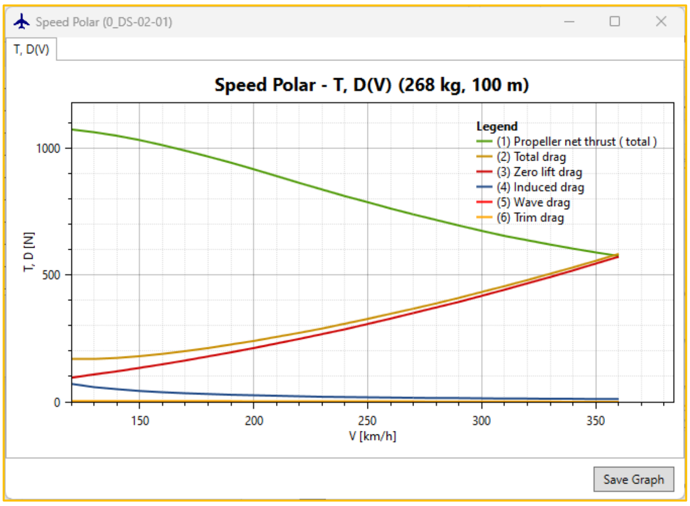
4. Module: Design Level 1 → To check, tune specifications



- Matching Point (Wing Loading, Power Loading)
- Geometry based on selected wing loading
- Maximum takeoff weight
- Market price, computed from geometry and technical choic
- All performance analyzed (Cruise, Stall, Takeoff, Climb)
- Propulsion based on selected power loading
- Generate a list of engine candidates from the engine database

5. Module: Design Level 2 → To define the best configuration to fulfill the requirements





- Defines the geometry
- Defines the propulsion
- Computes:
  - Lifting surface geometry
  - Weight and balance
  - Static and dynamic stability
  - Performance in stall, takeoff, climb, cruise, descent and landing, best range and best endurance flight conditions
  - Costs: market price, operating, R&D, manufacturing
- Checks
  - Interference between components (structure, systems…)
  - CG Range
  - Completion with regulation
  - Stall departure
  - Instability
- Tracks changes between runs
- Makes multiple runs
- Optimizes
  - Airfoil selection
  - Wing planform
- Provides expertise:
  - Modifications to be made to improve stability
  - Tire selection
  - To select the propeller
- Displays results under the form of:
  - Graphs
  - Tables
  - Reports
- Generates automatically a report (txt, doc file format)
- Exports results (csv, txt, doc) and geometry (stl file)

6. Module: Performance Analysis → To compute the performance for different flight conditions

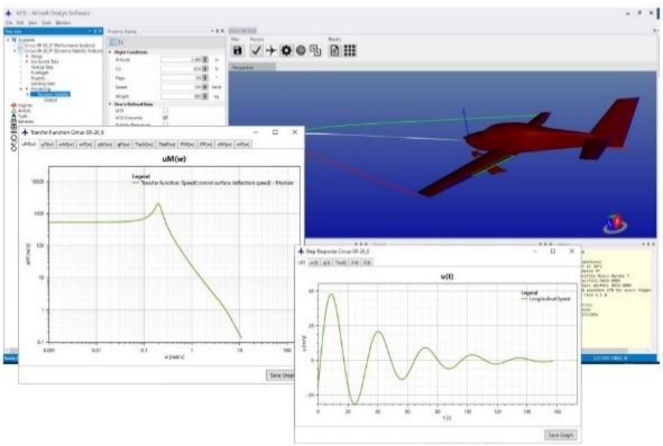
Track Changes from previous run (34) - [Item | Units | Value0 | Value1 | Change]

Airplane - Wetted Area	m²	43.792	43.478	-0.7 %
Fuselage - Wetted Area	m²	15.615	15.301	-2.0 %
Mass - Empty	kg	822.0	841.4	2.4 %
Mass - Glider	kg	519.1	528.7	1.9 %
Mass - Flight	kg	1037.4	1122.4	8.2 %
Mass - Fuel	kg	174.9	255.1	45.9 %
Mass - Wing	kg	163.2	163.1	-0.1 %
Mass - Fuselage	kg	76.3	76.4	0.1 %
Cruise - Flight speed	km/h	436	408	-6.5 %
Cruise - Power, required	kW	143.812	143.909	0.1 %
Cruise - Propeller efficiency (free)	%	92.1	92.6	0.5 %
Cruise - Drag - Total	N	1192	1273	6.8 %
Cruise - Drag - Zero lift	N	947	1023	8.0 %
Cruise - Drag - Induced	N	187	227	21.7 %
Cruise - Drag coefficient - Total	-	0.01978	0.01648	-16.7 %
Cruise - Drag coefficient - Zero lift	-	0.01572	0.01324	-15.8 %
Cruise - Drag coefficient - Induced	-	0.00310	0.00294	-5.1 %
Cruise - Friction Coefficient	-	0.00377	0.00380	0.9 %
Cruise - Induced drag factor (airplane)	-	0.801	0.819	2.2 %
Cruise - Lift coefficient	-	0.17	0.14	-15.3 %
Cruise - Range	km	1411	1319	-6.5 %
Best Rate of Climb - Rate of climb	m/s	11.093	10.007	-9.8 %
Best Rate of Climb - Flight speed	km/h	212	184	-12.9 %
Best Rate of Climb - Power, required	kW	148.761	138.727	-6.7 %
Best Rate of Climb - Propeller efficiency (free)	%	79.0	73.8	-6.7 %
Best Rate of Climb - Propeller installation efficiency	%	93.5	93.4	-0.1 %
Takeoff - Takeoff run	m	249	201	-19.4 %
Landing - Landing run	m	555	450	-18.9 %
Stall - Flight speed	km/h	114	99	-13.2 %
Stall - Lift coefficient (Maximum)	-	1.95	1.91	-1.7 %
Stability - Static Margin	%	22.8	15.6	-31.9 %
Aerodynamic Center - X	m	1.843	1.765	-4.2 %
Center of Gravity - X (Computed Position)	m	1.566	1.600	2.2 %
Center of Gravity - Z (Computed Position)	m	-0.043	-0.065	50.6 %

```
Messages ( Expertise ) - Main Flight Condition
  Flight conditions: 408 km/h | 2 433 m | 1 122.4 kg

  Expertise: Lift due to angle of attack derivative (Cla) [/rad]
  Cla (6.302) is in the range of historical values |5.367 to 6.451|

  Expertise: Pitching moment due to angle of attack derivative (Cma) [/rad]
  Cma (-0.980) is out of the range of historical values |-2.894 to -1.030|
  Cma | To get a more negative value, increase the static margin (do the opposite to get a more positive value)
  Cma | - Move the centre of gravity forward
  Cma | - Increase the size of the horizontal tail
  Cma | - Move the horizontal tail backwards
  Cma | - ...

  Expertise: Pitching moment due to rate of angle of attack derivative (CmRa) [/rad]
  CmRa (-3.588) is out of the range of historical values |-9.726 to -4.594|
  CmRa | To get a more negative value, increase the static margin (do the opposite to get a more positive value)
  CmRa | - Move the centre of gravity forward
  CmRa | - Increase the size of the horizontal tail
  CmRa | - Move the horizontal tail backwards
  CmRa | - ...

  Expertise: Pitching moment due to pitch rate derivative (Cmq) [/rad]
  Cmq (-13.526) is in the range of historical values |-33.902 to -13.220|
```

- Computes the performance for different flight conditions, defined by mass, altitude, power setting and CG position
- Computes the real impact of one modification made on the aircraft
- Makes multiple runs
- Checks
  - Interference between components (structure, systems…)
  - CG Range
  - Completion with regulation
  - Stall departure
  - Instability
- **Tracks changes between runs**
- Provides expertise:
  - **Modifications to be made to improve stability**
- Displays results under the form of:
  - Graphs
  - Tables
  - Reports
- Generates automatically a report (txt, doc file format)
- Exports results (csv, txt, doc) and geometry (stl file)

7. Module: Dynamic Stability → To model the dynamic behavior of the aircraft



- Computes the dynamic stability of a plane by analyzing:
  - the free response of the plane (eigenmodes)
  - the harmonic response to control inputs
  - the step response to control inputs

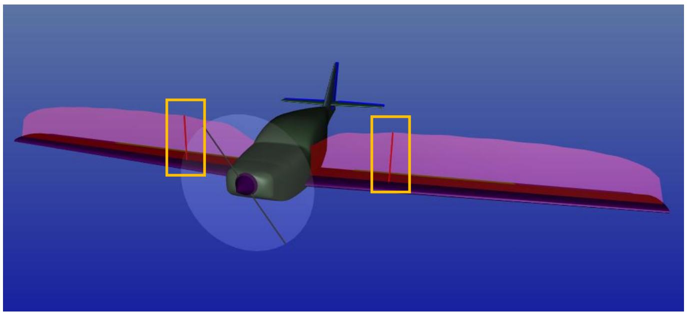
8. Module: Cost Analysis → To estimate R&D, manufacturing, operating costs, market price and breakeven point.

Production Costs (DAPCA Model)

Total FTA	1 -	1 -	1 -	1 -
Total Production	1 -	10 -	100 -	1 000 -
Unit Cost	33 852 158 $	5 441 515 $	1 398 652 $	585 380 $
Total Program Cost	33 852 158 $	54 415 151 $	139 865 185 $	585 380 446 $
Nonrecurring				
Development-support	5 263 824 $	5 263 824 $	5 263 824 $	5 263 824 $
Flight-tests	1 052 308 $	1 052 308 $	1 052 308 $	1 052 308 $
Materials				
Materials	476 050 $	1 858 670 $	10 929 047 $	68 308 753 $
Labor				
Engineering	13 273 917 $	17 525 814 $	25 155 652 $	36 559 644 $
Tooling	6 072 402 $	9 507 709 $	17 034 372 $	31 138 936 $
Manufacturing	3 488 641 $	10 404 681 $	43 098 888 $	187 488 361 $
Quality Control	499 801 $	1 490 630 $	6 174 575 $	26 860 577 $
Equipment				
Engine(s)	200 000 $	1 100 000 $	10 100 000 $	100 100 000 $
Propeller(s)	60 000 $	330 000 $	3 030 000 $	30 030 000 $
Avionics	40 000 $	220 000 $	2 020 000 $	20 020 000 $
Interior	40 000 $	220 000 $	2 020 000 $	20 020 000 $
Profit				
Production profit	3 385 216 $	5 441 515 $	13 986 518 $	58 538 045 $

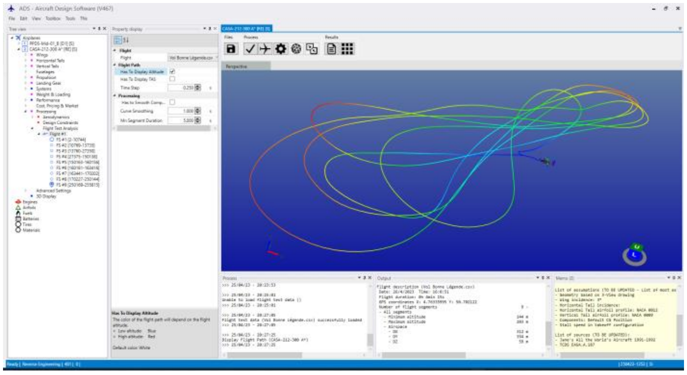
- Based on configuration, size and technology used on the aircraft, computes:
  - Research and Development costs
  - **Production costs**
  - Operating costs
  - Estimated market price
  - Breakeven point
- Models the influence of technical choices on the costs in general

9. Module: Lift distribution → To optimize the wing planform for safety and performance

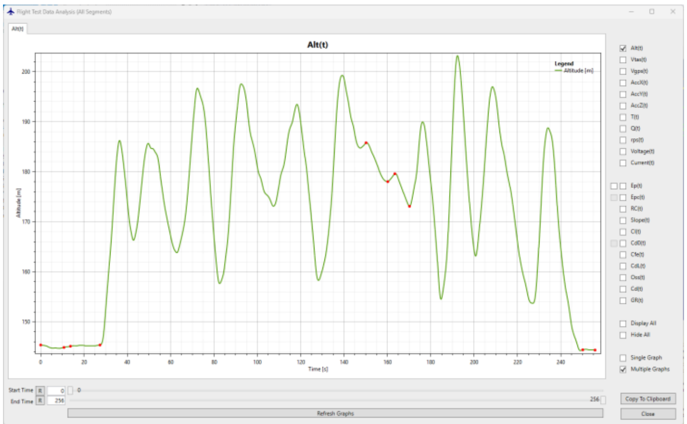


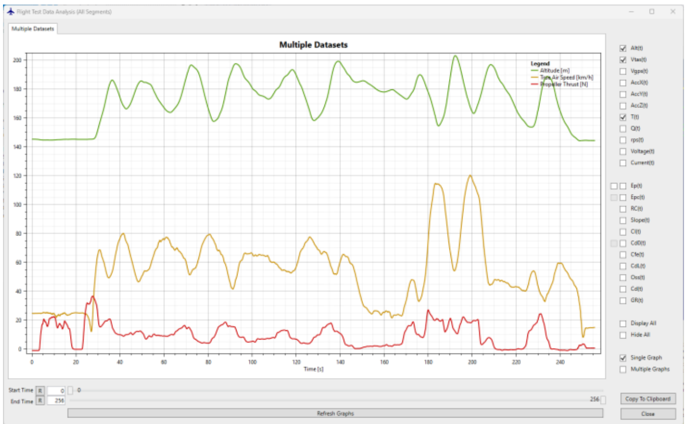
- According to the selected airfoils, the planform of the lifting surface and the flight conditions, computes:
  - Lift distribution
  - Load factor
  - Position of the maximum lift coefficient
  - Position of the stall departure
  - Oswald efficiency factor
  - Global lift coefficient
- Takes into account the presence of fuselage and external stores

10. Module: Flight Data Analyzer → UAV/Aircraft Optimization and Flight Performance Analysis



- Flight data collected by the AMS (Aircraft Monitoring System) is automatically loaded, and the flight trajectory is displayed in the 3D interface
- The flight is automatically divided into flight segments
- The full flight or a flight summary can be displayed in the Output window
- A color code can be overlaid on the trajectory to indicate either altitude or speed

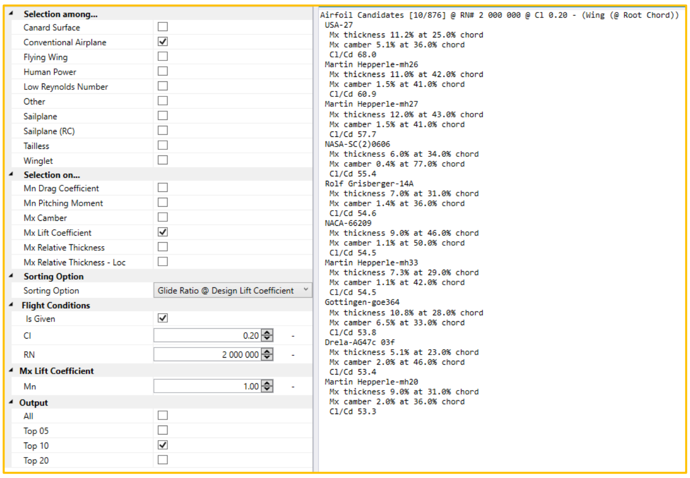




- Various time history plots can be displayed, either as single or multiple graphs
- The entire flight or selected portions can be visualized
- Segments can be added or removed
- Flight data collected by the AMS (Aircraft Monitoring System) that can be displayed includes: altitude, speed, accelerations, motor torque, propeller thrust, propeller RPM, and motor supply current and voltage
- Calculated values that can be displayed include: propeller efficiency, powertrain efficiency, rate of climb, climb gradient, aerodynamic lift and drag coefficients, Oswald efficiency factor, and lift-to-drag ratio
- Calculated values can be compared to target values
- A list of recommendations may be provided to help achieve unmet target values
- Graphs can be copied to the clipboard and then pasted into a report

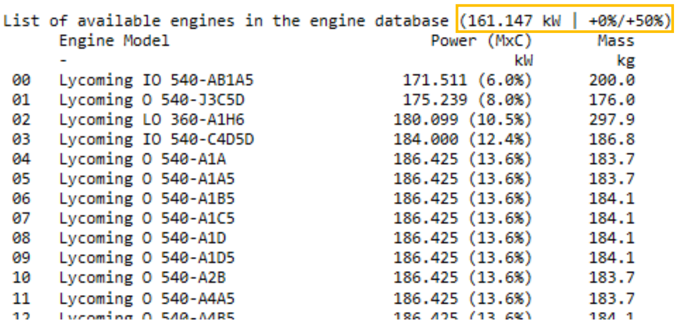
Set of optimization tools

11. Aerodynamics → Set of tools to select the best airfoils and wing planform



- To generate the optimal wing planform
- **To select the best airfoil according to the flight conditions and some geometric and aerodynamic criteria**
- To compute the aerodynamic characteristics of any airfoil geometry using Xfoil

12. Powerplant → List of engine candidates to fulfill the power requirement

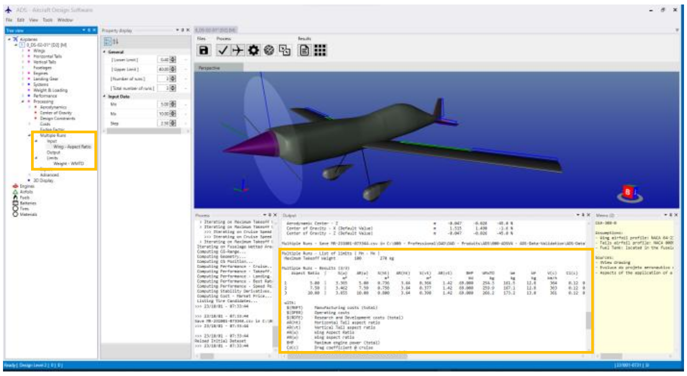


List of available engines in the engine database (161.147 kW | +0%/+50%)

	Engine Model	Power (MxC) kW	Mass kg
	-		
00	Lycoming IO 540-AB1A5	171.511 (6.0%)	200.0
01	Lycoming O 540-J3C5D	175.239 (8.0%)	176.0
02	Lycoming LO 360-A1H6	180.099 (10.5%)	297.9
03	Lycoming IO 540-C4D5D	184.000 (12.4%)	186.8
04	Lycoming O 540-A1A	186.425 (13.6%)	183.7
05	Lycoming O 540-A1A5	186.425 (13.6%)	183.7
06	Lycoming O 540-A1B5	186.425 (13.6%)	184.1
07	Lycoming O 540-A1C5	186.425 (13.6%)	184.1
08	Lycoming O 540-A1D	186.425 (13.6%)	184.1
09	Lycoming O 540-A1D5	186.425 (13.6%)	184.1
10	Lycoming O 540-A2B	186.425 (13.6%)	183.7
11	Lycoming O 540-A4A5	186.425 (13.6%)	183.7

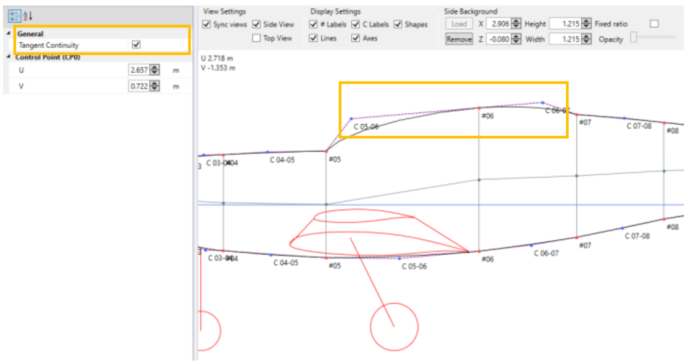
- Generates a list of engine candidates to power the aircraft based on the **computed power requirement** (Design Level 1).

13. Multiple Runs → Sequential computations performed to identify the optimal configuration



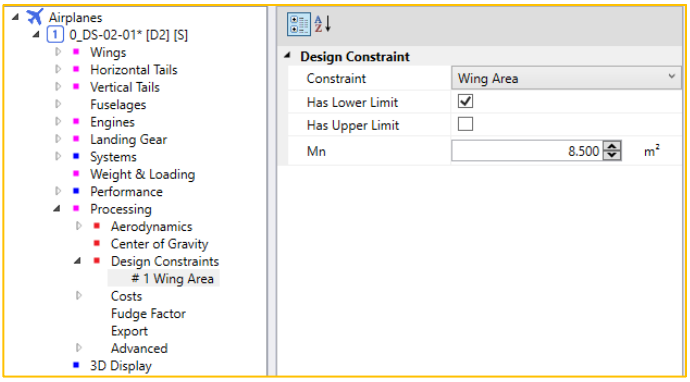
- Automatically runs a large number of different configurations by varying selected input parameters
- Defines constraint limits; a result is considered feasible if all defined constraints are satisfied (e.g., empty weight exceeds a minimum threshold)
- Automatically sorts the results
- **Displays results in tabular format, automatically copied to the clipboard for easy pasting into external documents**
- Generates a .csv file and saves it in a dedicated folder within the aircraft dataset
- Each configuration can be automatically saved under a specific name for further analysis in the **Version Comparator**
- The **Version Comparator** enables graphical visualization of results and allows quick identification of the optimal value for a geometric parameter

14. 3D Geometry → Unique set of features to optimize geometry



- Fuselage lofting
- **Forces tangent continuity**
- Plots cross section area (area rule)

15. Design constraints → Automatically controls results to meet different types of constraints



- Checks constraints due to the selected regulation:
  - Configuration
  - Speed
  - Mass
  - Load factors
  - Takeoff, climb and landing performance
- **Imposes some limits in the size of components** (the wing area must be higher than 8.5 m² to provide enough surface for solar cells for example)

Integrated expertise

16. Level of stability → Provides the user some tips to improve stability

```
Expertise: Rolling moment due to roll rate derivative (Clp) [/rad]
Clp (-0.567) is in the range of historical values |-0.535 to -0.448|

Expertise: Yawing moment due to roll rate derivative (Cnp) [/rad]
Cnp (-0.015) is out of the range of historical values |-0.045 to -0.022|
Cnp | To get a more negative value (do the opposite to get a more positive value):
Cnp | - Increase wing aspect ratio
Cnp | - Increase wing taper ratio
Cnp | - Move the vertical tail upwards
Cnp | - Move the winglets upwards
Cnp | - ...
```

- Computes all stability derivatives
- Informs the user if there is instability
- **Checks the level of stability is within limits (based on historical values)**
- **Gives the user some tips to improve stability if not within the limits**

17. Tracks changes → Displays only results that have changed from one run to the next

Track Changes from previous run (35) - [Item | Units | Value0 | Value1 | Change]

Item	Units	Value0	Value1	Change
Airplane - Wetted Area	m²	17.326	17.934	3.5 %
Wing - Area	m²	3.462	3.655	5.6 %
Wing - Wetted Area	m²	6.552	6.996	6.8 %
Horizontal Tail - Area	m²	0.758	0.800	5.6 %
Horizontal Tail - Wetted Area	m²	1.499	1.485	-0.9 %
Vertical Tail - Area	m²	0.377	0.398	5.6 %
Vertical Tail - Wetted Area	m²	0.637	0.814	27.7 %
Mass - Maximum takeoff	kg	259.9	266.2	2.4 %
Mass - Empty	kg	167.1	173.2	3.6 %
Mass - Glider	kg	90.5	96.6	6.7 %
Mass - Flight	kg	259.9	266.2	2.4 %
Mass - Fuel	kg	12.8	13.0	1.8 %
Mass - Wing	kg	18.7	23.5	25.3 %
Mass - Horizontal Tail	kg	2.0	2.1	6.0 %
Mass - Fuselage	kg	22.6	22.7	0.3 %
Cruise - Flight speed	km/h	363	361	-0.5 %
Cruise - Power, required	kW	58.084	58.113	0.1 %
Cruise - Propeller installation efficiency	%	92.0	92.1	0.1 %
Cruise - Drag - Total	N	572	580	1.4 %
Cruise - Drag - Zero lift	N	555	566	2.1 %
Cruise - Drag - Induced	N	17	13	-21.6 %
Cruise - Drag coefficient - Total	-	0.02712	0.02611	-3.7 %
Cruise - Drag coefficient - Zero lift	-	0.02631	0.02552	-3.0 %
Cruise - Drag coefficient - Induced	-	0.00079	0.00059	-25.6 %
Cruise - Friction Coefficient	-	0.00523	0.00517	-1.1 %
Cruise - Induced drag factor (airplane)	-	0.875	0.857	-2.0 %
Best Rate of Climb - Rate of climb	m/s	14.127	13.909	-1.5 %
Best Rate of Climb - Power, required	kW	50.079	50.087	0.0 %
Takeoff - Takeoff run	m	158	159	0.5 %
Landing - Landing run	m	234	229	-2.1 %
Stall - Lift coefficient (Maximum)	-	1.71	1.67	-2.4 %
Aerodynamic Center - X	m	1.584	1.551	-2.0 %
Aerodynamic Center - Z	m	-0.047	-0.026	-45.0 %
Center of Gravity - X (Default Value)	m	1.515	1.490	-1.6 %
Center of Gravity - Z (Default Value)	m	-0.047	-0.026	-45.0 %

- Displays all results that have changed between two runs
    - Initial value
    - New value
    - Change
- Very powerful to understand the real impact of one modification made on the plane

18. Analyzes the results → Displays qualitative analysis of results

```
Messages ( WARNING ) - [0]
  None

Messages ( Information ) - [21]
  - Airworthiness Requirements: all design requirements are met
  - Check CG Range: not performed !
  - Check for interference between Crew Members and Fuselage: not performed !
  - Convergence Factor: at least one is greater than 0.5%. The computation accuracy can be improved if all the convergence factors are taken less than or equal to 0.5%.
  - Expertise: At empty weight, the CG is located behind the main landing gear
  - Expertise: At the maximum takeoff weight, the CG is located behind the main landing gear
  - Expertise: Clr (0.046) is out of the range of historical values |0.080 to 0.142|
  - Expertise: Cma (-0.664) is out of the range of historical values |-2.894 to -1.030|
  - Expertise: CnB (0.042) is out of the range of historical values |0.042 to 0.092|
  - Expertise: Cnp (-0.015) is out of the range of historical values |-0.045 to -0.022|
  - Expertise: Oswald Efficiency Factor computed from McCormick (Processing/Advanced/Aerodynamics)
  - Expertise: the initial values used to start the iterative process are updated from run to run
  - Expertise: Total number of iterations (Fuselage Wetted Area): 1
  - Fudge Factor used for the computation of Airfoil Maximum Lift Coefficient (Wing): 1.115
  - Fudge Factor used for the computation of Weight: 0.870
  - Fuel Tank volume: there is extra volume (1.64 l) to increase the range
  - Fuel: Relative position of the fuel (computed): -0.6% MAC. Relative position of the fuel (given): 40.0% MAC
  - Payload: Relative position of the occupants (computed): 44.2% of fuselage length. Relative position of the payload (given): 44.0% of fuselage length
  - Payload: The maximum payload (80.0 kg) is higher than the computed mass of the occupants (61.5 kg). There is extra weight (18.5 kg) for luggage
  - Propeller efficiency computed from Propeller Charts (high accuracy)
  - Takeoff Performance: the propeller thrust has been computed by polynomial regression
```

- Displays warning messages, if any
- Displays information messages, if any
- Provides information about:
    - The compliance with the regulation
    - The CG position
    - The level of stability
    - The way some parameters were computed (propeller efficiency, Oswald efficiency factor…)
    - …

19. Checks compliance with regulation → Checks and informs if out of the limits of regulation

		0	1	2	3	4	5	6	7	8	9	10	11	12	13	
		CS-LSA	CS-VLA	CS-23N	CS-23U	CS-23A	CS-23C	CS-25	FAR-103	FAR-23N	FAR-23U	FAR-23A	FAR-23C	FAR-25	USAR	
	25	13	13	16	16	16	15	11	5	16	16	16	15	11	11	<<< Number of requirements for each regulation
General	Maximum fuel capacity								x							
	Number of engines	x	x	x	x	x	x	x		x	x	x	x	x	x	
	Maximum number of occupants	x	x	x	x	x	x		x	x	x	x	x			
	Type of engine	x	x	x	x	x	x	x		x	x	x	x	x		
	Maximum operating altitude			x	x	x	x			x	x	x	x			
Mass	Maximum takeoff weight	x	x	x	x	x	x			x	x	x	x		x	
	Minimum weight		x	x	x	x	x			x	x	x	x		x	
	Empty weight								x							
	Useful weight	x														
Speed	V_S			x	x	x	x			x	x	x	x			Stall speed determined by certification flight tests
	V_{S0}	x	x						x							Stall speed or minimum flight speed in landing configuration
	V_{S1}															Stall speed or minimum steady flight speed in a specific configuration
	V_F	x	x	x	x	x	x	x		x	x	x	x	x	x	Design flap speed
	V_C	x	x	x	x	x	x	x		x	x	x	x	x	x	Design cruise speed
	V_D	x	x	x	x	x	x	x		x	x	x	x	x	x	Design diving speed
	V_H								x							Maximum speed in level flight with maximum continuous power
Load factors	n_1	x	x	x	x	x	x	x		x	x	x	x	x	x	Positive maneuvering load factor
	n_{Ld}															Landing load factor
Takeoff speed	V_R			x	x	x	x	x		x	x	x	x	x	x	Rotation speed
	V_{LOF}							x						x		Lift off speed, speed at which the airplane first becomes airborne
	V_{TO}			x	x	x	x	x		x	x	x	x	x		Final takeoff speed
	$V_{CL\ AEO}$			x	x	x	x	x		x	x	x	x	x	x	Climb speed, all engine operative
	V_{15m}	x	x	x	x	x				x	x	x			x	Speed above the 15m (50ft) obstacle
Climb	V_z	x	x													Rate of climb
Landing	V_{Ref}	x	x	x	x	x	x	x		x	x	x	x	x	x	Reference landing approach speed

- Checks compliance with regulation regarding:
    - Maximum fuel capacity
    - Number of engines
    - Maximum number of occupants
    - Type of engine
    - Maximum operating altitude
    - Mass
    - Speed
    - Load factors
    - Takeoff, climb and landing performance

20. Tire selection → Selects tire size in function of ground run operation

AUXILIARY GEAR		
Tires		
Maximum static load	191	N
Maximum braking load	191	N
List of candidate tires from the tire database (sorted by increasing diameter)		
191 N < Maximum Load < 238 N		
Maximum Speed > 108 km/h		
Maximum Inflation Pressure (imposed by the runway surface) < 16.547 bar		
#1	Radial-46x17.0R20 PR 30	
#2	Radial-50x20.0R22 PR 32	
#3	Radial-50x20.0R22 PR 34	
#4	Radial-52x21.0R22 PR 36	
#5	Radial-H44.5x16.5R21 PR 30	

- Generates a list of tire candidates in function of:
  - Landing gear configuration
  - Maximum takeoff weight
  - Maximum ground speed
  - Runway surface

21. Airfoil selection → Selects the best airfoil for the specified flight condition

Selection among...		
Canard Surface	☐	
Conventional Airplane	☑	
Flying Wing	☐	
Human Power	☐	
Low Reynolds Number	☐	
Other	☐	
Sailplane	☐	
Sailplane (RC)	☐	
Tailless	☐	
Winglet	☐	
Selection on...		
Mn Drag Coefficient	☐	
Mn Pitching Moment	☐	
Mx Camber	☐	
Mx Lift Coefficient	☑	
Mx Relative Thickness	☐	
Mx Relative Thickness - Loc	☐	
Sorting Option		
Sorting Option	Glide Ratio @ Design Lift Coefficient	
Flight Conditions		
Is Given	☑	
Cl	0.20	-
RN	2 000 000	-
Mx Lift Coefficient		
Mn	1.00	-
Output		
All	☐	
Top 05	☐	
Top 10	☑	
Top 20	☐	

```
Airfoil Candidates [10/876] @ RN# 2 000 000 @ Cl 0.20 - (Wing (@ Root Chord))
 USA-27
  Mx thickness 11.2% at 25.0% chord
  Mx camber 5.1% at 36.0% chord
  Cl/Cd 68.0
 Martin Hepperle-mh26
  Mx thickness 11.0% at 42.0% chord
  Mx camber 1.5% at 41.0% chord
  Cl/Cd 60.9
 Martin Hepperle-mh27
  Mx thickness 12.0% at 43.0% chord
  Mx camber 1.5% at 41.0% chord
  Cl/Cd 57.7
 NASA-SC(2)0606
  Mx thickness 6.0% at 34.0% chord
  Mx camber 0.4% at 77.0% chord
  Cl/Cd 55.4
 Rolf Grisberger-14A
  Mx thickness 7.0% at 31.0% chord
  Mx camber 1.4% at 36.0% chord
  Cl/Cd 54.6
 NACA-66209
  Mx thickness 9.0% at 46.0% chord
  Mx camber 1.1% at 50.0% chord
  Cl/Cd 54.5
 Martin Hepperle-mh33
  Mx thickness 7.3% at 29.0% chord
  Mx camber 1.1% at 42.0% chord
  Cl/Cd 54.5
 Gottingen-goe364
  Mx thickness 10.8% at 28.0% chord
  Mx camber 6.5% at 33.0% chord
  Cl/Cd 53.8
 Drela-AG47c 03f
  Mx thickness 5.1% at 23.0% chord
  Mx camber 2.0% at 46.0% chord
  Cl/Cd 53.4
 Martin Hepperle-mh20
  Mx thickness 9.0% at 31.0% chord
  Mx camber 2.0% at 36.0% chord
  Cl/Cd 53.3
```

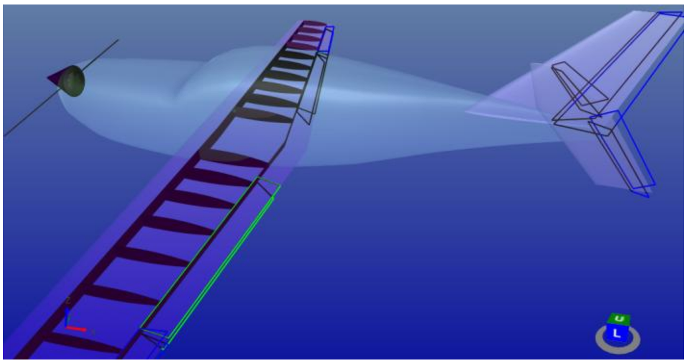
- Generates a list of airfoil candidates in function of:
  - Type of airplane
  - Flight conditions
  - Some geometric parameters:
    - Maximum relative thickness
    - Maximum camber
  - Some aerodynamic parameters:
    - Minimum drag coefficient
    - Maximum lift coefficient
    - Minimum pitching moment
- The candidates are sorted according to predefined criteria:
  - Maximum glide ratio
  - Maximum lift coefficient
  - Zero angle of attack pitching moment
  - Minimum drag coefficient
  - Zero lift angle of attack

22. Comparative analysis → Compares the airplane with its competitors on different criteria

QUALITY		
Symbols		
+ : best plane	.	
- : Worst plane	.	
AERODYNAMICS		
Friction coefficients (-) - Cruise		
0.00167 |-----o------------------------------| 0.04659	0.00515	-
+	Cessna-210-G	
-	PIUMA ALMERICO-12-000ELECTR	
Aerodynamic efficiency [Cf(limit) / Cf] (%) - Cruise		
8.9 |---------------o------------------------| 209.2	62.9	%
+	Cessna-210-G	
-	PIUMA ALMERICO-12-000ELECTR	
Flat plate area perpendicular to flow (m²) - Cruise		
0.051 |-o-------------------------------------| 1.719	0.076	m²
+	0CEA 311-02-01	
-	Edgley-Optica-01*	
Flat plate width perpendicular to flow (m) - Cruise		
0.226 |---o-----------------------------------| 1.311	0.276	m
+	0CEA 311-02-01	
-	Edgley-Optica-01*	
FUEL		
Fuel (l/100km) - Cruise		
4.9 |--o-------------------------------------| 83.6	7.3	-
+	Michel Colomban-MC 100-0b	
-	Cessna-208 F-Caravan	
Fuel (l/100km/100kg) - Cruise		
N/A	9.1	-

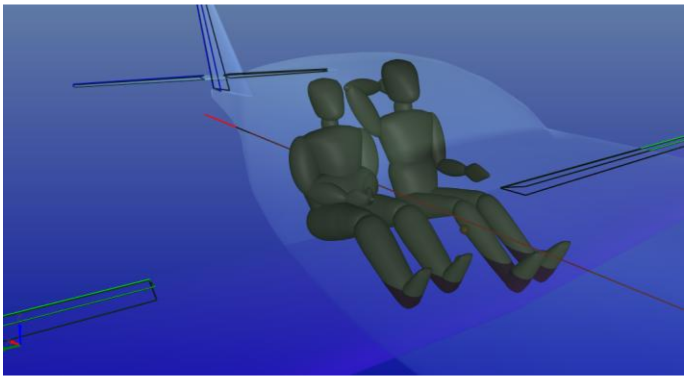
- The current airplane is compared with other airplanes taken from the database. The analysis focuses on:
  - Aerodynamics
  - Fuel consumption
  - C02 emissions
  - Mass
  - Performance
- The best airplane is displayed as well as the worst one
- The current airplane is located between the two limits

23. Aircraft Structure → Displays structural parts to check for interference between components

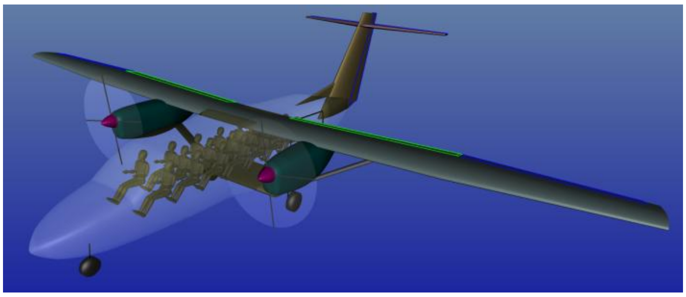


- The structure is generated automatically
- Some elements of the structure are represented, such as:
  - Spars
  - Ribs
  - Frames
  - Stringers
- The representation is mainly used to check the absence of interference between components, between the structure and the control surfaces, between the structure and the high lift devices…

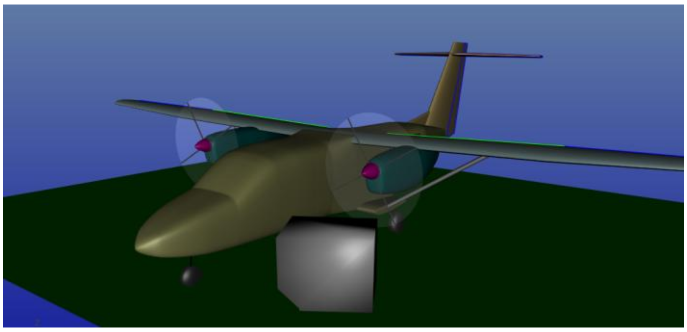
24. Occupants → Displays occupants to check cabin volume



- The occupants are generated automatically
- Controls on measurements:
  - Height
  - Fatness
  - Shoulder breath
- Controls position and attitude
- Checks interference with the fuselage
- Checks clearance with fuselage
- Checks minimum cockpit size to fit the occupants
- Lists anthropometric characteristics
- Puts in default sitting and standing position

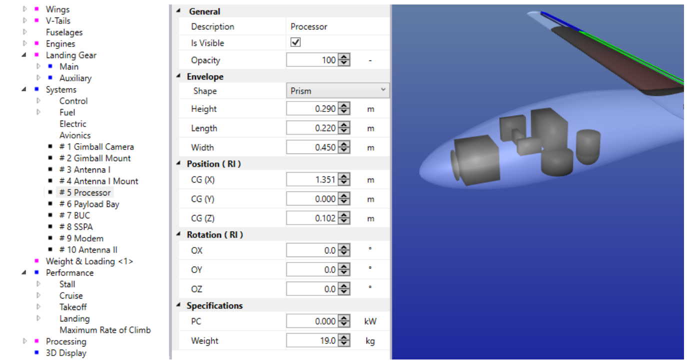


- For passenger transport aircraft, the seat layout can be quickly determined by specifying the row spacing and the number of seats per row.



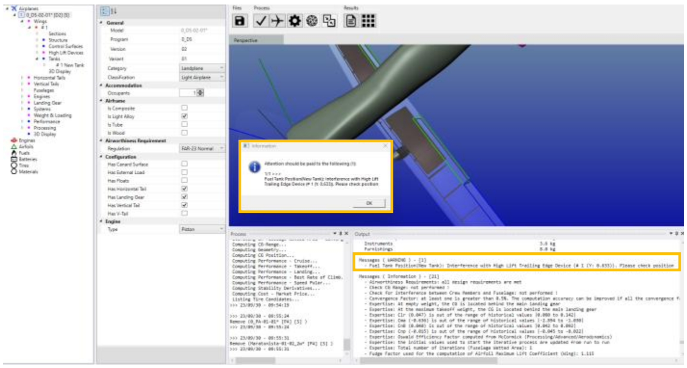
- In cargo aircraft, a range of standard container types can be selected, including LD-2 through LD-8 units, along with standard pallets.

25. Systems → Displays systems to check the available volume reserved for them



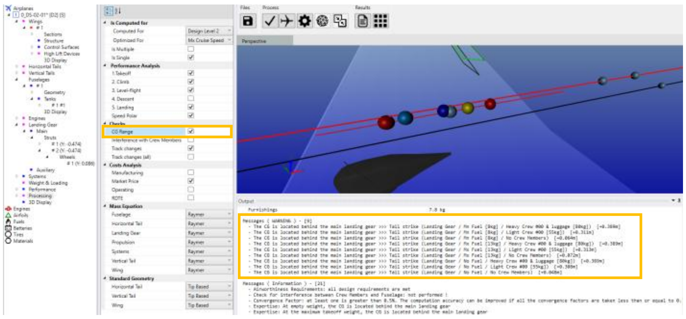
- The user may define unlimited number of systems
- Each system is defined with:
  - An envelope of different shape (prism, cylinder, cone, sphere) and size
  - Power consumption
  - Mass

26. Checks interference between components → Checks and warns if there is interference



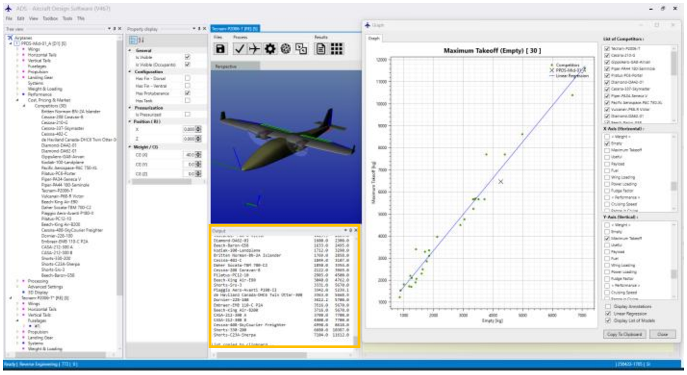
- Warning messages are displayed if exist interference between components:
  - Occupants
  - Tanks
  - Structure
  - High lift devices
  - Control surfaces
  - …

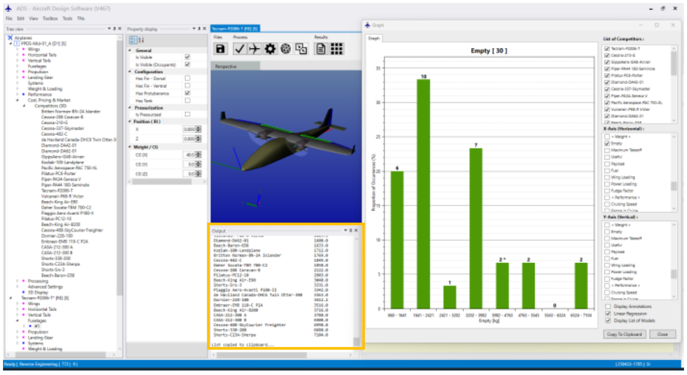
27. Checks CG Range → Checks the CG position for all load cases



- **Checks CG position for all load cases. The CG must be between the limits. If not, warning messages are displayed**
- Displays the CG of each component of the airplane (light blue)
- Displays on the mean aerodynamic chord:
  - The most forward position (red)
  - The most aft position, neutral point (red)
  - The true airplane CG (blue)
  - The default airplane CG (yellow)

28. Visual Competitor Analysis → Select and compare competitors graphically





- Competitors are selected from various categories
- Graphs can be generated either as scatter plots or histograms
- **The values displayed in the graph are also listed in the Output window**
- More than 70 parameters can be plotted
- Charts can be copied and included in reports
- A linear regression line can be displayed on the chart, with its equation shown in the Output window
- Annotations (model names) can be displayed on the chart
- The technical specifications associated with each aircraft can be displayed in the Output window: engine model, number of engines, propeller type, wing type, high-lift device type, landing gear type

29. Visual Version Analysis → Select and compare versions graphically

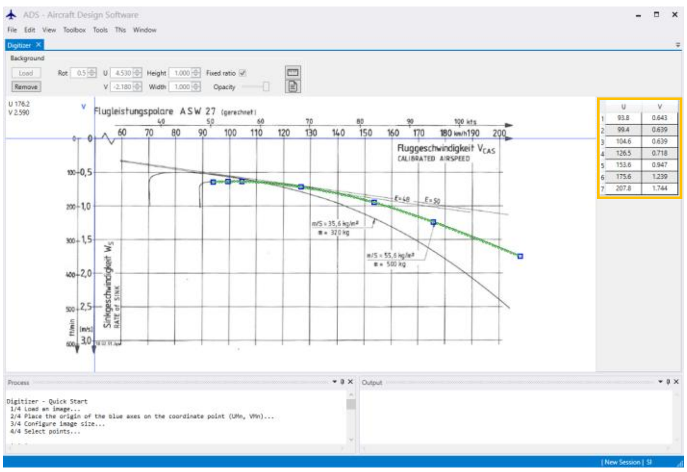
Unlike a competitor, a version is a variant of the same project. The **multiple run** feature can automatically generate a large number of versions, whose characteristics can be analyzed graphically in the **version comparator**.

It provides the same features as for competitors, except for:

- A polynomial regression curve can be displayed on the chart, with its equation shown in the Output window

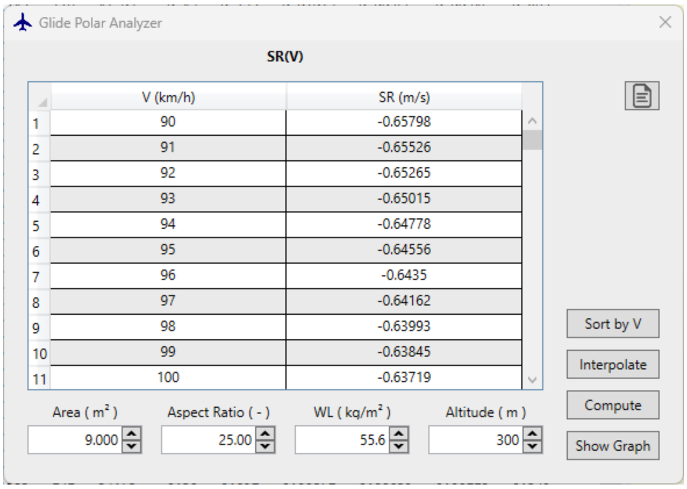
Toolbox

30. Digitizer → Digitizes any curve to retrieve the coordinates of the points that were used to draw it



- **Generates a list of points that can be copied/pasted in any spreadsheet or tables in ADS**
- In reverse engineering the analysis of the coordinates of a glide polar obtained by digitalization will make it possible to know at any speed the zero lift drag coefficient and the Oswald efficiency factor

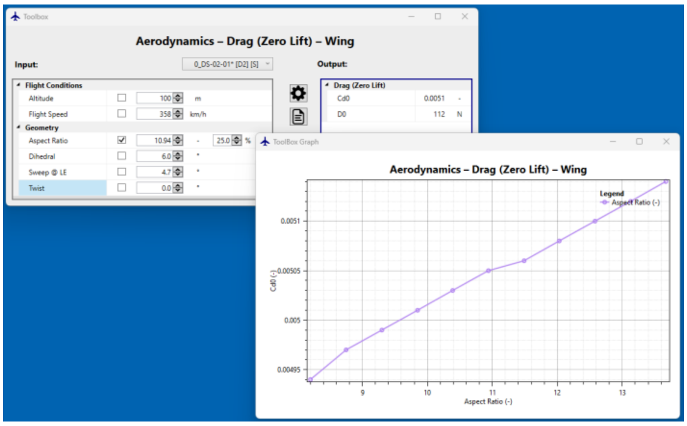
31. Glide Polar Analyzer → Analyzes the drag polar of a (motor)glider



- Computes at every speed of the glide polar, from the lower to the upper speed, every 1 km/h, the following information:
  - Total drag
  - Glide ratio
  - Lift coefficient
  - Drag coefficient
  - Zero lift drag coefficient
  - Induced drag coefficient
  - Osswald efficiency factor

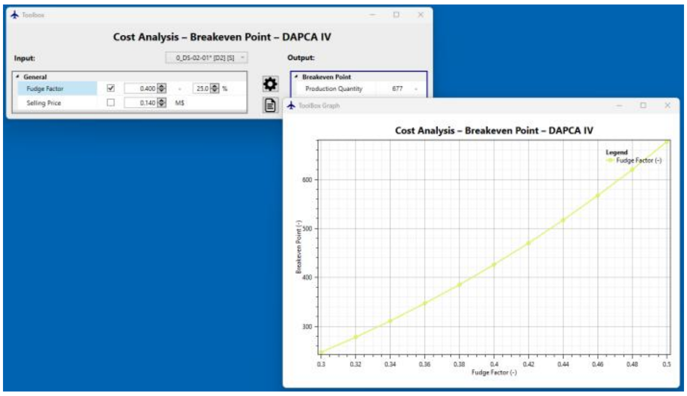
Tools

32. Aerodynamics / Zero Lift Drag → Sensitivity analysis in drag generation



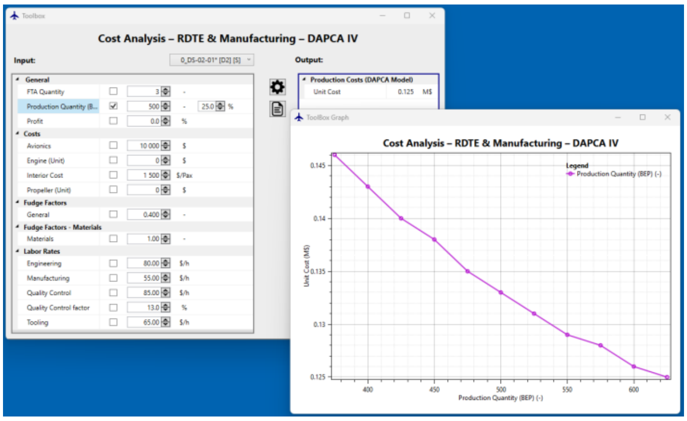
- Performs a sensitivity analysis and identify the predominant parameters in drag generation, or which parameter should be modified as a priority to minimize drag. The analysis can be done on the following components:
  - Airplane
  - Wing
  - Empennages
  - Fuselage
  - Landing gear
  - Floats
  - Tailboom
  - Engine
  - Nacelle
  - Miscellaneous
- A technical note presents the equations used in the computation of drag and lists the references.

33. Cost Analysis / Breakeven Point → Sensitivity analysis in breakeven point determination



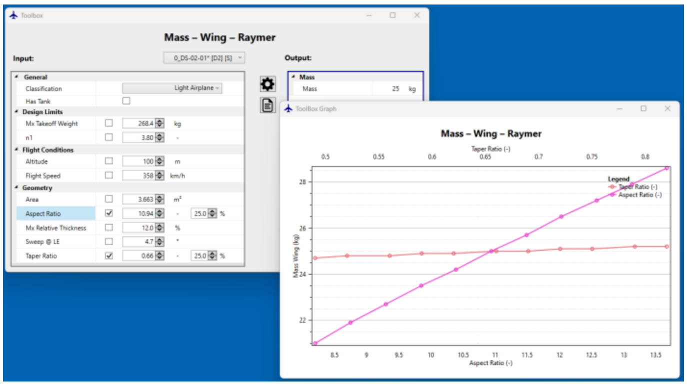
- Performs a sensitivity analysis in the determination of the breakeven point.

34. Cost Analysis / RDTE & Manufacturing → Sensitivity analysis on RDTE & manufacturing costs



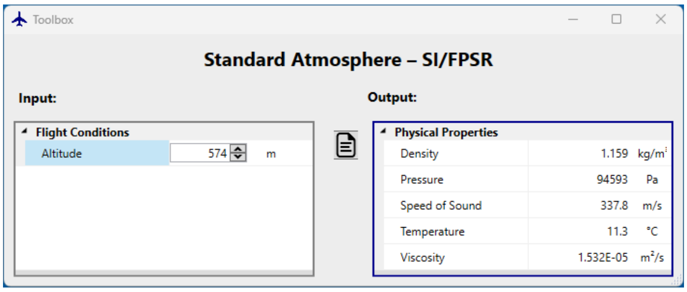
- Performs a sensitivity analysis and identify the predominant parameters which influence RDTE & manufacturing costs, or which parameter should be modified as a priority to minimize the cost.
- A technical note presents the equations used and lists the references.

35. Mass → Sensitivity analysis on mass estimation



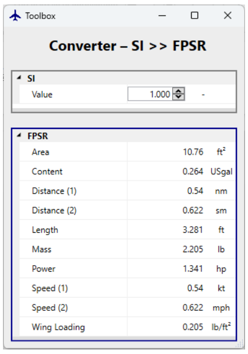
- Performs a sensitivity analysis and identify the predominant parameters in mass estimation, or which parameter should be modified as a priority to minimize the mass. The analysis can be done on the following components:
    - Wing
    - Empennages
    - Fuselage
    - Landing gear
    - Floats
    - Tailboom
    - Engine
    - Nacelle
    - Systems
    - Furnishing
- A technical note presents the equations used in the computation of mass and lists the references.

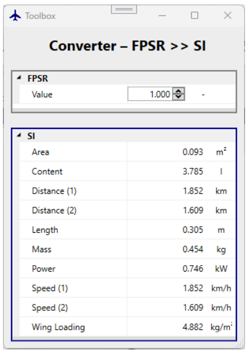
36. Standard Atmosphere → Lists the characteristics of the standard atmosphere at a given altitude



- Lists the characteristics of the standard atmosphere at a given altitude

37. Unit Converter SI << >> FPSR

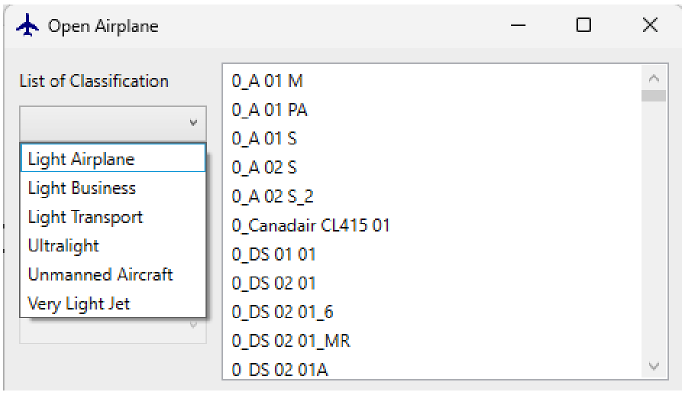




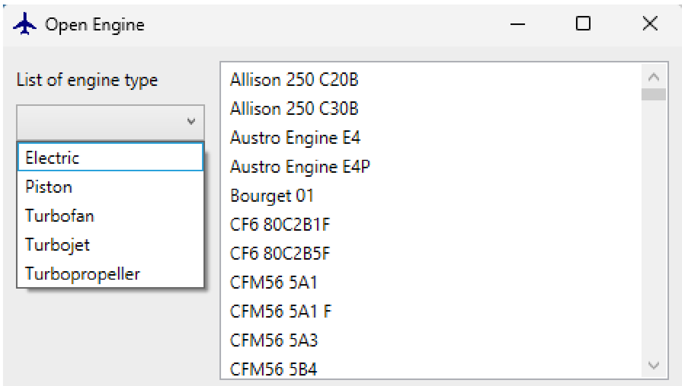
- The unit converter allows for the conversion of major physical quantities between the SI system and the FPSR system, in both directions

Database

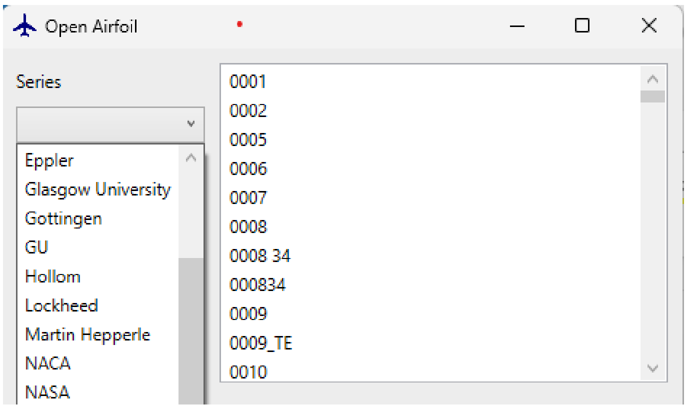
38. Database → Airplanes, Engines, Airfoils, Fuels, Batteries, Tires, Materials



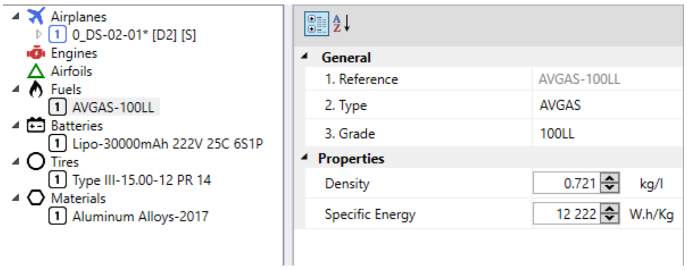
- The airplane database is divided in different categories:
  - Light Airplane
  - Light Business
  - Light Transport
  - Ultralight
  - Unmanned Aircraft
  - Very Light Jet
- For each aircraft in the database:
  - General information
  - Geometry
  - Systems
  - Mass
  - Performance
- The database is continuously updated with new airplanes
- The user may updated it himself with his own data



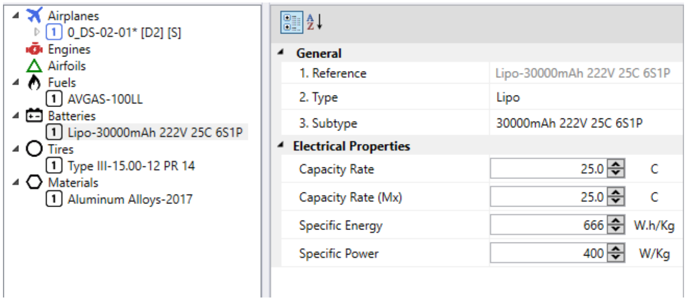
- The engine database is divided in different categories:
  - Electric
  - Piston
  - Turbofan
  - Turbojet
  - Turbopropeller
- For each engine in the database:
  - General information
  - Geometry
  - Systems
  - Performance
- The database is continuously updated with new engines
- The user may updated it himself with his own data



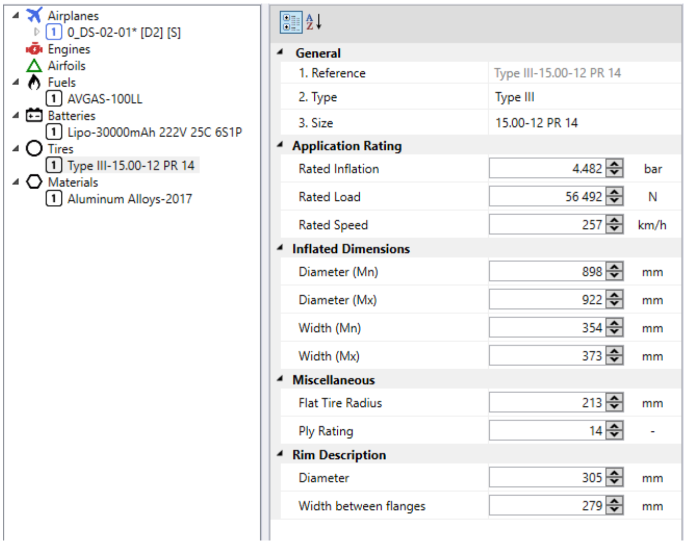
- The airfoil database is divided in different categories. Among them:
  - Eppler
  - NACA
  - NASA
  - Worthmann
  - …
- For each airfoil in the database:
  - General information
  - Airfoil coordinates
  - Aerodynamic characteristics for different Reynolds Number and Mach Number
- The database is continuously updated with new airfoils
- The user may updated it himself with his own data



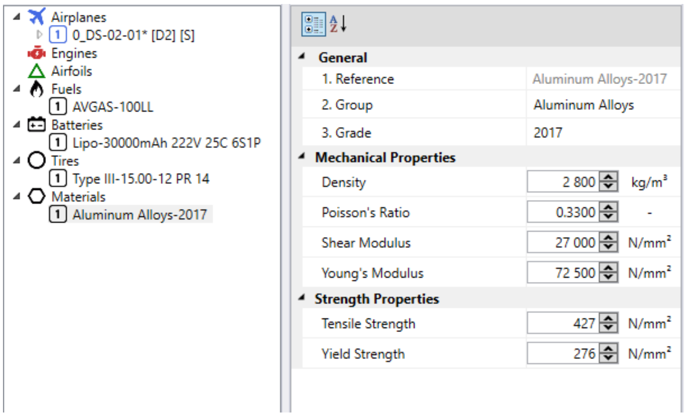
- For each fuel in the fuel database:
  - General information
  - Physical and chemical properties
- The user may updated it himself



- For each battery in the battery database:
  - General information
  - Electrical properties
- The user may updated it himself



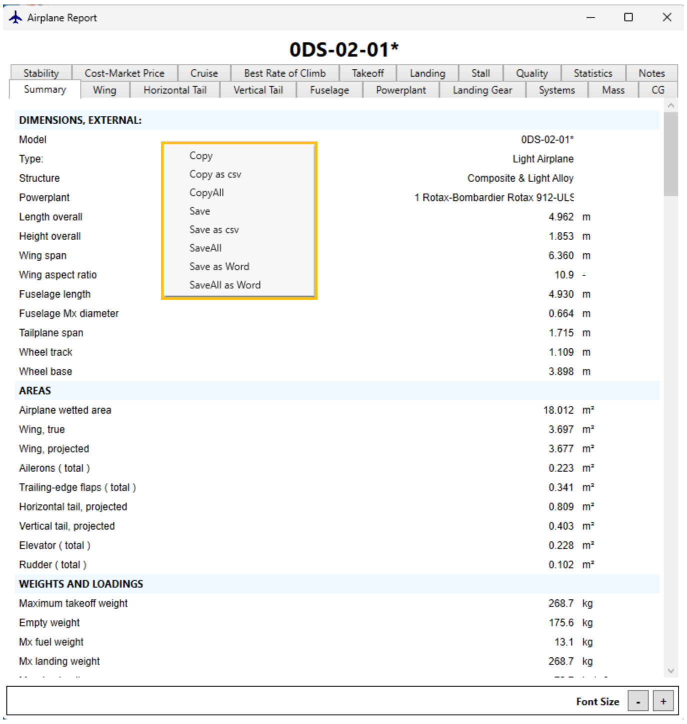
- For each tire in the tire database:
  - General information
  - Application rating
  - Inflated dimensions
  - Rim Description
- The user may updated it himself



- For each material in the material database:
  - General information
  - Mechanical properties
  - Strength properties
- The user may updated it himself

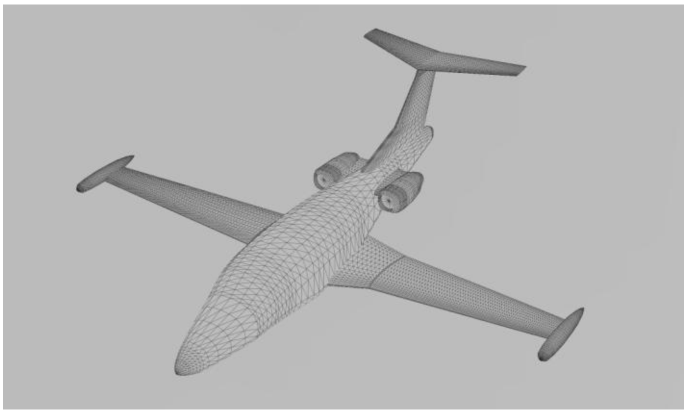
Export Functions

39. Airplane Report → Airplane report available in .doc, .txt, .csv file format



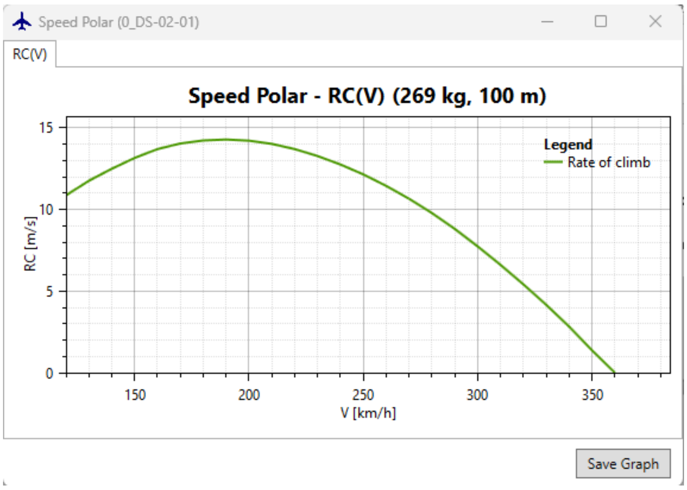
- Airplane report ready to be published
- **Airplane report may be**:
  - Copied in the clipboard
  - Copied as csv
  - Saved as doc
  - Saved as txt
  - Saved as csv
- One file for the whole document
- One file for a specific item
- Files are stored in a specific folder of the airplane dataset
- File path is displayed in the process window

40. 3D-Geometry → 3D Geometry may be exported in .stl file format



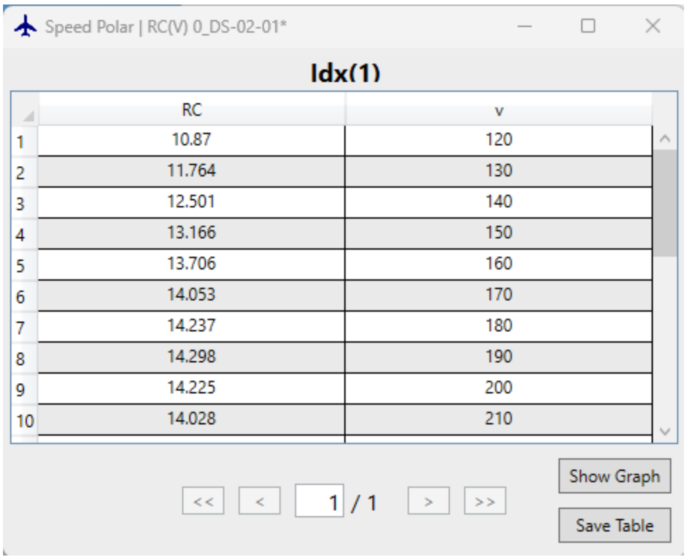
- One file for the whole geometry
- One file for each component (wing, fuselage…)
- Files are stored in a specific folder of the airplane dataset

41. Graphs → Graphs are saved in .bmp, .pdf, .png file format



- Save graph generates:
  - .bmp
  - .pdf
  - .png
- Files are stored in a specific folder of the airplane dataset

42. Tables → Tables are saved in .csv file format



	RC	v
1	10.87	120
2	11.764	130
3	12.501	140
4	13.166	150
5	13.706	160
6	14.053	170
7	14.237	180
8	14.298	190
9	14.225	200
10	14.028	210

- Save table generates .csv file format:
- Files are stored in a specific folder of the airplane dataset
- File path is displayed in the process window

Customized software

43. Add new modules → Great flexibility of the software

Thanks to its modular architecture, the software can be easily extended by adding new modules to meet specific customer requirements. The following features have been implemented in ADS in response to specific requests:

- VTOL (Vertical Take-Off and Landing)
- STOL (Short Take-Off and Landing)
- Seaplane
- Solar-powered aircraft
- Airliners
- Ducted fan systems

44. Frequent new releases → Frequent new releases demonstrate OAD’s high level of responsiveness

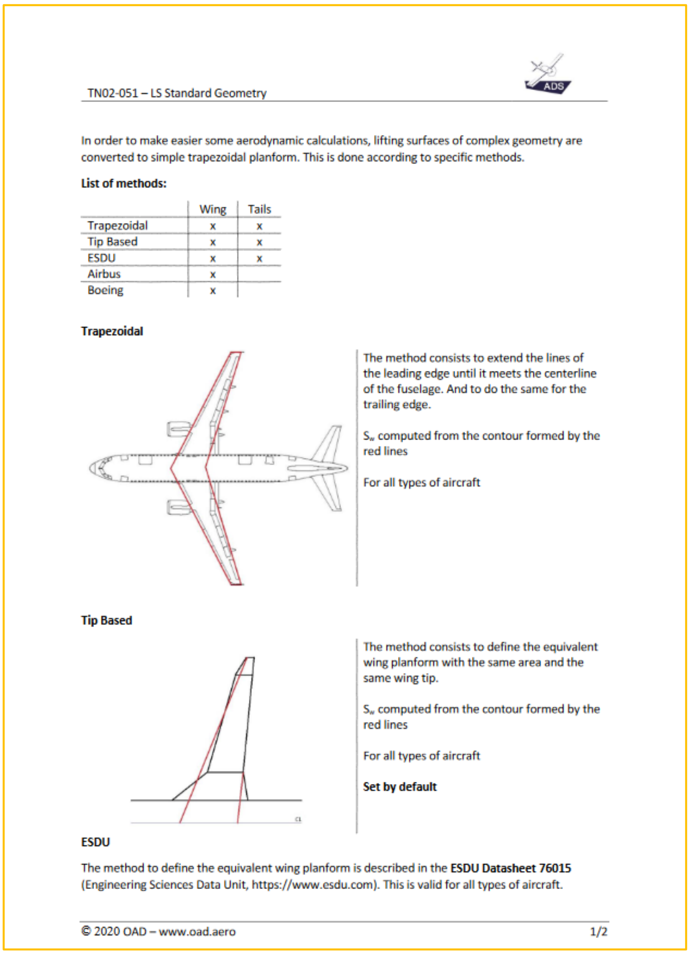
- As soon as an issue is reported, OAD makes every effort to resolve it as quickly as possible
- When a customer requests a new feature, OAD evaluates the request and, when feasible, includes it in the next software release.
- Customer satisfaction is OAD’s top priority.

Technical assistance

45. Getting started with the software → OAD assists the customer getting started with ADS

- Online training sessions are available to assist users during their initial use of the software.
- OAD provides expert support to review the user's work until they feel confident using the software independently

46. Technical documentation → Technical notes and videos accessible directly from the software



TN02-051 – LS Standard Geometry

In order to make easier some aerodynamic calculations, lifting surfaces of complex geometry are converted to simple trapezoidal planform. This is done according to specific methods.

List of methods:

	Wing	Tails
Trapezoidal	x	x
Tip Based	x	x
ESDU	x	x
Airbus	x	
Boeing	x	

Trapezoidal

The method consists to extend the lines of the leading edge until it meets the centerline of the fuselage. And to do the same for the trailing edge.

S_w computed from the contour formed by the red lines

For all types of aircraft

Tip Based

The method consists to define the equivalent wing planform with the same area and the same wing tip.

S_w computed from the contour formed by the red lines

For all types of aircraft

Set by default

ESDU

The method to define the equivalent wing planform is described in the **ESDU Datasheet 76015** (Engineering Sciences Data Unit, https://www.esdu.com). This is valid for all types of aircraft.

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- **Concise technical notes** provide explanations on many topics
- Short videos show how to complete a task
- Many additional information displayed on the user interface regarding:
  - Historical values
  - Reference
  - Theory

47. Technical support → OAD may assist the customer at any time

- Users may contact OAD at any time for clarification regarding the algorithms used to solve a problem or to better understand the results provided by the software.
- Users may also request OAD to carry out specific tasks as part of a consulting service

References

48. ADS for everyone → Serving customers from all sectors, including small, medium, and large companies, as well as individuals and universities