43 good reasons to adopt ADS

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

Foreword: buying a modeling tool is an investment that can save you a lot of money

All-in-One: Module based software

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

Set of optimization tools

9. Aerodynamics → Set of tools to select the best airfoils and wing planform
10. Powerplant → List of engine candidates to fulfill the power requirement
11. Multiple Runs → Computations carried out in sequence to reach the best configuration
12. 3D Geometry → Unique set of features to optimize geometry
13. Design constraints → Automatically controls results to meet different types of constraints

Integrated expertise

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

Toolbox

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

Tools

28. Aerodynamics / Zero Lift Drag → Sensitivity analysis in drag generation
29. Cost Analysis / Breakeven Point → Sensitivity analysis in breakeven point determination
30. Cost Analysis / RDTE & Manufacturing → Sensitivity analysis on RDTE & manufacturing costs
31. Mass → Sensitivity analysis on mass estimation
32. Standard Atmosphere → Lists the characteristics of the standard atmosphere at a given altitude

Database

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

Export Functions

34. Airplane Report → Airplane report available in .doc, .txt, .csv file format
35. 3D-Geometry → 3D Geometry may be exported in .stl file format
36. Graphs → Graphs are saved in .bmp, .pdf, .png file format
37. Tables → Tables are saved in .csv file format

Customized software

38. Add new modules → Great flexibility of the software
39. Frequent new releases → Extremely high responsiveness on the part of OAD

Technical assistance

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

References

43. ADS for everyone → Customers from all horizons: small, medium and large companies, individuals and universities

Foreword: buying a modeling tool is an investment that can save you a lot of money

The engineer needs to use modeling tools like aircraft design software to make the best design choices.

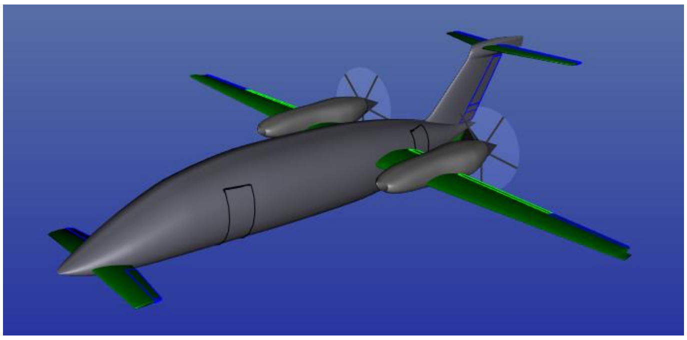
Modeling systems has become an invaluable tool for engineers looking to optimize them. By deploying precise models, it becomes possible to analyze their behavior, predict their performance and identify areas for improvement.

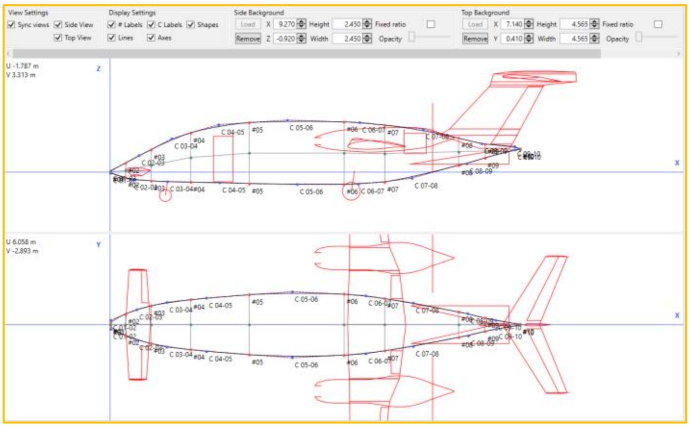
By using the models, engineers can understand how each component interacts with others, how inputs affect outputs, and how changing one element can influence the entire system. This in-depth understanding is essential to identify weak points, inefficiencies and opportunities for optimization.

Systems modeling offers the possibility to simulate and test alternative scenarios without implementing them directly in reality. This makes it possible to explore different configurations and solutions while limiting costs. Using these simulations, engineers can evaluate each option, facilitating the decision-making process for system optimization.

All-in-One: Module based software

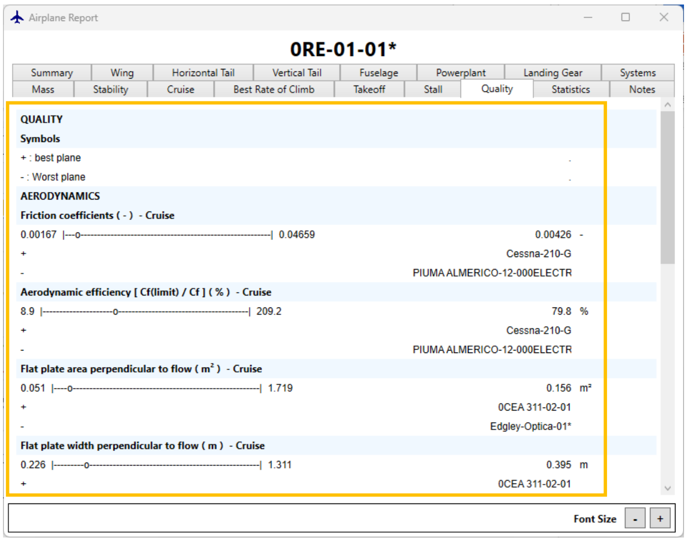
1. Module: CAD → Unique toolset to generate exact geometry, quickly and efficiently





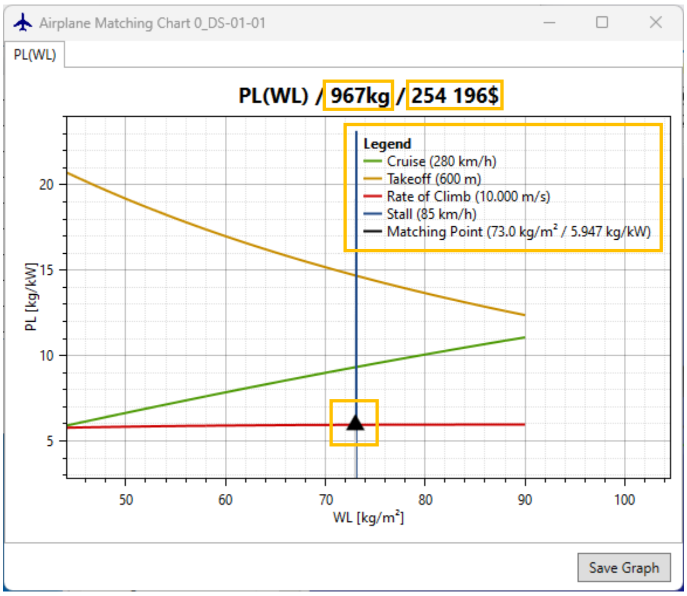
- To be used to generate a new design or reproduce an existing airplane
- **Bodies define from longitudinal control lines and control stations, based on conics**
- Lifting surfaces define from airfoil geometry
- Conics defined from Conic Shape Parameter (CSP)
- Operation on 3D-shapes:
  - Body lofting
  - 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)

2. Module: Reverse Engineering → To do an extremely detailed analysis of existing aircraft



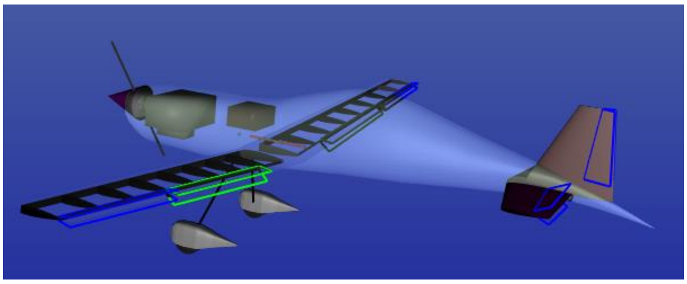
- Geometric analysis
- Performance analysis
- Weight breakdown
- Weight and balance
- Aerodynamic efficiency analysis
- Mass efficiency analysis
- Propulsion efficiency analysis
- Comparative analysis with airplanes from airplane database

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

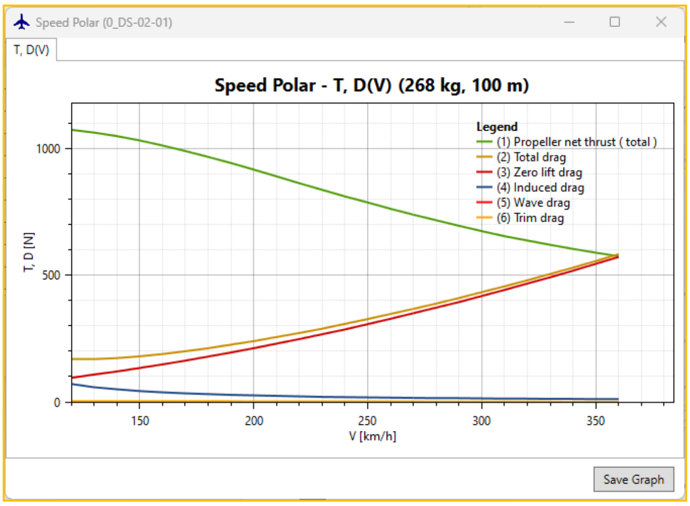


- Matching Point (Wing Loading, Power Loading)
- Geometry based on selected wing loading
- Maximum takeoff weight
- Market price, computed from geometry and technical choice
- All performance analyzed (Cruise, Stall, Takeoff, Climb)
- Propulsion based on selected power loading
- Generate a list of engine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

4. Module: Design → 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)

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

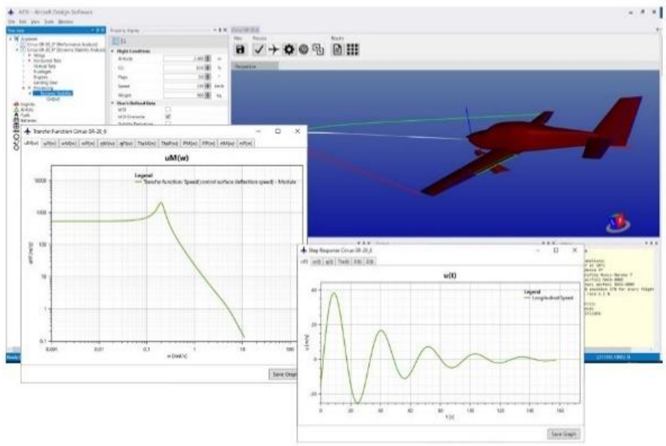
Track Changes from previous run (34) - [Item | Units | Value0 | Value1 | Change]

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)

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



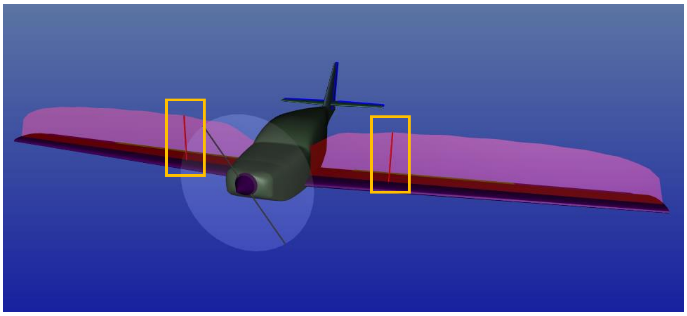
- Computes the dynamic stability of a plane by analyzing:
  - the free response of the plane (eigenmodes)
  - the harmonic response to control inputs
  - the step response to control inputs

7. 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

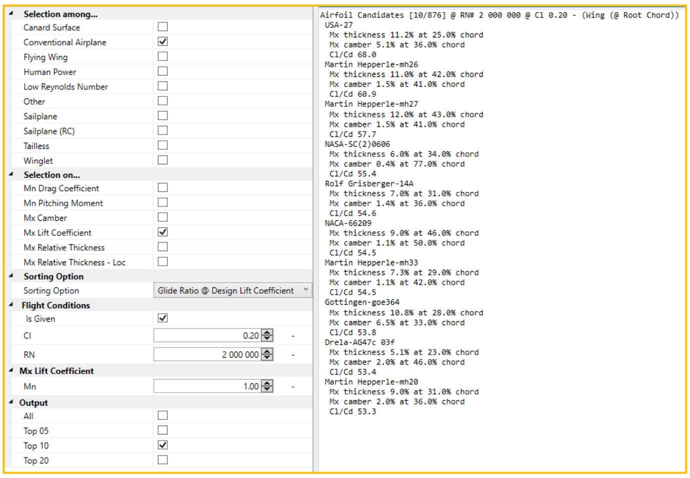
8. Module: Lift distribution → To optimize the wing planform for safety and performance



- 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

Set of optimization tools

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



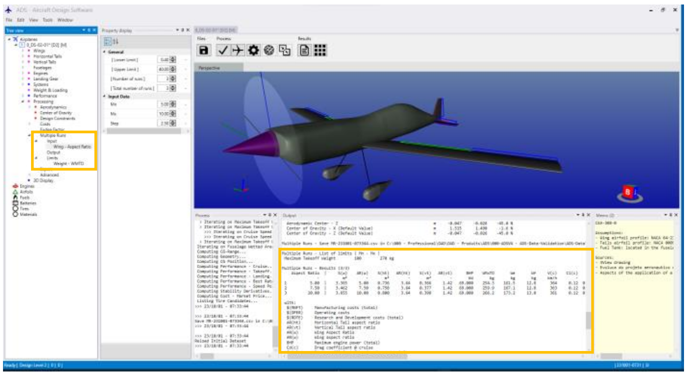
- To generate the optimal wing planform
- **To select the best airfoil according to the flight conditions and some geometric and aerodynamic criteria**
- To compute the aerodynamic characteristics of any airfoil geometry using Xfoil

10. 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)        Mass
                                                       kW          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
```

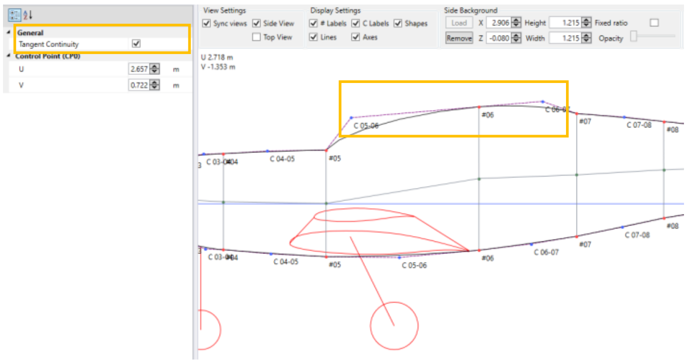
- Generates a list of engine candidates to power the aircraft based on the **computed power requirement** (Design Level 1).

11. Multiple Runs → Computations carried out in sequence to reach the best configuration



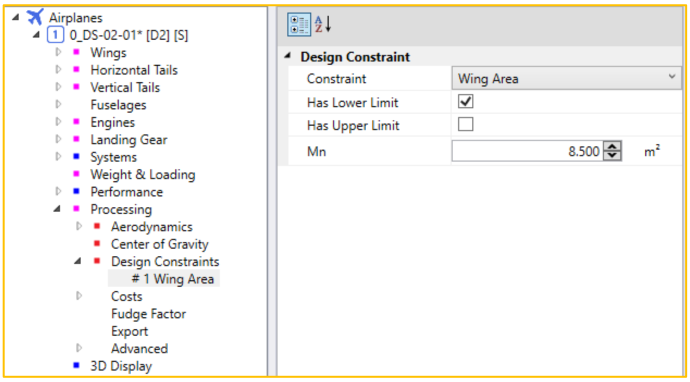
- **Performs automatically a large number of different configurations by varying some input data**
- Defines some limits
- Sorts automatically the results
- **Displays results under the form of table**
- Generates a .csv file and save it in a specific folder of the airplane dataset

12. 3D Geometry → Unique set of features to optimize geometry



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

13. 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

14. 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

15. 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

16. 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…)
  - …

17. 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

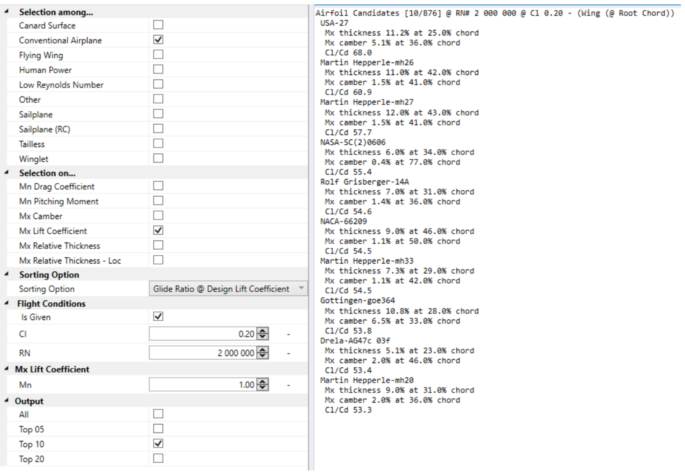
- Checks compliance with regulation regarding:
  - Maximum fuel capacity
  - Number of engines
  - Maximum number of occupants
  - Type of engine
  - Maximum operating altitude
  - Mass
  - Speed
  - Load factors
  - Takeoff, climb and landing performance

18. 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

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



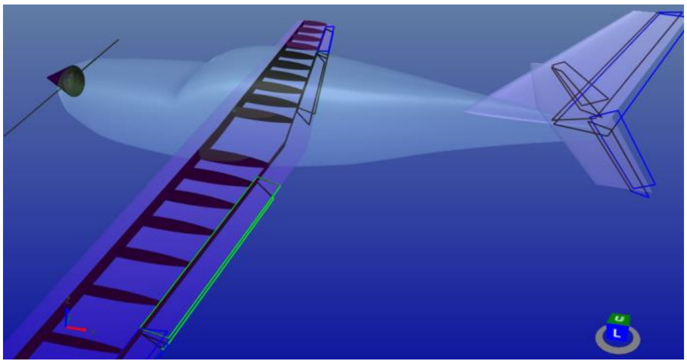
- Generates a list of airfoil candidates in function of:
  - Type of airplane
  - Flight conditions
  - Some geometric parameters:
    - Maximum relative thickness
    - Maximum camber
  - Some aerodynamic parameters:
    - Minimum drag coefficient
    - Maximum lift coefficient
    - Minimum pitching 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

20. 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	-

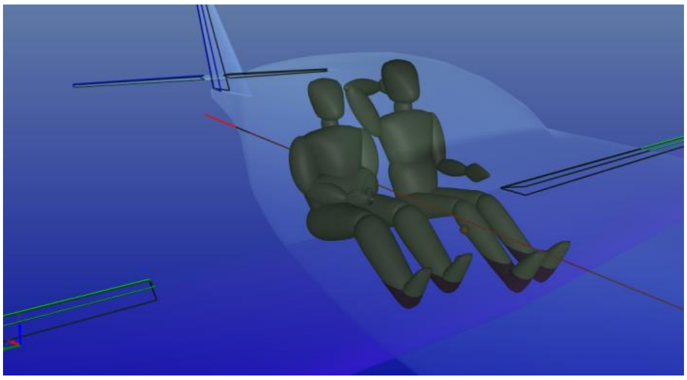
- The current airplane is compared with other airplanes taken from the database. The analysis focuses on:
  - Aerodynamics
  - Fuel consumption
  - C02 emissions
  - Mass
  - Performance
- The best airplane is displayed as well as the worst one
- The current airplane is located between the two limits

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



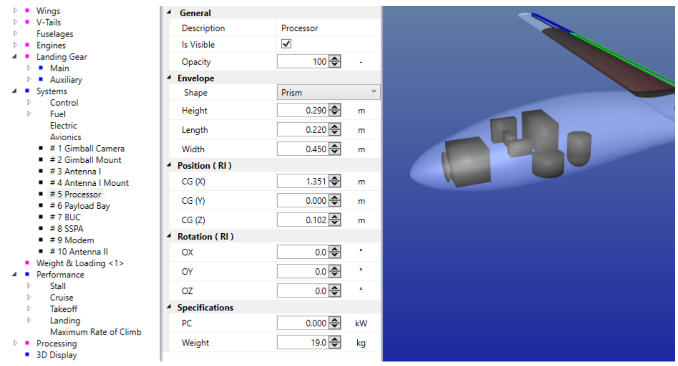
- The structure is generated automatically
- Some elements of the structure are represented, such as:
  - Spars
  - Ribs
  - Frames
  - Stringers
- The representation is mainly used to check the absence of interference between components, between the structure and the control surfaces, between the structure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

22. Occupants → Displays occupants to check cabin volume



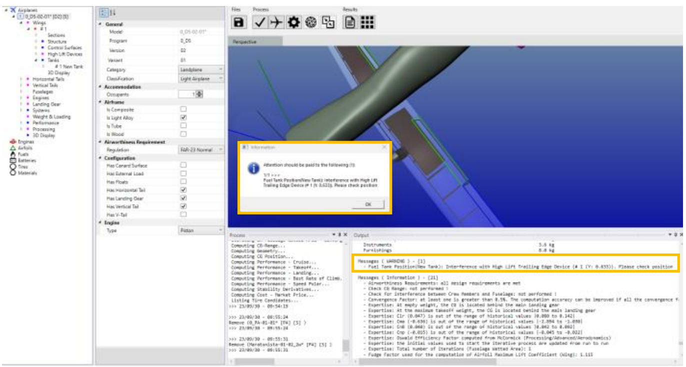
- The occupants are generated automatically
- Controls on measurements:
  - Height
  - Fatness
  - Shoulder breath
- Controls position and attitude
- Checks interference with the fuselage
- Checks clearance with fuselage
- Checks minimum cockpit size to fit the occupants
- Lists anthropometric characteristics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

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



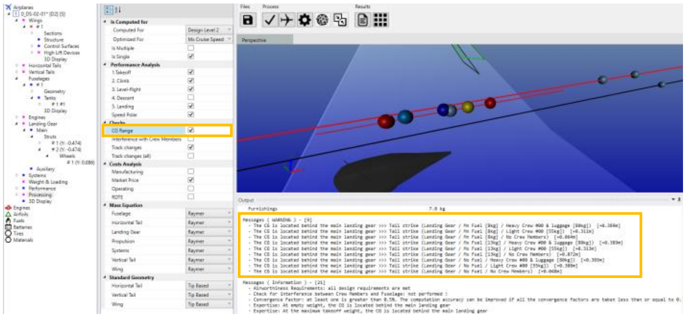
- The user may define unlimited number of systems
- Each system is defined with:
  - An envelope of different shape (prism, cylinder, cone, sphere) and size
  - Power consumption
  - Mass

24. 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
  - …

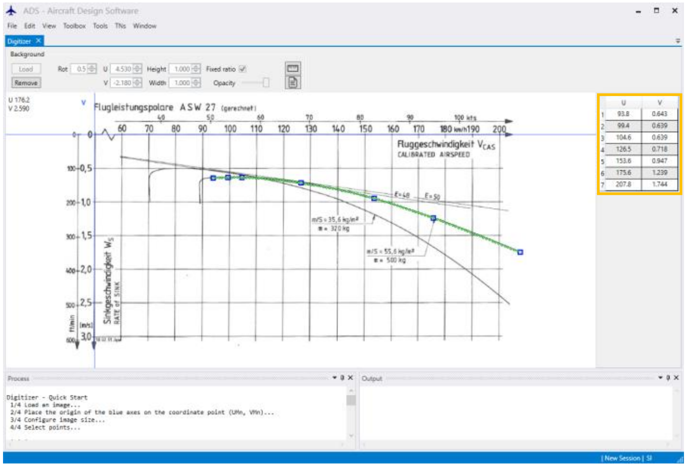
25. Checks CG Range → Checks the CG position for all load cases



- **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)

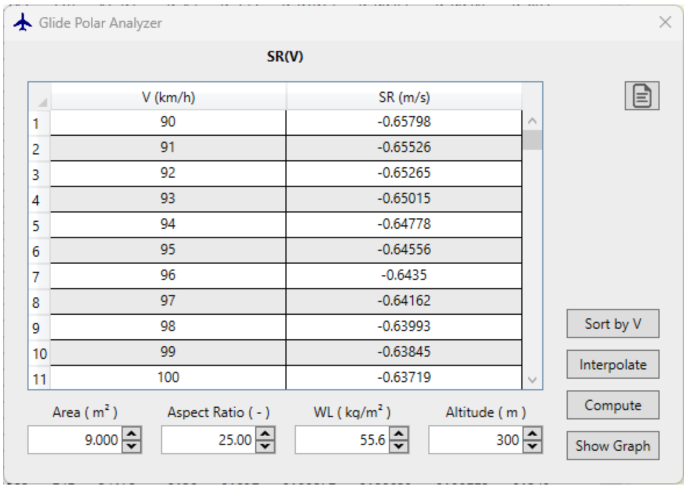
Toolbox

26. 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

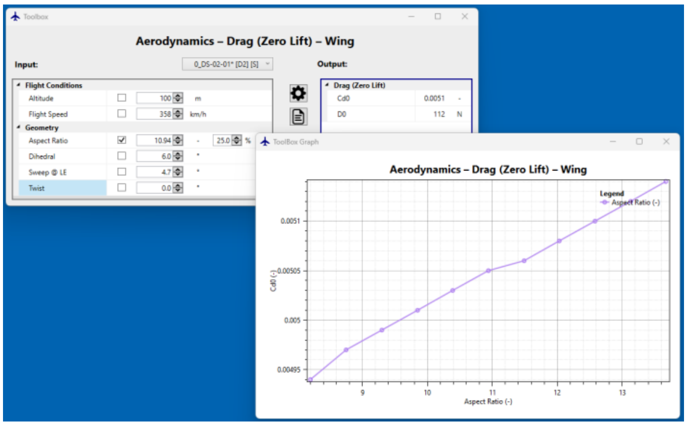
27. Glide Polar Analyzer → Analyzes the drag polar of a (motor)glider



- 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

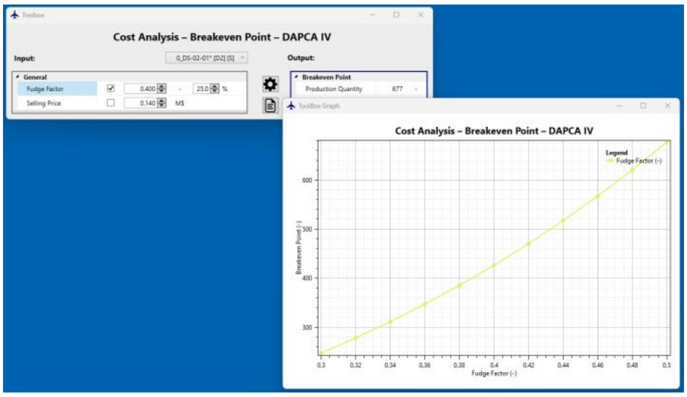
Tools

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



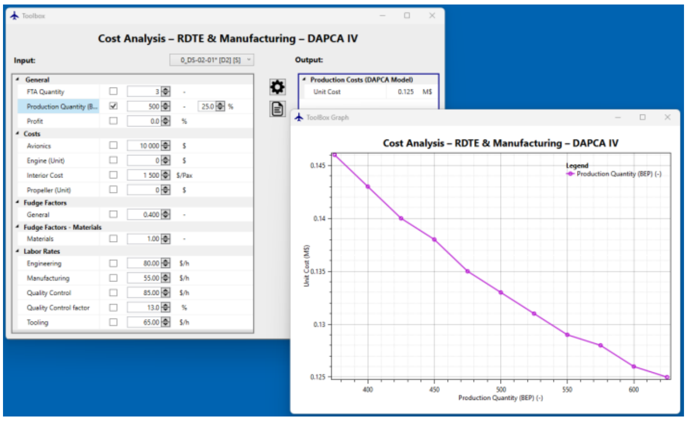
- Performs a sensitivity analysis and identify the predominant parameters in drag generation, or which parameter should be modified as a priority to minimize drag. The analysis can be done on the following components:
  - Airplane
  - Wing
  - Empennages
  - Fuselage
  - Landing gear
  - Floats
  - Tailboom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

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



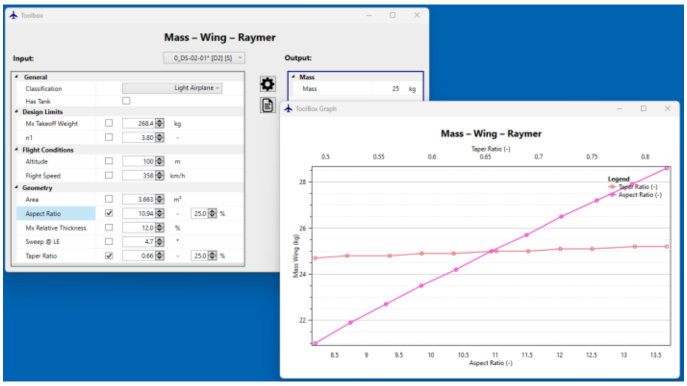
- Performs a sensitivity analysis in the determination of the breakeven point.

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



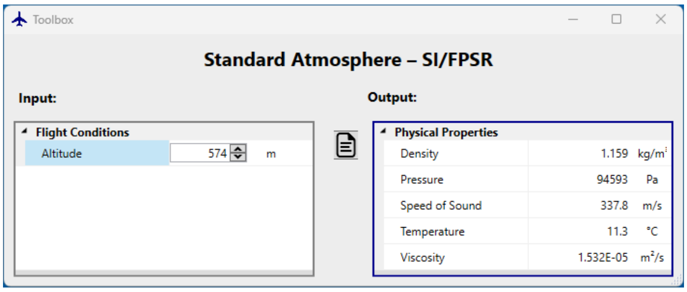
- Performs a sensitivity analysis and identify the predominant parameters which influence RDTE & manufacturing costs, or which parameter should be modified as a priority to minimize the cost.
- A technical note presents the equations used and lists the references.

31. 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.

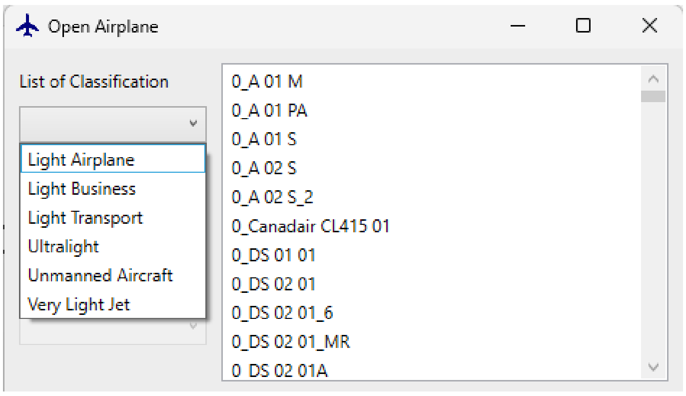
32. Standard Atmosphere → Lists the characteristics of the standard atmosphere at a given altitude



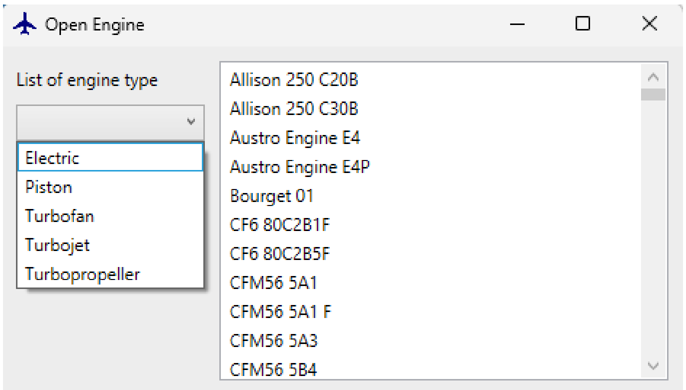
- Lists the characteristics of the standard atmosphere at a given altitude

Database

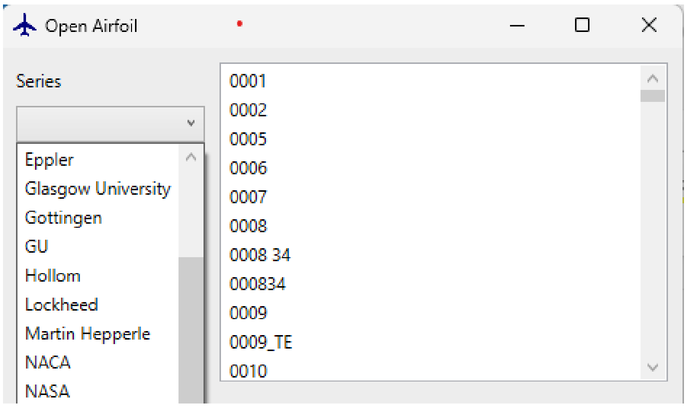
33. Database → Airplanes, Engines, Airfoils, Fuels, Batteries, Tires, Materials



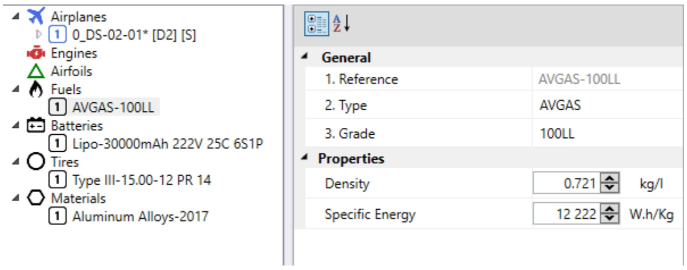
- The airplane database is divided in different categories:
  - Light Airplane
  - Light Business
  - Light Transport
  - Ultralight
  - Unmanned Aircraft
  - Very Light Jet
- For each aircraft in the database:
  - General information
  - Geometry
  - Systems
  - Mass
  - Performance
- The database is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



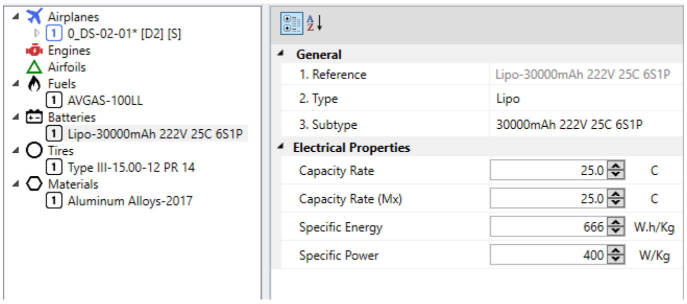
- The engine database is divided in different categories:
  - Electric
  - Piston
  - Turbofan
  - Turbojet
  - Turbopropeller
- For each engine in the database:
  - General information
  - Geometry
  - Systems
  - Performance
- The database is continuously updated with new engines
- The user may updated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



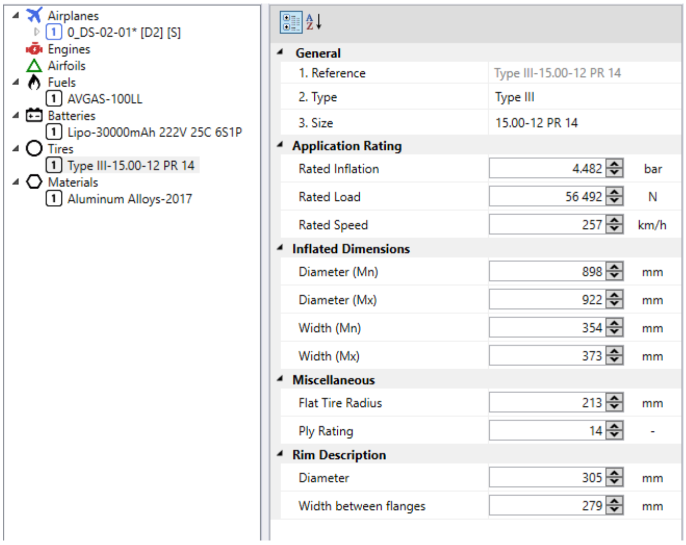
- The airfoil database is divided in different categories. Among them:
  - Eppler
  - NACA
  - NASA
  - Worthmann
  - …
- For each airfoil in the database:
  - General information
  - Airfoil coordinates
  - Aerodynamic characteristics for different Reynolds Number and Mach Number
- The database is continuously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



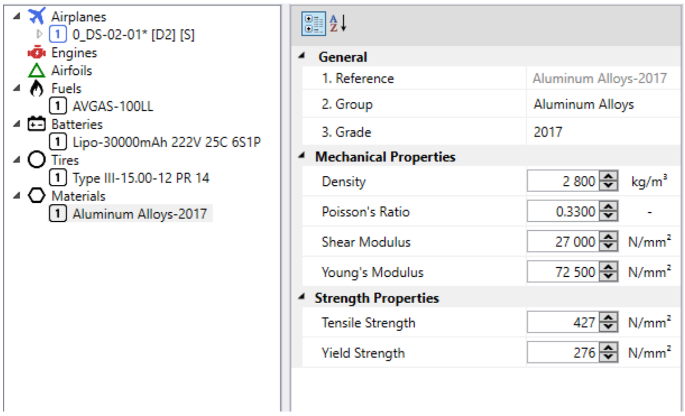
- For each fuel in the fuel database:
  - General information
  - Physical and chemical properties
- The user may updated it himself



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



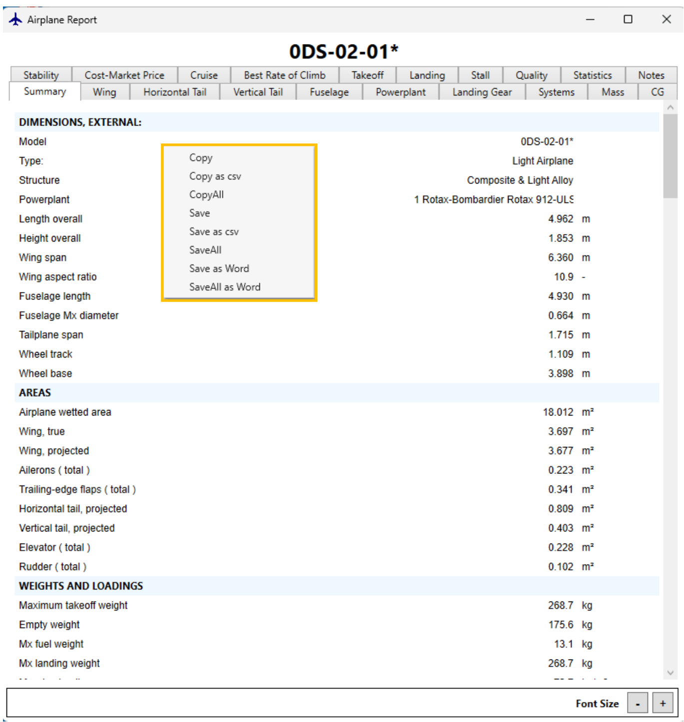
- For each tire in the tire database:
  - General information
  - Application rating
  - Inflated dimensions
  - Rim Description
- The user may updated it himself



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

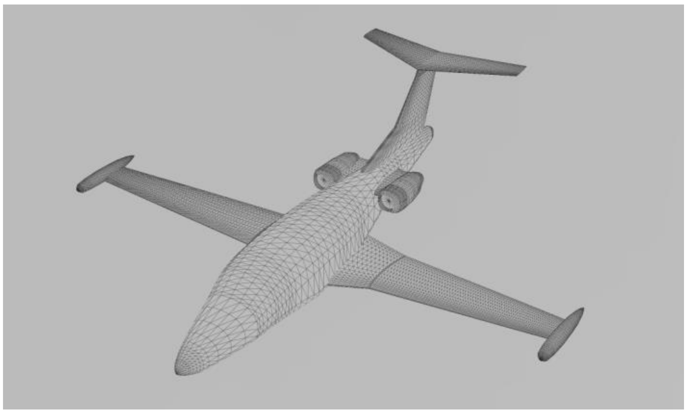
Export Functions

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



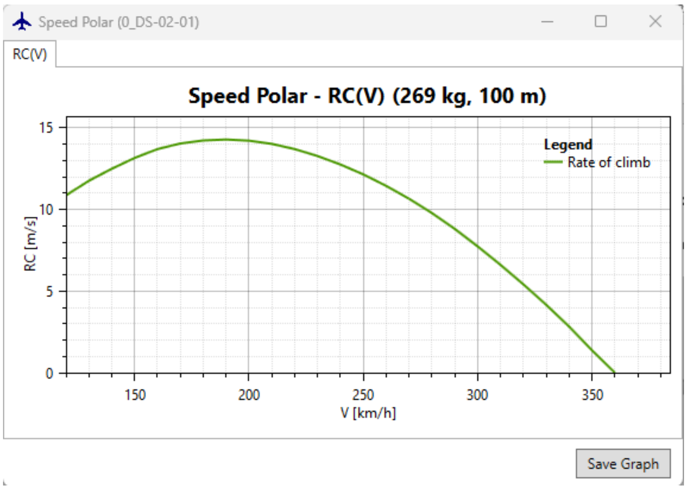
- Airplane report ready to be published
- **Airplane report may be**:
  - Copied in the clipboard
  - Copied as csv
  - Saved as doc
  - Saved as txt
  - Saved as csv
- One file for the whole document
- One file for a specific item
- Files are stored in a specific folder of the airplane dataset
- File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

35. 3D-Geometry → 3D Geometry may be exported in .stl file format



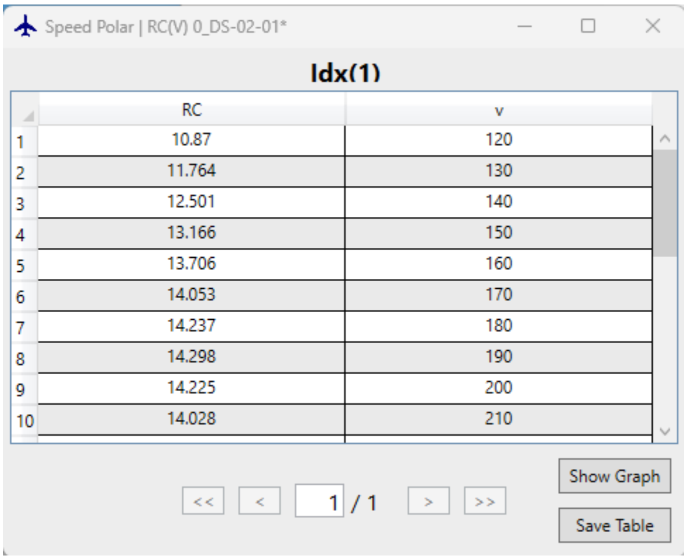
- One file for the whole geometry
- One file for each component (wing, fuselage…)
- Files are stored in a specific folder of the airplane dataset

36. 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

37. 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

38. Add new modules → Great flexibility of the software

- Thanks to its modular architecture, it is very easy to add new modules to the software to meet a specific customer need.
- The Following features have been implemented in ADS following specific request :
  - VTOL
  - STOL
  - Seaplane
  - Solar plane
  - Airliners
  - Ducted fan

39. Frequent new releases → Extremely high responsiveness on the part of OAD

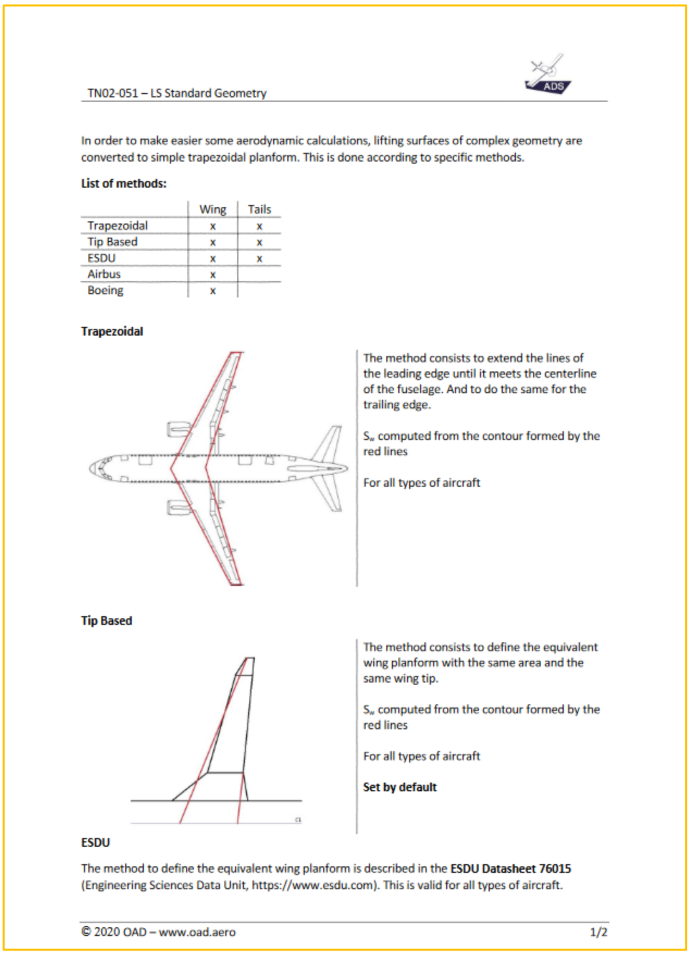
- As soon as an issue is reported, OAD does everything possible to correct it as quickly as possible.
- If a customer wants to see a new feature in the software, OAD reviews the request, and if possible adds it in the next release
- OAD’s priority is customer satisfaction

Technical assistance

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

- Online training are offered to help the user when getting started with the software
- OAD offers its expertise to verify the work done by the user until he feels comfortable with the software

41. 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

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

- User may contact OAD at any time for clarification on the algorithms used to solve a problem, the results provided by the software…
- User may ask OAD to perform some work in the frame of consulting

References

43. ADS for everyone → Customers from all horizons: small, medium and large companies, individuals and universities