DARcorporation

Design • Analysis • Research

What's New in AAA?

Version 5.0

August 2022

This document contains a selection of the new features in AAA 5.0, organized according to the different modules in AAA. The following table includes an overview of the growth of AAA 5.0 compared to 4.0 in numbers.

	AAA 4.0	AAA 5.0
Lines of Code	309,695	354,629
Unique Parameters	5,790	6,177
Variables on All Windows	12.247	12,987
Output Parameters	3,745	4,211
Series of Calculations	694	773
Input/Output Windows	599	667
Plots	152	191
Unique Data Curves on Plots	581	601
Tables	193	232
Help System (MB)	80	82

Because of the improved methods in AAA 5.0, the user is recommended to go through each module and update the results when opening a file made in AAA 4.0 or prior versions. AAA will inform the users of changes and extra information needed.

The Installation Manuals describe the installation procedure. The manuals are available in pdf format on the installation CD and can be downloaded from www.darcorp.com.

The AAA Manual describes all general program features and all modules.

AAA 5.0 airplane examples have been added and are available for download from www.darcorp.com. More examples will be added over time, so keep visiting www.darcorp.com for updates.

Enhancements and Modifications

Highlights

- AAA 5.0 allows for increased flexibility in the types of configurations that can be designed. While previous versions needed a fuselage to be modeled, methods have been updated so that users can now design a true flying wing. With the current interest in VTOL configurations in mind, AAA 5.0 makes it easier to design aircraft with tilting wings for different flight conditions. The center of gravity of fixed equipment can either be kept constant or variable between different flight conditions to reflect different flight configurations.
- Power effects such as blown wing effects are more accurately calculated, making AAA 5.0 well suited for Distributed Electric Propulsion configurations.
- AAA 5.0 now includes the Inherent Tail Surface Area Sizing module, which calculates the required tail surface area for a given desired static margin. More elaborate than the conventional volume method, the new calculation takes into account changes in center of gravity and aerodynamic center due to the tail surface change. This is compatible with conventional horizontal tails, V-tails, canards and three-surface aircraft.
- Users have more options for control surfaces such as drag rudders, differential canard and differential elevators.
- The Weight, Aerodynamics and Stability & Control modules have been significantly overhauled to streamline the work flow. Weight, Center of Gravity and Moment of Inertia calculations have been split into different submodules. The Stability & Control module was restructured so the different functionalities are easier to find.

Weight

1. The Weight module has been rearranged into three separate categories; Weight, Center of Gravity and Moment of Inertia.
2. The Class II empty weight, take-off weight, center of gravity and inertia tables have been reworked. Each individual component is now an individual item instead of being combined into one summed weight. This table includes several weight methods and averages their results, and the user can choose to include or exclude individual methods per individual item.
3. Passenger bags are now separated from the passenger location and are treated as individual payload items with their own center of gravity and inertia.
4. Engines and propellers can now tilt around a user-defined pivot point and the center of gravity and inertia will be calculated accordingly.

5. New DAR method is implemented for Class II Air Induction weight for G.A. Aircraft.
6. New DAR method is implemented for weight of electric engines.
7. All weight methods are improved for flying wing configurations.
8. Weight, center of gravity and inertia calculations of removable stores, fuel tanks and weapons are improved and depending on whether they are attached or not.
9. The fuselage center of gravity is now calculated based on wetted area.
10. The current aircraft center of gravity, empty weight center of gravity and miscellaneous weight center of gravity locations can be shown on a top and side view geometry plot. Individual component center of gravities can also be plotted.
11. Center of gravity locations for all lifting surfaces can now be set manually.
12. Center of gravity and moments of inertia of tiltable nacelles, inlets and ducts are now calculated and flight condition dependent.

Aerodynamics

1. Selecting an airfoil in the geometry module will automatically define its aerodynamic properties in the aerodynamics module.
2. The drag and effects on aerodynamic center of external bodies such as stores, weapons and fuel tanks are now calculated.
3. C_L/C_D versus C_L, $\sqrt{C_L}/C_D$ versus C_L and C_L^3/C_D^2 versus C_L plots can now be generated.
4. The end-plating effect on the effective aspect ratio of vertical tails and twin vertical tails has been expanded and the results are shown more clearly.
5. Aerodynamic center due to bodies is now dependent on the pitching moment coefficient due to angle of attack derivative for that body, for which the calculation is added.
6. The lift generated by nacelles is now accounted for in the aircraft pitching moment calculation.
7. Effects of power on the drag of control surfaces are now accounted for.
8. Drag from drag rudders is now accounted for in trim.
9. The spanwise Y-location of the vertical tail aerodynamic center is now calculated.
10. Windmilling drag of propellers is calculated more accurately depending on RPM.
11. Ground effects are added to the zero-angle-of-attack lift coefficient calculation and can be calculated to lower altitudes.

12. Calculations related to lift, aerodynamic center and pitching moment for aircraft without empennage are now moved to a separate module.
13. The no-empennage lift coefficient now includes contributions of nacelles and pylons.
14. Nacelles and pylons are now split into two separate modules with their own respective calculations.
15. Zero-lift pitching moment calculations moved from the aircraft module to each individual lifting surface.
16. Profile drag and induced drag of high lift devices are now broken down into individual contributions instead of only one total result.
17. Aerodynamic center locations of all lifting surfaces and bodies are now shown in terms of the mean geometric chord.
18. Induced drag and total drag are now shown per individual nacelle.

Performance

1. Minimum stall speed can now be lowered to 0.1kts.

Geometry

1. The aircraft 3-view now allows for each individual component to be included or excluded from the plot.
2. Fuel tank and weapon geometry modules have been added.
3. Powerplant components such as nacelles, inlets, ducts, propellers and engines can now be tilted around a user-selected point through an incidence, toe and camber angle. This point can be unique for each component or can be set to follow that of the engine.
4. The lateral tip-over angle based on the most critical landing gear is now shown in the landing gear geometry plot. The critical forward and aft landing gear for lateral tip-over is identified for each flight condition.
5. Wing incidence can now be increased to 90 degrees to allow for VTOL aircraft.
6. All geometry can be exported to Aeropack.
7. All components can be scaled and moved in X, Y and Z directions individually.
8. The maximum volume of stores is now calculated.
9. The cross-sectional areas for all bodies such as float, nacelle, tailboom and stores can now be plotted.
10. The area of high lift devices is now split over leading edge and trailing edge devices as opposed to one parameter for the total area.

Stability and Control

1. The inherent tail surface sizing plot can be used to help with the sizing of all types of longitudinal stability surfaces.
2. Longitudinal and directional hingemoment calculations have been added for all control surfaces.
3. Sizing plot for varying elevon chord and deflection can now be generated.
4. Contributions of external fuel tanks and external weapons on stability and control derivatives can now be calculated.
5. The contribution of ventral fins to stability and control derivates can now be calculated.
6. The stick fixed and stick free static margin plots can now be plotted.
7. Differential horizontal tails can now be selected as trim surface for straight line flight trim.
8. Differential canards can now be modeled in the stability and control modules.
9. Drag rudders can now be used in stability and control modules.
10. Directional stability calculations of twin vertical tails have been improved.
11. Ground effects can now be accounted for in trim.
12. The incidence of vertical tails and V-tails is accounted for in lateral-directional straight line flight trim.
13. A plot of the directional stability derivative as a function of vertical tail or V-tail area can now be shown.
14. The inputs of all stability and control derivatives modules have been simplified.
15. Lateral and directional control derivatives are now calculated in separate modules.
16. The trim diagram has been updated and expanded.
17. Individual components such as tailbooms, floats, stores, nacelles, fuel tanks, engines and weapons can be linked to move with the wing so that their influence on stability and control is automatically updated in the wing location module.
18. Aerodynamic pitching moment of horizontal tails, canards and V-tails are included in the take-off rotation calculation if the surface airfoils are non-symmetric. Pitching moment due to miscellaneous components is included in the take-off rotation calculation.
19. The moments due to thrust forces and normal forces have been split into two separate variables.
20. Thrust and moment terms due to engine out and windmilling engine and/or stopped propeller are accounted for in the take-off rotation calculation.
21. Thrust coefficients and derivatives are now calculated.
22. The effects of thrust, normal force and propwash effects are expanded and improved in stability and control modules and trim.

23. The effects of normal force from propellers, jets and ducted fans are now accounted for in stability and control modules and trim.
24. The user can now set the aircraft minimum required yawing-moment-coefficient-due-to-sideslip derivative.
25. Miscellaneous lift and moment contributions can now be accounted for in trim modules.

Dynamics

1. Outputs of dynamics module now change depending on which dynamic modes are present.
2. The user interface of the dynamics module has been streamlined.
3. Differential canards can now be modeled in the dynamics modules.
4. Drag rudders can now be modeled in the dynamics modules.
5. Flight attendant cost is added to direct operating costs.
6. Crew cost only shows cost of crew that are present.

General

1. Wings can now be tilted to allow for VTOL configurations. The geometry, center of gravity and moments of inertia are updated when wings are tilted.
2. The help section of modules and descriptions of variables has been greatly expanded.
3. Typical Windows shortcuts for saving, printing, etc. now work in AAA.
4. Copy and paste macros now work in table cells. Full tables can be copied from a source such as Excel.
5. The configuration menu has been streamlined and divided in multiple modules.
6. New warnings have been put in place throughout all modules to warn the user of things to be aware of in their configuration. Where practical, the user is prevented from choosing conflicting settings.
7. AAA can now detect and repair corrupted files. Temporary files now get deleted upon exiting AAA as opposed to upon opening.
8. AAA gives a warning if a user attempts to open a AAA file that is open on another computer on the same network.
9. Files from AAA 5.0 can be exported to AAA 4.0.
10. Several variables have been made either flight dependent or independent by default. These include but are not limited to the empty weight center of gravity locations of components that have been made flight condition dependent to allow for landing gear retraction or moving components in VTOL configurations.

11. Aircraft can now be modeled without fuselage, to allow for flying wing configurations.
12. Twin vertical tails can now be installed on twin tailbooms.
13. If there is more than one type of longitudinal or directional control surface, the user can choose which one is used for trim.
14. Drag rudders can now be selected for lateral trim.
15. User can now define the feedback control system.
16. The user can choose between Class I or Class II weight in the flight condition dialog. Variables that are dependent on this include a subscript showing which class is in use.
17. Laminar and turbulent coefficients of friction, laminar and turbulent boundary layer thickness and reference length are now added to the atmosphere module. Reynolds number gets calculated in the atmosphere module.
18. Plot colors have been improved for legibility.
19. Aileron deflections are now separated between left and right surfaces.
20. Miscellaneous weight items, lift, drag and moment can now be enabled or disabled in the project settings.
21. Weight, center of gravity and inertia tables can now be copied to other flight conditions