



## What's New in AAA?

Version 3.3

**February 2011**

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AAA 3.3 contains various enhancements and revisions to version 3.2 as well as bug fixes. This version has 287,000 lines of code and 4,800 unique input/output variables.

Section 1 shows the enhancements and modifications made to AAA. Major enhancements include new modules and calculations. The second section contains bug fixes.

The AAA Manual describes the installation procedure and all modules. The manual is available in pdf format on the installation CD.

# 1. Enhancements and Modifications

Differences between AAA 3.2 and AAA 3.3 are:

1. Addition of Wind Tunnel module to correct drag data from wind tunnel scale to full scale.
2. Wind Tunnel drag curves can be defined for different control surface deflections and those drag polars can be used in the different trim modules. Linear interpolation for control deflection is used to calculate the drag.
3. More GOTO buttons have been added to variables.
4. More feedback to the user when a problem occurs at startup of AAA.
5. Help expanded.
6. More interim variables are shown in the output.
7. L/D from Weights has been moved from Class I Drag to Weight Sizing.
8.  $\bar{C}_{m0_{py}}$  has been added to the  $C_{m0} >$  zero-lift module under Moment module in Aerodynamics.
9.  $C_{L_{py\alpha}}$  can now be locked in the pylon lift table and the output uses this locked parameter to calculate  $C_{L_{\alpha_{py}}}$ .
10. Plotting  $C_{L_{cv}}$  and  $C_{m_{cv}}$  as a function of  $\delta_{cv}$  has been implemented.
11. Untrimmed Drag Trendline option has been added to the Recalculate Dialog window.
12. Trim Diagram uses wing stall angles of attack.
13. Wing Incidence is shown in the legend of the trim diagram.
14. A Material Factor field has been implemented in Class II Structures Weights to account for composite construction for all structural components.
15. V-n Diagram module updated to include more outputs of the intermediate calculations. This includes: density and gravity, Airplane Mass Ratio:  $\mu_g$ , Gust Alleviation Factor:  $K_g$ , Interpolated Multiplying Factors used for calculating  $V_{C_{eas_{min}}}$  &  $V_{D_{eas_{min}}}$ :  $K_C$  &  $K_D$  respectively, and Gust Speeds & Gust Slope Values:  $U_{dev}$  &  $\left(\frac{\partial n}{\partial V}\right)_V$  respectively.
16. V-n Diagrams show all the load values from the gust corner points as outputs.
17. V-n Diagram for flaps deflected flight conditions has been created and displays the Design Equivalent Flap Speed,  $V_{F_{eas}}$ .
18. Both the V-n Diagram module and plotting of the V-n Diagram have been added to the Recalculate All window.

19. When loading files from previous versions, AAA now performs a check for certain variables within the V-n Diagram module that are marked Flight Condition Independent and informs the user if AAA believes those certain variables should be switched from Flight Condition Independent to Flight Condition Dependent.
20. Unnecessary output variables have been removed from the FAR 25 V-n Module.
21. A wing structure factor has been added to allow the user to define how much wing structure is in the fuselage to take into account the weight of the structure inside the fuselage.
22. A horizontal tail structure factor has been added to allow the user to define how much tail structure is in the fuselage to take into account the weight of the structure inside the fuselage.
23. A vertical tail structure factor has been added to allow the user to define how much tail structure is in the fuselage to take into account the weight of the structure inside the fuselage.
24. A V-tail structure factor has been added to allow the user to define how much tail structure is in the fuselage to take into account the weight of the structure inside the fuselage.
25. A canard structure factor has been added to allow the user to define how much canard structure is in the fuselage to take into account the weight of the structure inside the fuselage.
26. AAA now recognizes independent sets of geometry for elevons and ailerons on flying wing configurations.
27. The input values for the Thrust/Power versus speed plot are now shown as points on the curves.
28. The pylon and nacelle drag coefficients and friction coefficients are calculated separately and shown as output parameters.
29. The Fwd-Aft C.G. Plot now displays the location of the empty weight C.G. and the current C.G. It shows the most forward and most aft  $X_{cg}$  locations are shown in the legend.
30. FAR23 Velocity-load (V-n) Diagram has been revamped to reflect current FAR23 methods, as opposed to the simplified methods of Roskam Airplane Design Part V.
31. Total C.G. now plots a sideview of the airplane with all variable c.g. components.
32. The Flying Qualities Tab in the Flight Condition dialog window now shows all the flight phases together.
33. There is now a module that calculates the manifold pressure.

34. The user can now define the maximum deflection angle of the left and right ailerons individually.
35. The load factor for a certain flight condition is displayed in the flight condition dialog box.
36. The lift curve slope at  $M = 0.6$  is now calculated for flights in transonic flow.
37. Propeller data can be input separately for multiple propellers. The power effects module is completely updated.
38. The discrepancy in Figure 8.15 in *Airplane Design: Part VI* by Dr. Jan Roskam and DATCOM methods has been resolved and the factor of 1.05 is included in the calculation of the correction factor for plain flap lift.
39. The forward and aft ends of bodies in the 3-view are now closed with lines that connect the upper and lower surfaces in the top and side views.
40. The three-view displays only the geometry that is defined in AAA.
41.  $C_{y_{vee\beta}}$  is included in the lift module for V-tail configurations
42. The maximum change in lift coefficient is calculated in the power effects module.
43. Slat Geometry is now implemented in the Geometry module
44. The zero-lift pitching moment coefficient with no empennage and flap effects accounts for nacelles and pylons.
45. AeroPack Geometry is now combined with regular geometry input.
46. Time delay transfer function module is added to Dynamics > Control.
47. Primary trim surface is now flight condition dependent and shown as a selection in the flight condition dialog window.
48.  $T_{avail}$  or  $P_{avail}$  is shown as an output in the Thrust/Power-Speed module for the current flight condition.
49. Database variable names can now be shown in the work pad window by selecting them in the Setup Options Dialog.
50. Power Effects now accounts for the change in the maximum wing lift due to power effects.
51. Trim Diagrams show load factor as an input parameter and the design point calculated also accounts for the load factor.
52. Trimmed Lift (T from D) module works for a V-tail configuration.
53. Trimmed Lift (T from D) and Trimmed Lift (T = Const) modules work for three-surface configurations.
54. Performance > Analysis > Climb > Climb Performance and Time to Climb now show propeller efficiency as an input.

55. Trim Diagrams now show two buttons to plot canard/canardvator deflection lines and regular control surface deflection lines for three-surface configurations.
56. Fuselage section curves are linearly interpolated between the fuselage sections.
57. Maneuvering Flight Type parameter is shown as in input in Long. Trim and Lat-Dir Trim modules.
58. Drag Polar selection for Performance > Analysis > Cruise > Maximum Speed, Trimmed Lift (T from D), Trim Diagram and Long. Trim modules are now flight condition dependent and shown in the Flight Condition dialog window.
59. Export option can now be organized by specifying flight conditions as rows or columns in Setup > Options menu.
60. Updated Cost Escalation Factor CEF in the Cost module. Update includes inflation up to December 2010 based on Consumer Price Index.

## 2. Problem Fixes

This section lists problems found in AAA 3.2 and earlier versions which are fixed in AAA 3.3.

### 2.1 Weight

1. User cannot go into the Weight Iteration module if vertical tail is defined and horizontal tail is not defined.
2. The results of Class II air/press/icing weight estimation show GD method in air/press/icing module but not in Weight Iteration module.
3. The results of the USAF methods for Armament and Weapons Provisions do not show up in weight iteration table.
4. Tailboom Gear Attachment Factor help file says that the user should select either 0 for unattached gear or 0.7 for attached gear. However, when the suggested value is selected from the help menu the values are 1.0 and 1.7 respectively.
5. The Class I empennage weight is not split correctly when taken into Class II Weight Iteration if multiple vertical tails are defined.
6. Main landing gear weight according to the Cessna method is now shown as an output for the G.A. category.
7.  $N_{pax}$  and  $N_{crew}$  are shown as inputs for UAV's in the Instr/Avionics/Electronics Weight module and the output is calculated as zero.

### 2.2 Aerodynamics

1. When exporting the input and output values to spreadsheet from Aerodynamics>Lift>Airplane> $C_L-\alpha$ , a "File I/O" error occurs and prevents any spreadsheet from being created. Text file format is functional, however, spreadsheet is not. This is the only module in AAA which has this problem.
2. The "go to" button in the  $C_{L_{max}}$  module references the correct  $c_{l_{max}}$  module for all lifting surfaces
3. For single vertical and horizontal tail configurations  $C_{y_{v\beta}}$  is calculated using the Z location of the vertical tail apex if the vertical tail is not attached to the fuselage.
4. The Trimmed Lift module now iterates with the Ground Effects module.
5. Fuselage zero lift pitching moment uses angles in degrees instead of radians.

## 2.3 Performance

1. Performance Analysis > Cruise > Maximum Speed module does not work if the available thrust/power curve has a negative slope at maximum speed.

## 2.4 Geometry

1. If airfoils are defined and saved and then the airfoil folder location is changed, AAA crashes.
2. If airfoil folder path is incorrect, AAA still creates an empty directory in that path location.
3. Landing Gear if defined and saved as zero gives an error when you click on the Landing Gear module in Geometry.
4. If HT apex is aft of fuselage vertex,  $h_{fh}$ , doesn't equal zero.
5. The area of the V-Tail is being calculated to aircraft center line regardless of where the root section is located in space.
6. The Y-axis is flipped around in the aircraft 3 view plot. Rather than pointing starboard it is pointing to port.
7. The V-tail is not plotted correctly in the airplane 3-view.
8. AAA does not allow for negative coordinates for fuselage center line in the region of the wing and HT.
9. If wing is not defined, an error message will not show up if the user clicks on Airplane under the Geometry module.
10. If vertical tail geometry is located behind the fuselage, AAA now correctly calculates  $h_{fv}$  and  $w_{fv}$  to be zero.
11. If the vertical tail is outside the fuselage, the height of the fuselage in the region of the vertical tail is set to zero.
12. The three-view of the aircraft can update with changes in the geometry.
13. If only AeroPack and Volume Coefficient inputs are complete and Geometry > Airplane is selected, the program gives a floating point error.
14. Twin prop configurations show only starboard side propeller in Geometry > Airplane
15. Geometry > Airplane module displays the wing twist for multiple panels incorrectly.
16. AAA crashes is Geometry > Airplane is selected without defining the fuselage.
17. Geometry > Airplane module assumes that the cross sections of bodies like nacelles, fuselage, tailbooms and stores are always symmetric about the centerline.
18.  $Z_{fc_w}$ ,  $Z_{fc_h}$ ,  $Z_{fc_c}$ ,  $Z_{fc_v}$  and  $Z_{fc_{vee}}$  are incorrectly calculated in the Airplane Coordinate System in the Fuselage Geometry module.

19. Some of the cross sectional areas are calculated as negative numbers for certain cases in the Airplane Coordinate System in the Fuselage Geometry module.
20. Lateral Tip-Over angle is not calculated if nose gear or tail gear is defined as the last gear in the table.

## 2.5 Propulsion

No Changes

## 2.6 Stability and Control

1. Trimmed Lift (T from D) message for a 3-surface configuration is incorrect.
2.  $C_{mT_1}$  is incorrectly calculated for a Ducted Fan configuration.
3. A fuselage base area of zero will yield a floating point divide by zero error when calculating  $C_{m_q}$ .
4. The  $\frac{c_{l\delta}}{c_{l\delta-theory}}$  values are more accurate at higher Mach numbers
5. Warning about nacelles removed from the pitch rate modules, as these modules do not use nacelle parameters when they are not selected.
6. Module for calculating airplane pitching-moment-coefficient-due-to-speed derivative,  $C_{m_u}$ , no longer shows the output as new values after pressing Calculate unless the values have actually changed.
7. For a propeller airplane with power effects ON, the Trimmed Lift (T = Const) module does not iterate with  $\alpha$ .
8. Aileron Force and Rudder Force use incorrect interconnect spring constants.
9. Rudder Force module does not account for twin vertical tails.
10.  $X_{ac_v}$  and  $Z_{ac_v}$  are not calculated in  $C_{y_r}, C_{l_r}, C_{n_r}, C_{y_p}, C_{l_p}, C_{n_p}, C_{y\dot{\beta}}, C_{l\dot{\beta}}, C_{n\dot{\beta}}$  modules if only all the input parameters in these modules are filled out for a new file.

## 2.7 Dynamics

1. Positive and negative aileron deflection angles give different results in the Roll Performance module.

## 2.8 Loads

1. The stall line in the V-n diagram is not determined from current weight.
2. For commuter and FAR25 aircraft,  $n_g$  should be determined from the intersection of  $V_c$  and  $C_{N_{\max}}$  gust lines rather than the  $V_B$  gust line.
3. If  $V_A > V_C$ , then the V-n Diagram module would say, "It is impossible to calculate the design maneuvering speed ....  $V_A$  need not exceed  $V_C$ ." And  $V_A$  would not calculate. This has been changed to just say, " $V_A$  need not exceed  $V_C$ .  $V_A$  is set equal to  $V_C$ ."
4. The Multiplying Factors used for calculating  $V_{C_{\text{eas}_{\min}}}$  &  $V_{D_{\text{eas}_{\min}}}$  :  $K_C$  &  $K_D$  respectively, are now interpolated to correspond with the analyzed aircraft's wing loading for all airplane categories.
5. The V-n diagram now shows a warning message if the user defines the  $C_{L_{\max(-)}}$  as a positive number, and can not graph the diagram until the change is made.
6. The V-n diagram  $C_{N_{\max(+)}}$  stall curve was being plotted over a range of values:  $[0, n(V_A)]$  whereas it needed to, and now plots to across the following domain of values:  $[0, V(n_{\text{lim}})]$ .

## 2.9 Structures

No Changes

## 2.10 Cost

No Changes

## 2.11 General

1. Define a file without nacelles. Create multiple flight conditions. Save file. Add nacelles. Switching flight conditions will either give an error message or data from only one flight condition for the nacelles is shown. Flight condition dependent data for nacelles is not stored, only data for the current flight condition.
2. Define a file without pylons. Create multiple flight conditions. Save file. Add pylons. Switching flight conditions will either give an error message or data from only one flight condition for pylons is shown. Flight condition dependent data for pylons is not stored, only current flight condition. For commuter and FAR25 aircraft,  $n_g$  should be determined from the intersection of  $V_c$  and  $C_{N_{\max}}$  gust lines rather than the  $V_B$  gust line.

3. If AeroPack fuselage is not defined and the “airplane” or “empty cg plot” is accidentally clicked an error occurred.
4. Nacelle, pylons, tail booms and float input parameters are removed when the number of nacelles, pylons, tail booms, or floats has been lowered.
5. Flight condition dependant parameters are cleared from nacelle and pylon  $C_{L_0}$  tables if a new flight condition is created without copying from another flight condition.