

Announcing the Release of PRODAS Version 3.6.6

I am pleased to announce the release of PRODAS Version 3.6.6. Besides the customary small improvements (i.e. Bug fixes) this release adds exciting new capabilities. We have taken our world class 6DOF and extended it to make it perfect for Trade Studies and basic System Simulation analysis.

For example, let's say you need to check four muzzle velocities at 10 quadrant elevations. All perfectly doable with the current PRODAS, but now you can do it with a single click of the mouse. In addition, you can input system error estimates and assess dispersion or impact CEP. Spend a little time with the new white paper "6DOF Trade Studies" (search help for "Trade Studies" in PRODAS Version 3.6.6 or find it on our website) and you will be amazed at this added capability.

And lastly, but certainly not least, this is the first release of PRODAS that fully supports the **WINDOWS 8** operating system.

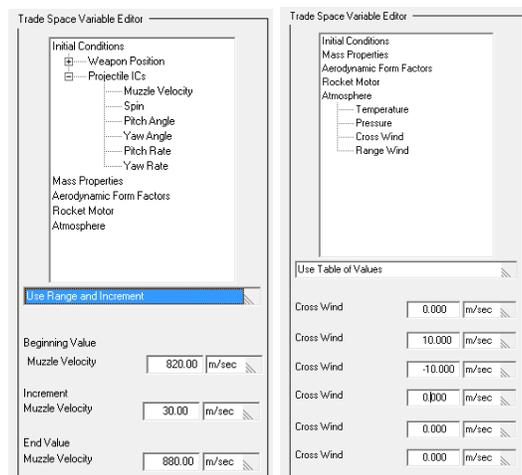
Have a great spring,

Mark Steinhoff
VP Software Products
Arrow Tech Associates

6DOF to Include Trade Studies

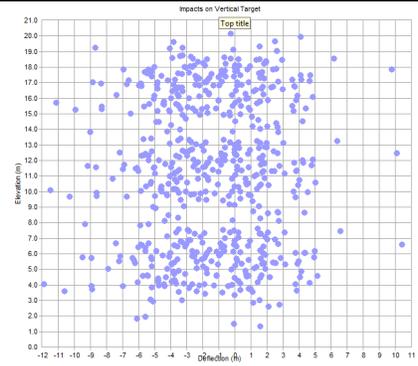
Without changing the way single trajectories have been run in the past, you now have the option to create scenarios with variations to any of the trajectory inputs, apply an error budget if desired and run up to 10,000 trajectory simulations with a single click of the Execute Button. This capability is great for trade studies to help refine a new design or to develop safety fans in preparation for testing or for any other case where multiple runs are required. This supplements other capabilities in PRODAS that help users complete multiple runs efficiently.

There are three new input tabs on the new 6DOF that implement the trade study feature. The first is for development of trade study scenarios. It includes an editor where the user inputs the values for each parameter to be evaluated. A scenario generator then generates a table of inputs to be passed to the 6DOF simulation. This table can be edited by the user allowing even more flexibility. The second tab is used to input an error budget. An editor is used to enter one standard deviation errors for the inputs. The number of rounds to be simulated is entered and the Error Generator generates a set of errors that are also passed to the 6 DOF simulation. The same errors are run for each scenario. The last tab contains the



output of the trade study in a tabular, plotted and formatted form. A White Paper (available at www.PRODAS.com web site) provides a full description and example. A huge advantage of PRODAS is the efficient algorithm. The plot shown is 600 .50 cal trajectories run at 3 muzzle velocities with a typical error budget. This ran in 45 seconds after spending just a few minutes to set up the inputs.

Maintenance customers will see a new module in Version 3.6.6 called 6DOF with Trade Studies. The old 6DOF is still there too. In the next release we'll be eliminating the old 6DOF as all its capability is included in the new module.



Internal Point Mass - Free Body Dynamics

Another new feature of the 6DOF trajectory is the ability to simulate projectiles containing moveable internal components. Projectiles containing movable internal components, when compared with rigid but otherwise equivalent projectiles, have been observed to have different damping rates, range losses and rapid spin downs. This theory was originally developed and validated by Dr. Murphy of ARL (formerly BRL) in the mid 50's regarding fuzing mechanisms. The projectile flight behavior resulting from an internal mass free body dynamics has been observed on numerous experiments covering all calibers. The theory has since been employed in 6DOF simulation and experimentation. This capability is now included in the **PRODAS 6DOF Fixed Plane** Trajectory module.

Further technical information can be found in these references:

- “Influence of Moving Internal Parts on Angular Motion of Spinning Projectiles”, C.H. Murphy, Journal of Guidance and Control, March-April 1978. (Also AIAA Paper 77-1138)
- “Analysis of Aeroballistic Range Data of 20mm Projectiles With A Moving Internal Component”, Hathaway, W., Cobb, K., Whyte, R., and Pierro, R., Fourth International Symposium on Ballistics, Monterey, California, October 1978.

BALANS Upgrade

Several enhancements have been added to Arrow Tech's in-bore balloting code. First, a general upgrade to the user interface including a new geometry error checking capability. Second, there are two significant upgrades to the statistical BALANS analysis.

General User Interface Upgrade

Inputs have been reorganized to make things easier to find and to better follow the model development process.

A Geometry Check tab has been added that helps users get all the inputs correct. The tab outlines all the “rules” in both graphic and equation format. It includes an error check application that performs various checks and gives clear feedback to the user where problems exist. This helps make sure that the inputs meet the requirements for the BALANS analysis to execute properly and to produce meaningful results. Historically, it's been difficult for the occasional BALANS user to get all of this correct. We hope this tool will make it easier and we look forward to your feedback.

BALANS Tutorial_Finish - In-Bore Balloting Analysis

Formatted Results | Tabular Results | Plotted Results

Analysis Setup | Model Generation | Nodes/Springs | Elements/Materials | Bore Straightness Defn | Bore Diameter Defn | Forcing Function | Initial Conditions | Geometry Check

A – Barrel Length as determined by position of last node
B – Distance to Obturator
C – Travel as determined by last value in Forcing Function Table
D – Distance to Station 1 on Bore Straightness Definition Tab
E – Difference between “last” and “Station 1 Ref Node” Axial locations in Straightness Table
F – Bore Diameter Profile Reference to Origin
G – Length of Bore Diameter Profile as determined by last Axial Location in Bore Profile table
H – Location of aft Projectile Spring as determined by Dist to Obturator and spring node positions

RULES
 $B + C \geq A$
 $D + E \geq A$
 $B \geq D$
 $F + G \geq A$
 $B > F$
 $H \geq D$
 $H \geq F$

Geometry Check Data

Units	Start	End	OK?
	mm	mm	
Red=Lock			
Barrel Length	0.0000	0.0000	<input type="checkbox"/>
Forcing Function	0.0000	0.0000	<input type="checkbox"/>
Aft Spring Travel	0.0000	0.0000	<input type="checkbox"/>
Bore Straightness Profile	0.0000	0.0000	<input type="checkbox"/>
Bore Diameter Profile	0.0000	0.0000	<input type="checkbox"/>

Zeros with a check for Aft Spring Travel indicate that there is no spring aft of the Obturator.
Zeros with a check for Bore Dia. Profile indicate that a constant bore diameter has been specified.

Run Geometry Check

Variable Forcing Function

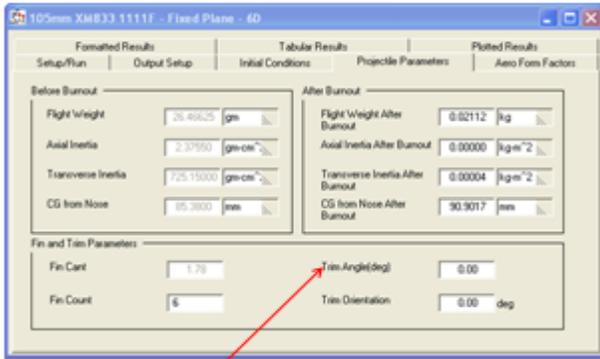
A random draw of the pressure-time forcing function has been implemented to address the real-world problem of barrel-projectile interactions arising from shot-to-shot changes in the pressure, muzzle velocity, and resulting in-bore travel time variability that is seen with all ammunition. The BALANS user now has the capability to enter forcing function data representing plus and minus one, two and three standard deviations. For each trial, BALANS uses a random draw of standard deviation to interpolate between these inputs. In our experience, this has been an important addition to BALANS in order to more accurately simulate the real-world excitation of the small caliber gun/projectile systems.

More Options to Describe Initial In-Bore Orientation

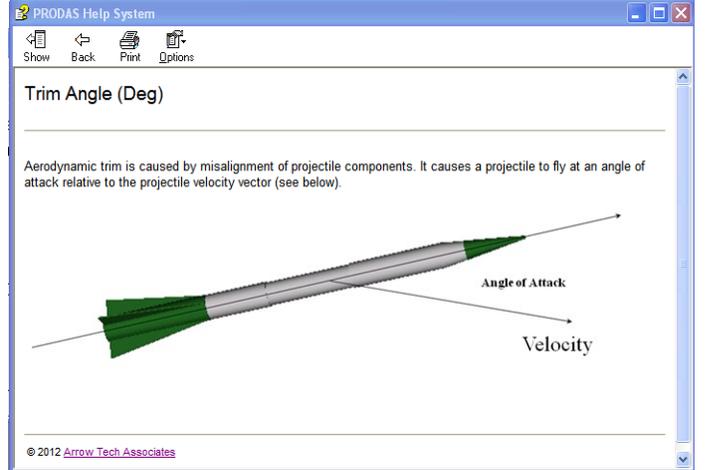
For systems where the projectiles are not rigidly attached to cartridge cases, the BALANS user now has the capability to describe the initial angular orientation using statistical inputs. All projectiles have some initial angle with the barrel as a result of clearances of case with chamber or for large caliber systems bourrelet clearances and gravity. BALANS now allows the initial orientation to be described with a normal distribution with a mean angle and standard deviation as inputs or as a uniform distribution with the minimum and maximum angle as inputs. These options allow a more accurate description of initial conditions for various families of projectiles. For instance gravity has little effect on initial angle orientation of small caliber rounds while it is a significant factor in large caliber systems. The result is the potential for better dispersion estimates.

Expanded PRODAS Help

In the last release we added new on screen help. You can click on any caption, press the “F1” key and have help for that data item appear on screen. We’ve expanded this feature so that nearly every item on the PRODAS screens has this instant help available. If you haven’t tried it yet – check it out.



Click on caption,
press F1



CASAS Users Get the Heat

The Baer-Frankle Interior Ballistics module now includes an algorithm to approximate the inside cartridge case surface temperature (vs. time). Previously, the Baer-Frankle algorithm could be used to generate the pressure forcing function but the CASAS user would have to use a different source for the temperature forcing function. The combination of the Baer-Frankle algorithm and the CASAS software provides a unique capability to generate both forcing functions for input to the Case-Chamber Analysis all self-contained within PRODAS.

Arrow Tech has a new Address

We made a big move across the hall! Please note our new mailing address. Only the Suite number changed.

Arrow Tech Associates, Inc.
1233 Shelburne Road; Suite D-7
So. Burlington, VT 05403

How can I get PRODAS V3.6.6 now?

Current PRODAS maintenance customers can go to our support site and download!

If you would like to purchase PRODAS please contact John Whyte (jwhyte@prodas.com).

My Product Support has expired, how can I bring it up to date?

PRODAS product support is paid on an annual basis and covers all PRODAS Software on a per site basis. Per our published PRODAS Maintenance Agreement product support can be re-instated if there has been a lapse in coverage with defined penalties. To access the Maintenance Agreement terms click on the following link: [Maintenance Agreement](#)

For a quote to reinstate your product support please contact John Whyte (jwhyte@prodas.com).

To remove your name from our mailing list, please [click here](#)

Questions, comments or to request the latest pricing information please email us at: info@prodas.com or call 802-865-3460

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