PRODAS Newsletter

ARROW TECH

If You Can't Get a Bigger Target

Summer 2007

The Latest News from Arrow Tech

Here it is. The long promised PRODAS newsletter. We have tried to keep it short and interesting, a mix of product announcements and technical information. And we are going to try to publish it quarterly. As always if you have received this by mistake, we apologize and there is a link at the bottom of this letter to opt-out.

So what's in this edition?

- ***New Product 1*** – MISL3 aerodynamic estimator from Nielson Engineering
- ***New Product 2*** – Rocket Motor Design Tool from Talley Engineering
- ***Upgraded Product*** – Projectile Tracing Tool
- ***New Program*** – Web based PRODAS Product Support
- ***Technical Hints*** – Using Macros for System Simulation

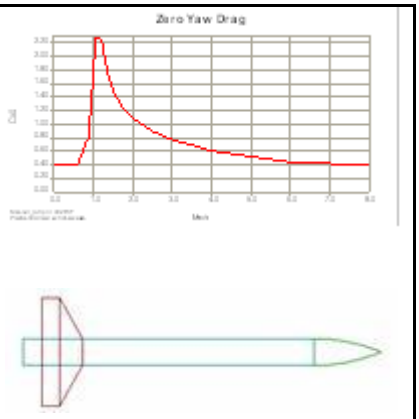
Thanks for taking a look,

Mark Steinhoff
Arrow Tech Associates

MISL3 Aero Prediction Code

This new module was developed in conjunction with ***Nielsen Engineering & Research, Inc***. MISL3 predicts missile aerodynamics for analysis and design. It efficiently predicts longitudinal and lateral aerodynamic characteristics and is essential for generating aerodynamic databases for flight simulations. The software is capable of modeling axi-symmetric bodies with up to three cruciform fin sections and fully deflectable fins. Bodies may have conical changes in body diameter for flares and boat tails. The missile can have up to 3 fin sections with 1,2,3,4 or 8 fins per section. The fin aspect ratio can be between .25 and 10 and a fin taper ratio between 0 and 1. Fins with aspect ratios between 1 and 4 can be deflected (control fins).

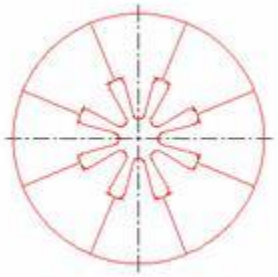
For further information please contact Alan at extension 12 or alan@prodas.com.



ROCKET MOTOR DESIGN TOOL

This new module was developed in conjunction with ***Talley Defense***. Four different grain geometries can be analyzed resulting in Thrust versus Time for Rocket Motors. The grain geometries are STAR, WAGON WHEEL, SLOTTED CYLINDER and SEGMENT. Several input parameters are chosen affecting the resulting grain burn and Rocket Performance.

For further information please contact Jeff at extension 19 or jsiewert@prodas.com



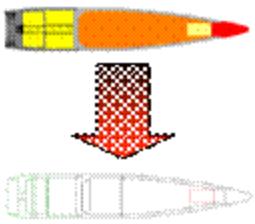
ENHANCED PROJECTILE TRACING TOOL

The projectile tracing tool has undergone a major upgrade to make it one of the best ways yet to build a PRODAS model.

Whether you have a PRO-E model or a JPEG off of the web, the Projectile Tracing Tool can help you quickly build a PRODAS model. Get up and running quickly.

Check out the tutorial found at http://www.prodas.com/XQ/ASP/P.602/QX/webPageXML4.htm.

For further information please contact Mark at extension 18 or mark@prodas.com



PRODAS PRODUCT SUPPORT

Do you currently have Product Support? If so, you are now able to download updates to PRODAS from our web site. These updates include bug fixes, operating system upgrades, performance enhancements and functionality upgrades.

If you don't have Product Support you may wish to get on board and protect your investment in PRODAS V3. Call us today for pricing.

Remember that when you purchase a new copy of the PRODAS Main Analysis Software the first year of product support is free.

For further information please contact John at extension 13 or jwhtye@prodas.com

Universities Using PRODAS V3

PRODAS V3 is currently used by several domestic and foreign Colleges and Universities. Some use the software as part of their course curriculum and some in conjunction with industry research and development projects.

The following Universities have owned and used PRODAS V3;

- West Point
- Johns Hopkins University
- Georgia Institute of Technology
- University of Alabama
- Drexel University
- Cranfield University Defense
- Academy of the UK
- Helmut-Schmidt University-Hamburg
- Korean Military Academy
- Canadian Royal Military Academy
- Institute of St. Louis—France
- Military Institute for Weapons and Ammo Technology-Czech Republic
- Military Institute of Engineering-Brazil
- National University of Singapore

If you are interested in having a University you work with add PRODAS to their curriculum, please contact Lin at extension 11 or lin@prodas.com.

Ask the Experts

Do you have a question about our software products or a specific question concerning bullet design? If so, please submit them to info@prodas.com. We will pick two and answer them in our next newsletter

Technical Hints – Using Macros for System Simulations

Evaluating the effectiveness of a guided projectile has become a very hot topic as of late. At Arrow Tech, we have moved beyond hand waving and have developed techniques that we are very comfortable with when presenting results. Using the PRODAS macro capability, we literally fly thousands of guided trajectories when evaluating a control concept or GNC algorithm. When we say a concept will have a CEP of 15 meters it's not just a guess, but a prediction based on real world physics.

Using PRODAS macros you can:

- Iterate an analysis (Including Guided Trajectory) with multiple sets of initial conditions.
- Test GN&C algorithms against real world IC sets so they aren't "tuned" to a particular situation
- Generate Control Authority plots or calculate CEP for guided projectiles
- Consolidate and analyze results, output into EXCEL compatible files

So how do you get started? First I would study the technical documentation on PRODAS Macros within the HELP system. It is very complete. Then I would experiment with the macro examples that ship with PRODAS. These will give you a basic understanding of how they work.

The following macro code will fly ten trajectories and accumulate the results. Copy it and paste it into notepad then save it as sysExample.PVB in the C:\PROGRAM FILES\PRODASV3\SCRIPTS sub-directory. Then open a projectile file (preferably artillery, if it is protected with a #, "Save As" something else. The M1 works fine) and then select "Edit/Run VB Script" from the PRODAS "Tools" menu. You should see your new macro. Run it. It will attempt to write a results file in the subdirectory C:\TEMP. If you don't have one on your computer, you can either make one or change the macro to put it somewhere else. Good Luck !

```
'=============================================================================================
============
'MACRO written as an example of system sismulation for the July 2007 PRODAS newsletter
'              ARROW TECH ASSOCIATES
'=============================================================================================
============
'=============================================================================================
============
SUB MAIN() 'ALL SCRIPTS MUST HAVE A SUB MAIN
DIM PROJ
dim MV(10),Q(10),R(10),V(10),W(10),AZ(10),EL(10)


'========================== Define Initial Condition Deltas
=====================================
'These were developed using system error and random draws within an EXCEL macro

MV(1)=8.902:Q(1)=-3.766:R(1)=-0.540:V(1)=0.102:W(1)=1.558:AZ(1)=0.401:EL(1)=-0.621:
MV(2)=-3.399:Q(2)=-5.947:R(2)=-5.751:V(2)=-0.165:W(2)=-1.582:AZ(2)=-0.390:EL(2)=0.812:
MV(3)=1.028:Q(3)=-5.867:R(3)=0.467:V(3)=3.319:W(3)=-0.283:AZ(3)=-0.561:EL(3)=0.045:
MV(4)=6.737:Q(4)=-3.495:R(4)=0.651:V(4)=0.075:W(4)=-1.686:AZ(4)=1.115:EL(4)=0.264:
MV(5)=-8.466:Q(5)=6.924:R(5)=10.464:V(5)=0.743:W(5)=-0.878:AZ(5)=0.790:EL(5)=-0.460:
MV(6)=-3.250:Q(6)=8.044:R(6)=-1.175:V(6)=0.396:W(6)=0.573:AZ(6)=0.212:EL(6)=-0.567:
MV(7)=6.044:Q(7)=5.328:R(7)=11.144:V(7)=2.449:W(7)=-0.747:AZ(7)=-0.616:EL(7)=-1.340:
MV(8)=4.160:Q(8)=2.675:R(8)=25.820:V(8)=-2.147:W(8)=1.555:AZ(8)=-0.027:EL(8)=-0.410:
MV(9)=-4.700:Q(9)=5.408:R(9)=-11.884:V(9)=0.164:W(9)=-4.047:AZ(9)=0.545:EL(9)=-0.040:
MV(10)=12.864:Q(10)=1.023:R(10)=-3.643:V(10)=-3.375:W(10)=3.099:AZ(10)=0.795:EL(10)=-
1.134:

'========================== Setup Results file and Write Header
=====================================
'this file can be opened with EXCEL by right clicking on it and choosing "Open With..."
option
```

```
SET RESULTS = MACROSYSTEM.INITIALIZERESULTSFILE
resultsFilename= "C:\TEMP\PRODAS Macro Results.TXT"

RESULTS.OPENFILE  resultsFilename     'SET THE RESULTS PATH
RESULTS.WRITEHEADER

LINEOUT= "I" & chr(9)
LINEOUT= LINEOUT & "Miss Dist"& chr(9)
LINEOUT= LINEOUT & "dx" & chr(9)
LINEOUT= LINEOUT & "dy" & chr(9)
LINEOUT= LINEOUT & "dz" & chr(9)
RESULTS.WRITESTRING LINEOUT

LINEOUT= " " & chr(9)
LINEOUT= LINEOUT & "m"& chr(9)
LINEOUT= LINEOUT & "m" & chr(9)
LINEOUT= LINEOUT & "m" & chr(9)
LINEOUT= LINEOUT & "m" & chr(9)
RESULTS.WRITESTRING LINEOUT

'========================== Attach to the open projectile
=======================================

set proj=MacroSystem.AttachCurrentProjectile

if proj is nothing then
      msgbox "Open a projectile first"
      exit sub
end if


PROJ.FORCEUNLOCKPROJECTILE  'MAKE SURE IT IS READY TO BE CHANGED

'============================== MAIN LOOP
=========================================================

FOR I = 0 TO 10


'=========First run is nominal, other runs are compared to
it==================================
```

```
        if I=0 then 'fire nominal
                deltaAZ = 0
                deltaEL = 0
                deltaMV = 0
                deltaIP = 0
                deltaIY = 0
        else
                deltaAZ = AZ(I)/1000.0 'was in millirad
                deltaEL = EL(I)/1000.0
                deltaMV = MV(I)
                deltaIP = Q(I)
                deltaIY = R(I)
        end if


'============================== SET INPUT PARAMETERS
==========================================

        PROJ.SETDATAPOINTVALUE "Airplane","useAirplane", false
        PROJ.SETDATAPOINTVALUE "TRAJECTORY","RangeFinal", 100000 'make sure it flys to the
gound
        PROJ.SETDATAPOINTVALUE "Trajectory","TimeFinal", 300

        PROJ.SETDATAPOINTVALUE "TRAJECTORY","AZIMUTH", 0.0 + deltaAZ
        PROJ.SETDATAPOINTVALUE "TRAJECTORY","MUZZLEVELOCITY", 800 + deltaMV
        PROJ.SETDATAPOINTVALUE "TRAJECTORY","QE", 1.006 + deltaEL
        PROJ.SETDATAPOINTVALUE "TRAJECTORY","INITIALPITCHRATE", 0 + deltaIP
        PROJ.SETDATAPOINTVALUE "TRAJECTORY","INITIALYAWRATE", 0 + deltaIY


 '============================== RUN THE ANALYSIS
================================================

        PROJ.EXECUTEANALYSIS "TRAJ20006D"                              'RUN A 6DOF
TRAJECTORY

 '============================== Output to a cross Plot
========================================

        legendText="Run " & I          'set up a legend
        proj.DataTableToCrossPlot "Trajectory", "TrajResultsData", legendText

 '============================== Query the Output Table
```

```
=======================================

       set dataOutTbl2 = proj.openDataTable("Trajectory","TrajResultsData")

       dx=dataOutTbl2.cellValue(dataOutTbl2.rows,2)
       dy=dataOutTbl2.cellValue(dataOutTbl2.rows,3)
       dz=dataOutTbl2.cellValue(dataOutTbl2.rows,4)
       set dataOutTbl2 = nothing

       if i=0 then
              idx=dx
              idy=dy
              idz=dz
              minR=0
       else
              minR= sqr((dX-idx)^2+(dY-idy)^2+(dZ-idz)^2)
       end if

 '============================== Write it out to the results
file================================
       LINEOUT= I & chr(9)
       LINEOUT= LINEOUT & minR & chr(9)
       LINEOUT= LINEOUT & dx & chr(9)
       LINEOUT= LINEOUT & dy & chr(9)
       LINEOUT= LINEOUT & dz
      RESULTS.WRITESTRING LINEOUT

NEXT

 '============================== close the file ================================
RESULTS.CLOSEFILE         'CLOSE THE RESULTS FILE
SET RESULTS = NOTHING

END SUB
```

We would be happy to talk about your requirements and help you figure out how the PRODAS analysis system can deliver the results you need.

For further information please contact Mark at extension 18 or mark@prodas.com

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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