

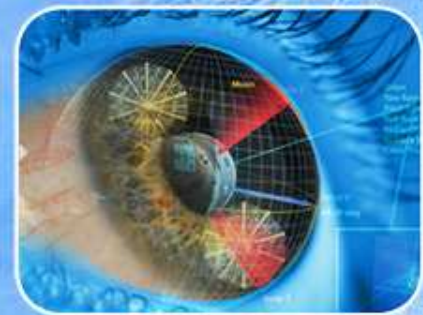
OCTOBER 7-9, 2008 • CHICAGO

TOTAL ACCESS

Ballistic Missile Defense Intercept Debris Analysis

Matt Feldmeier
Dynetics, Inc.

 **agi** 20 USERS'
08 CONFERENCE



Company Overview – Dynetics, Inc.

- Founded 1974 in Huntsville, AL
- Employee-owned large business (1,007 employees)
- Recently winner of one of the five best places to work in Madison County, AL (250+ employees)

Program/Project Overview

- Missile Defense Agency – Target and Countermeasure Programs
 - Provide targets for flight tests for various Ballistic Missile Defense System Elements (THAAD, AEGIS, GMD, etc.)
 - Must integrate into a complex scenario of sensors, interceptors, targets, and missile ranges
 - Provide a reliable and safe scenario while meeting all mission objectives from multiple parties (interceptors, sensors, range safety)

Challenges

- Must provide a target scene that meets all BMDS test objectives while complying with all range safety restrictions
- Provide mission planners and managers geospatial understanding of the intercept scenario and parameter's effects on range safety
- Head off potential issues related to intercept debris footprints as early as possible in the mission planning stages

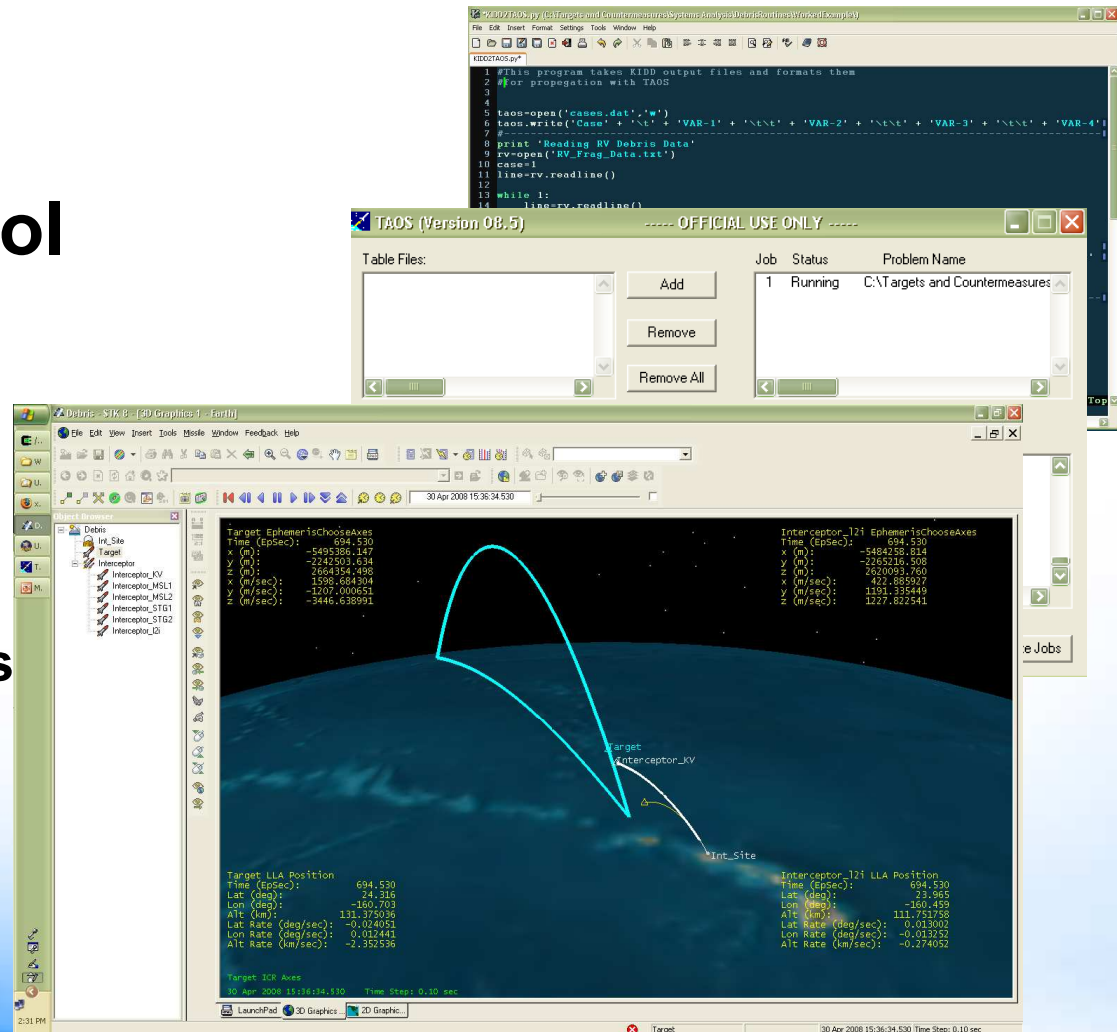
Solution



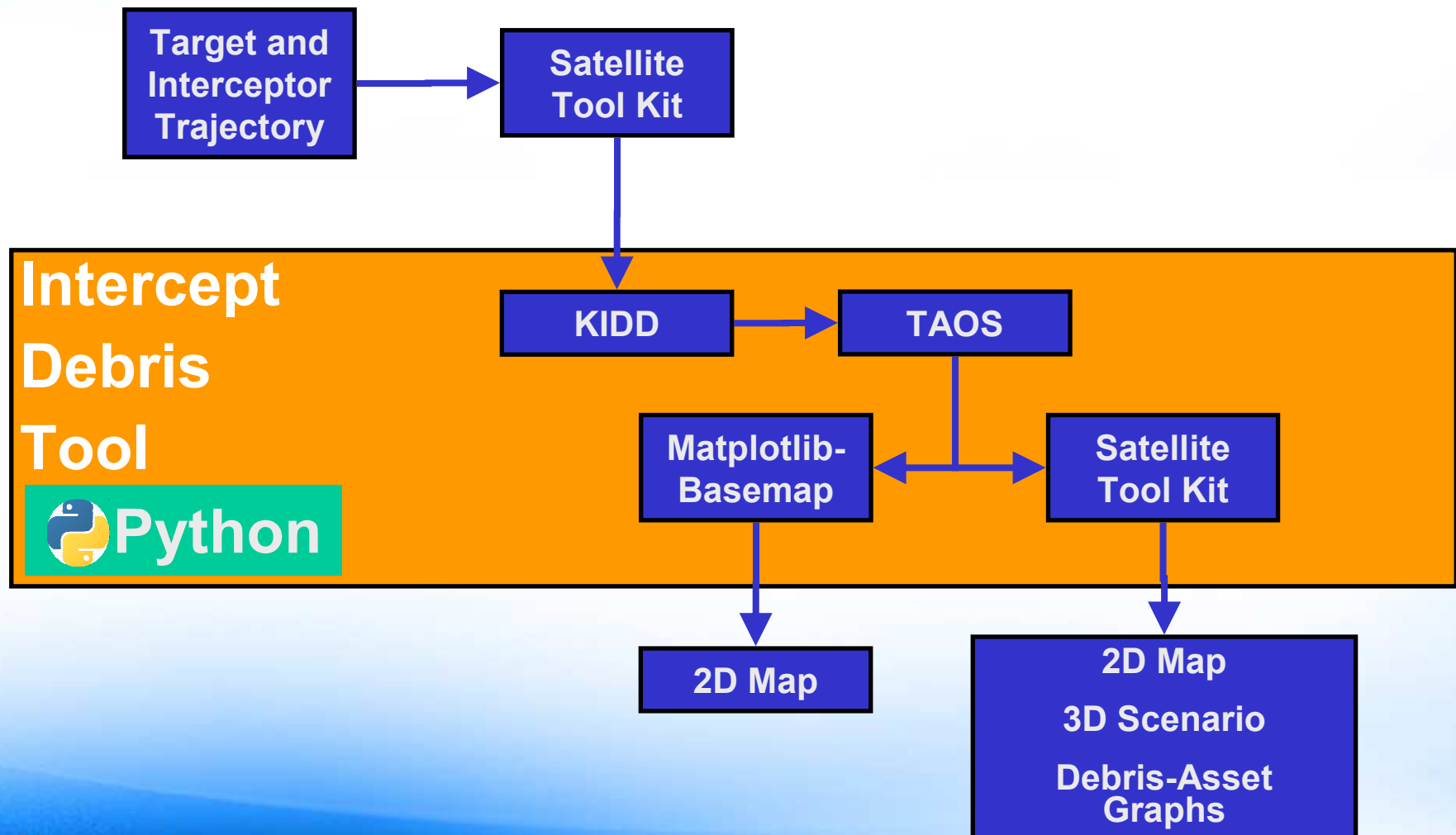
Lockheed Martin Ballistic Missile Intercept Debris Tool

Pulls together

- Satellite Tool Kit
- KIDD (Kinetic Impact Debris Distribution)
- TAOS (Trajectory Analysis Optimization Software)



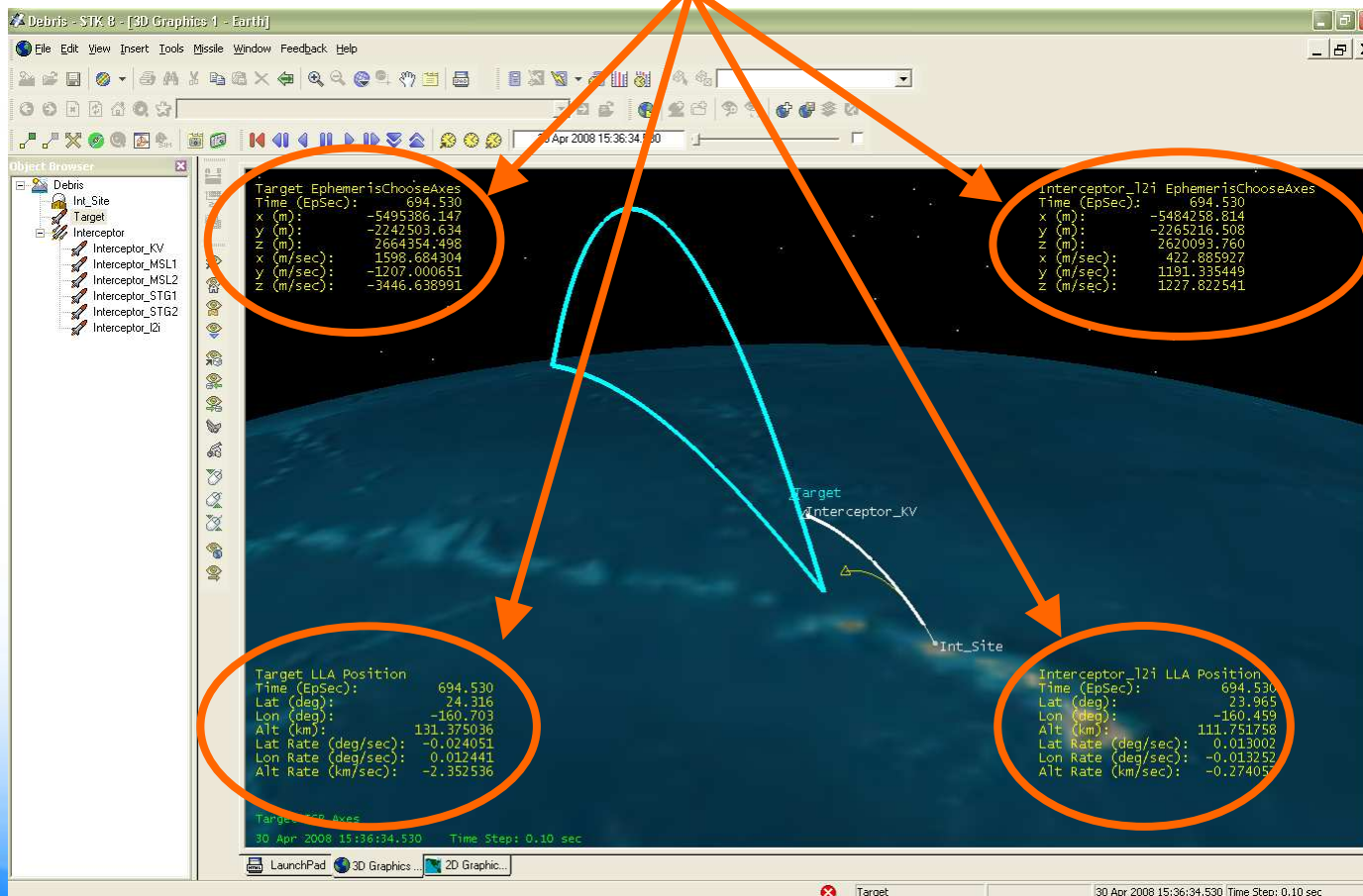
Solution – Block Diagram



Solution – Flow

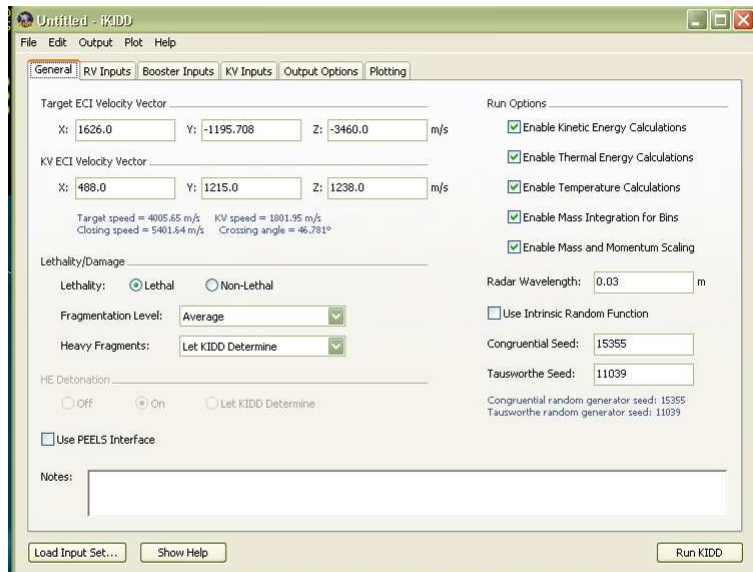


Extract Position Velocity Vectors from STK

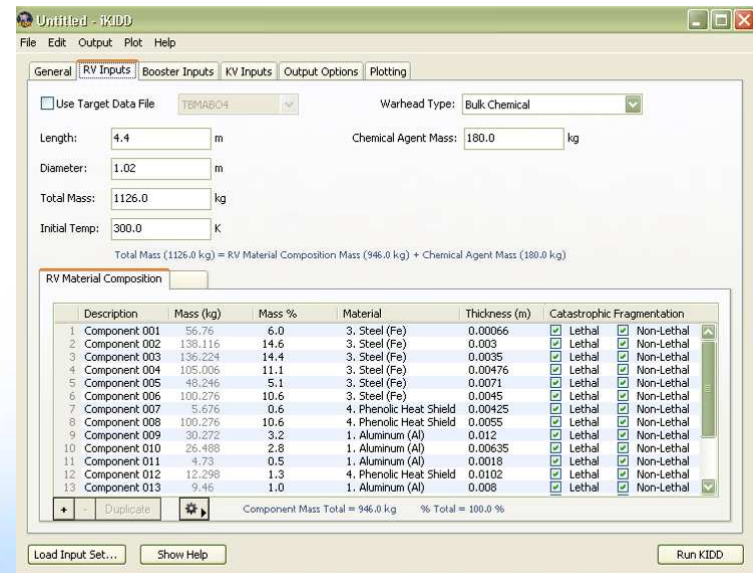
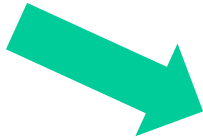


Solution – Flow

Insert ECI Velocities to KIDD



KIDD outputs debris mass, velocity, ballistic coefficient



Solution – Flow

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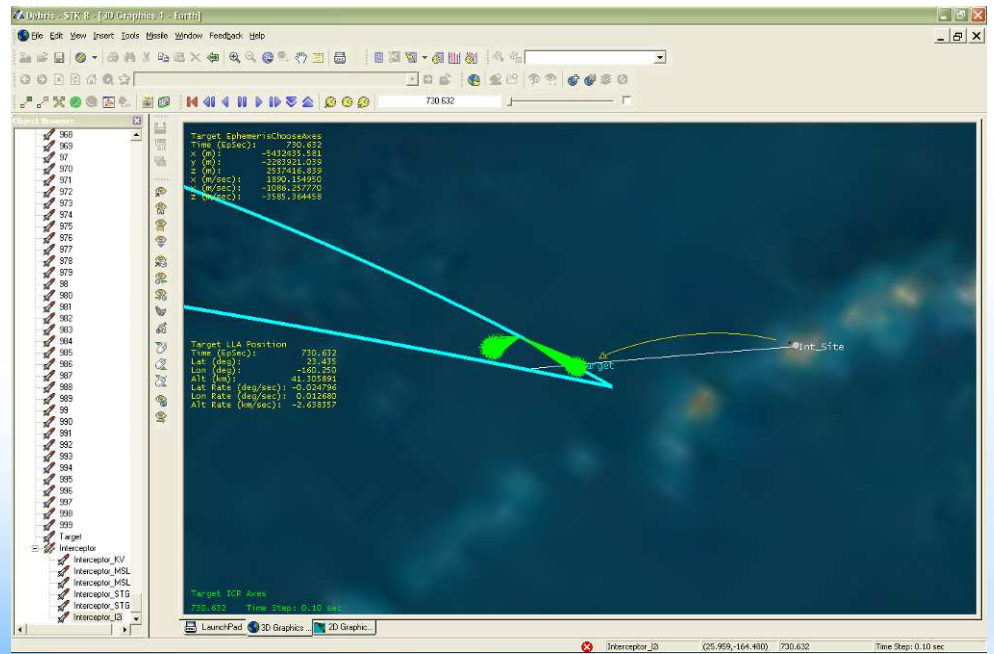
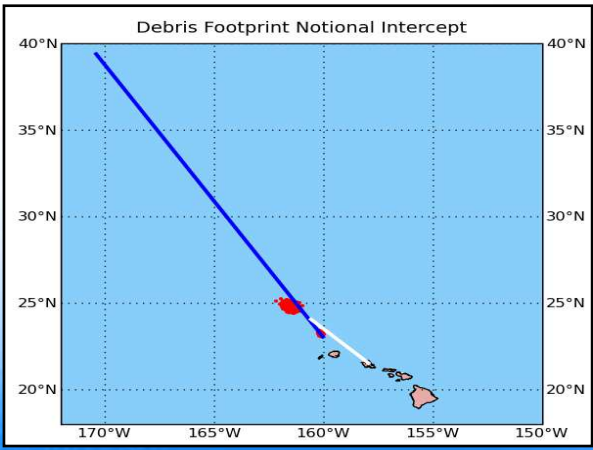
1 # This program takes KIDD output files and formats them
2 # for propagation with TAOS
3
4
5 taos=open('cases.dat','w')
6 taos.write('Case' + '\n' + 'VAR-1' + '\n' + 'VAR-2' + '\n' + 'VAR-3' + '\n' + 'VAR-4')
7
8 print 'Reading RV Debris Data'
9 rv=open('RV_Frag_Data.txt')
10 case=1
11 line=rv.readline()
12
13 while 1:
14     line=rv.readline()
15     if len(line) < 1:
16         break
17     data=line.split()
18     #          ECIVX          ECIVY          ECIVZ          MASS
19     writeline( str(case) + '\n' + str(float(data[2])) + '\n' + str(float(data[3])) + '\n' )
20     taos.write(writeline)
21     case=case+1
22     rv.close()
23
24 print 'Reading KV Debris Data'
25 kv=open('KV_Frag_Data.txt')
26 line=kv.readline()
27
28 while 1:
29     line=kv.readline()
30     if len(line) < 1:
31         break
32     data=line.split()
33
34 KIDD2TAOS.py *|dos:lat:1:python|1.616b          |%|wrap:auto 80:left|tabs:4:indt|1 2. 2 Top
    
```



Tool automatically loads debris objects (as missile objects for analysis or multi-track objects for purely visualization). Then loads these objects into a constellation then chain object for accesses and distances to various facilities.



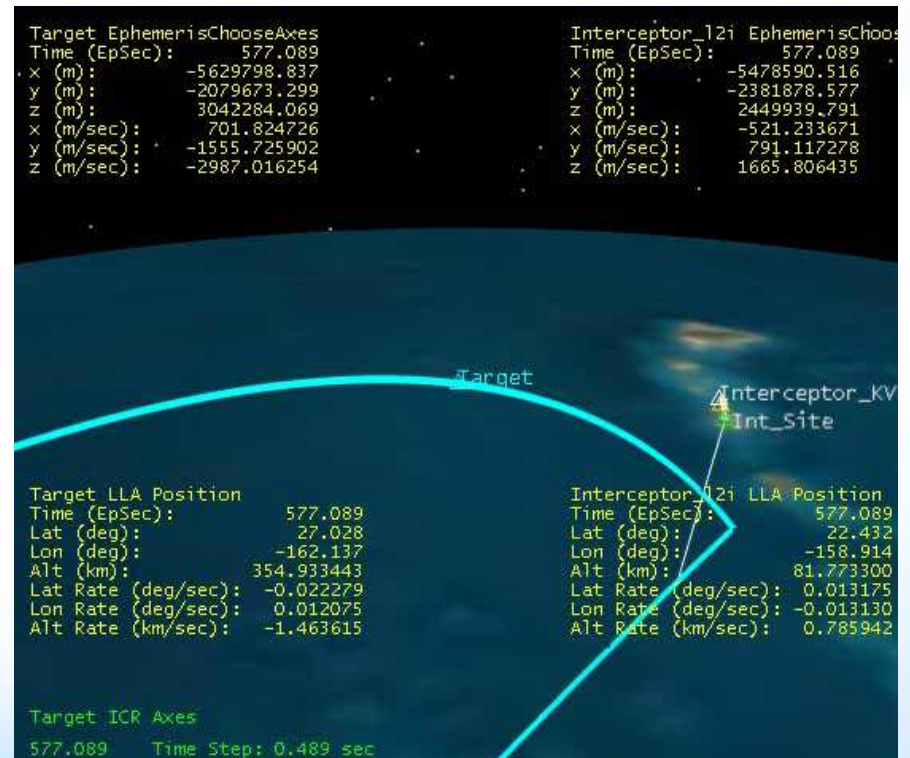
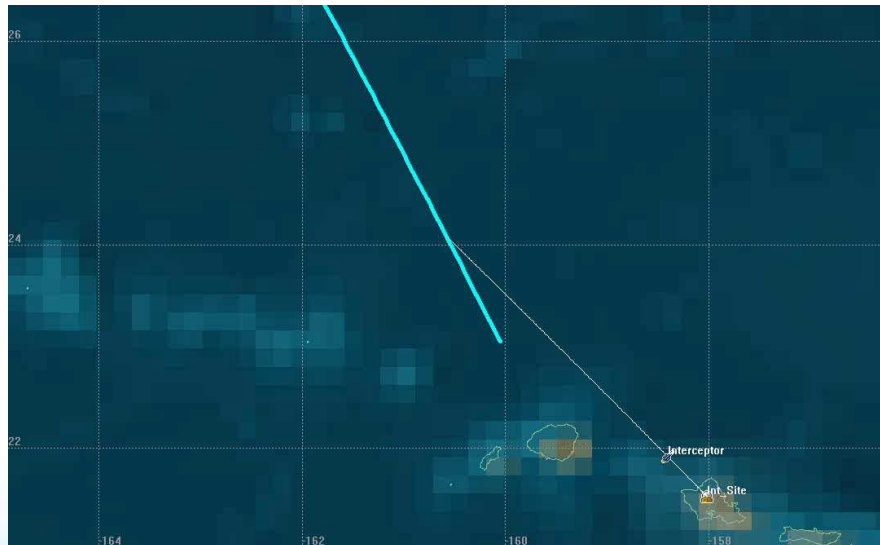
Tool plots debris on map with Matplotlib



Results

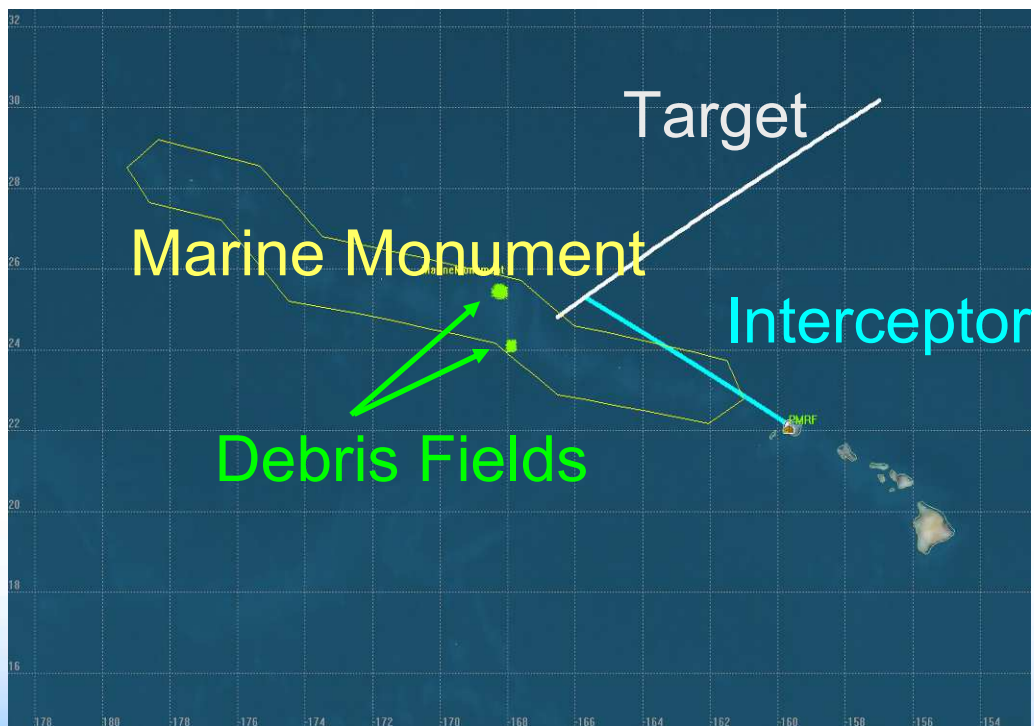


2D and 3D Animations

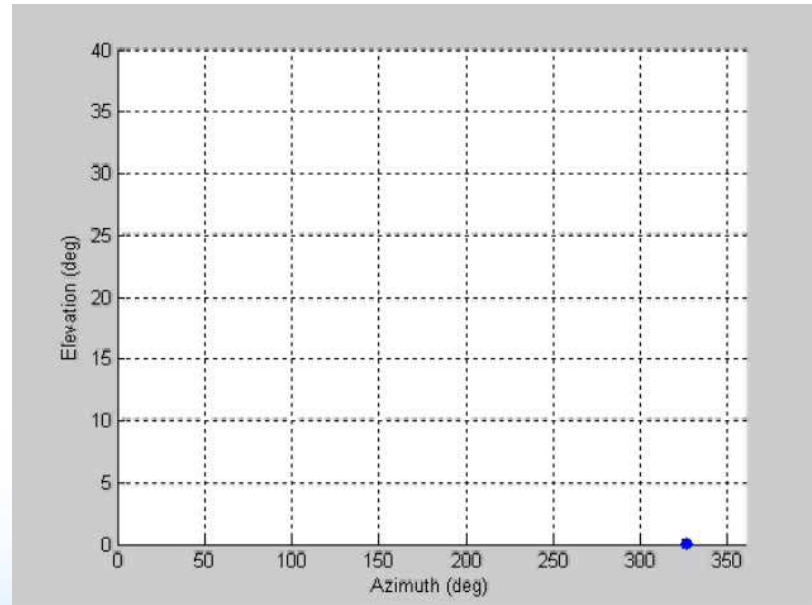


Results – Cont.

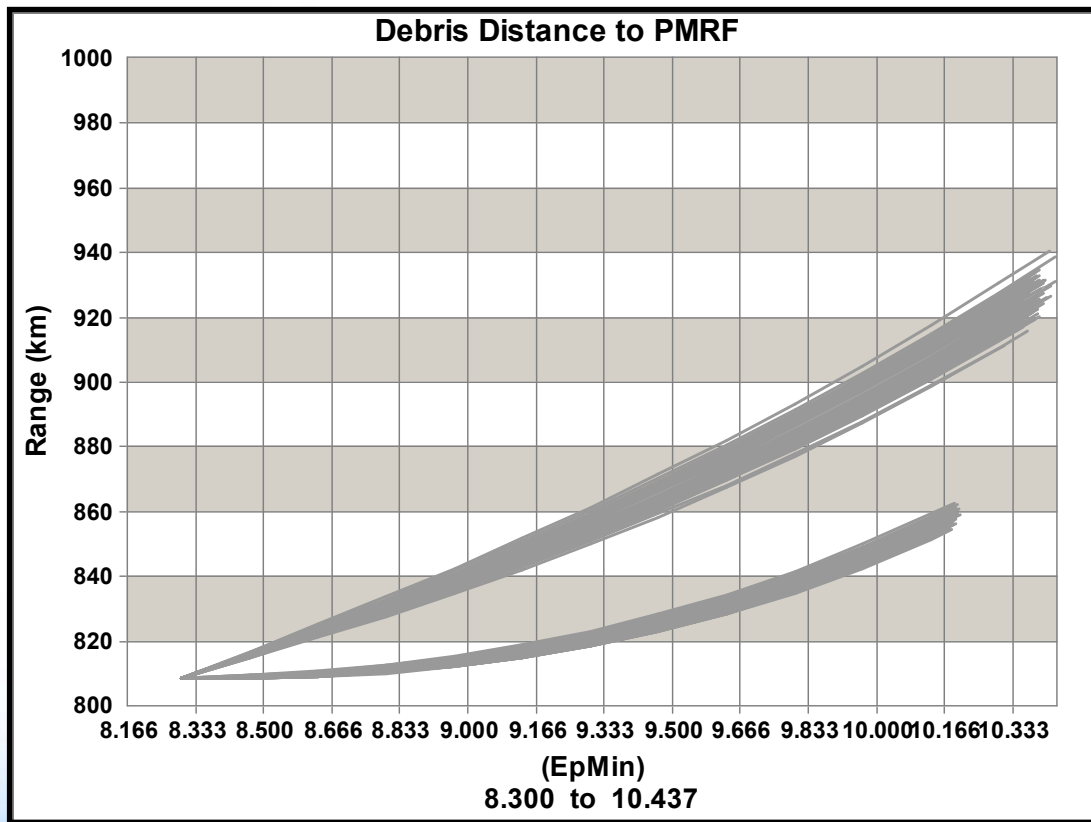
Maps with facilities and areas of interest



Sensor field of view animations



Results – Cont.



Plots of debris distances to various facilities and areas of interest

Benefits

- **Improved mission manager situation awareness**
- **Increase responsiveness of analysis**
- **Ability to anticipate customer needs and mission issues**
- **Increased internal capability of trajectory assessment**

Future Work

- Improve speed of Python code
- Create Monte-Carlo capability to examine different intercept points and target trajectories quickly
- Expand scope of tool in include range-initiated destruct debris and instantaneous impact points
- Expand list of standard auto-loaded facilities (currently tool auto-loads PMRF, RTS (Meck Island), and Marine Monument
- Create provisions to utilize alternate intercept and propagation codes as ease-of-use or contractual obligations demand/permit
- Incorporate radar and infrared signature analysis from KIDD and visualize with Python/Matplotlib or STK

Thanks

- Dynetics, Inc. and Lockheed Martin Space Systems Company
- Luis Montano, Kel Elkins, Grant Triffo, Mike Shepherd, Jim Henry, Scott Light, and the whole AGI team for the excellent support
- Amanda (Rocket Girl) for the blog mention (sorry-just couldn't rock the faux-hawk!)

Contact Information



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Backup - Software

- KIDD-Kinetic Impact Debris Distribution
 - Version 6.0.1 by Computer Sciences Corp of Huntsville, AL
- TAOS-Trajectory Analysis and Optimization Software
 - Version 8.5 by Sandia National Lab of Albuquerque, NM
- STK-Satellite Tool Kit
 - Version 8.1.3 by Analytical Graphics, Inc. of Exton, PA