AGI USER EXCHANGE
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NAVSOC Flight Dynamics and COLA Operations

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Program Overview

- Naval Satellite Operations Center (NAVSOC)
  - Point Mugu California
- Flight dynamics operations for Fleet Satellite (FLTSAT) and UHF Follow-On (UFO) geostationary spacecraft
  - Orbit determination
  - Station-keeping maneuvers
  - Product generation
  - COLA

Topics

- Flight Dynamics
  - Orbit Determination
  - Maneuver Planning
- COLA Operations

Why AGI Products?

- NAVSOC wanted to modernize Flight Dynamics in anticipation of the MUOS project
- NAVSOC has need for more accurate orbit determination than legacy software system to support activities such as close approach calculations

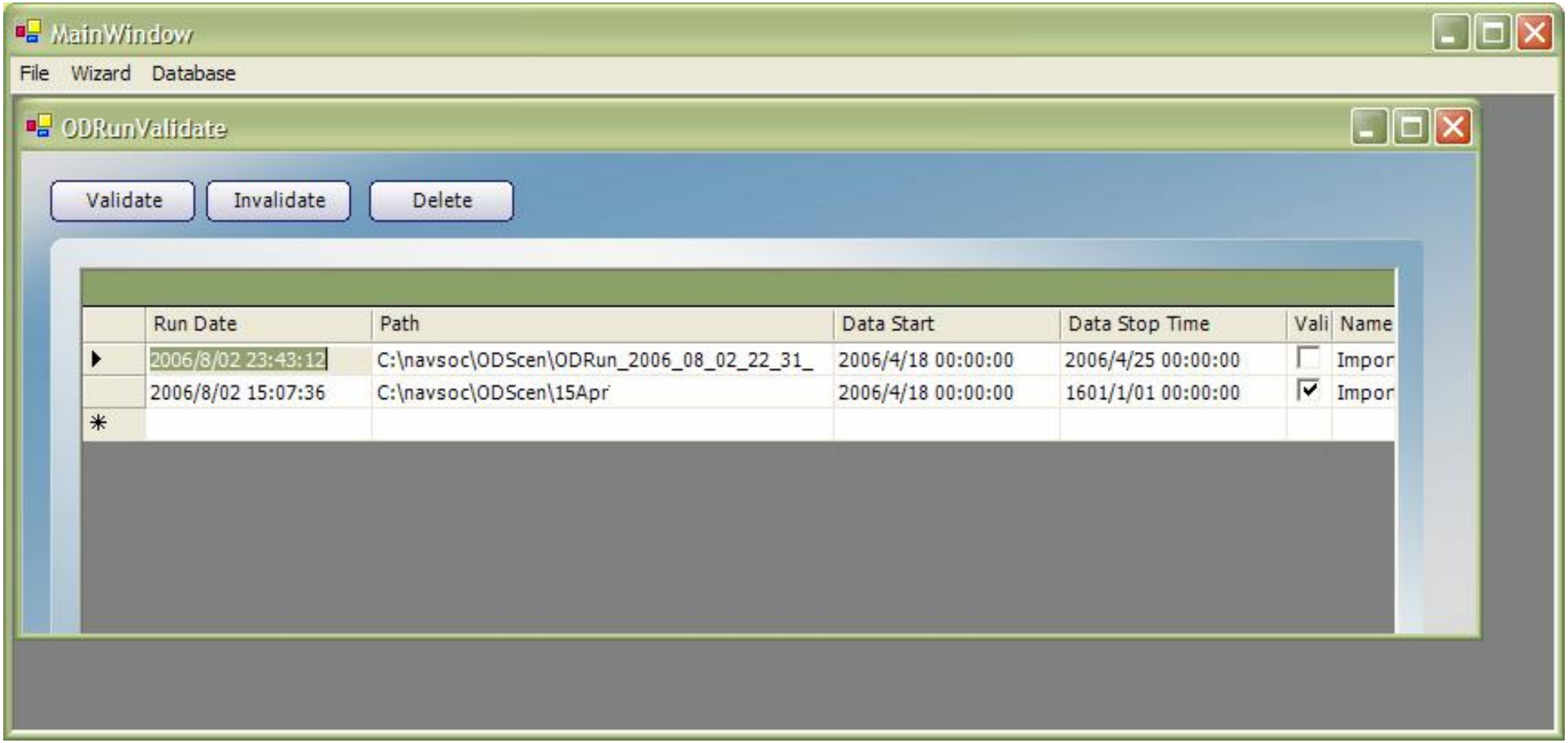
Design Goals

- More accurate Orbit determination
- Quicker recovery after maneuvers
- Automate process
- GUI for standard workflows
- NOT ONLY a fully automated system
  - User's should be able to run manually

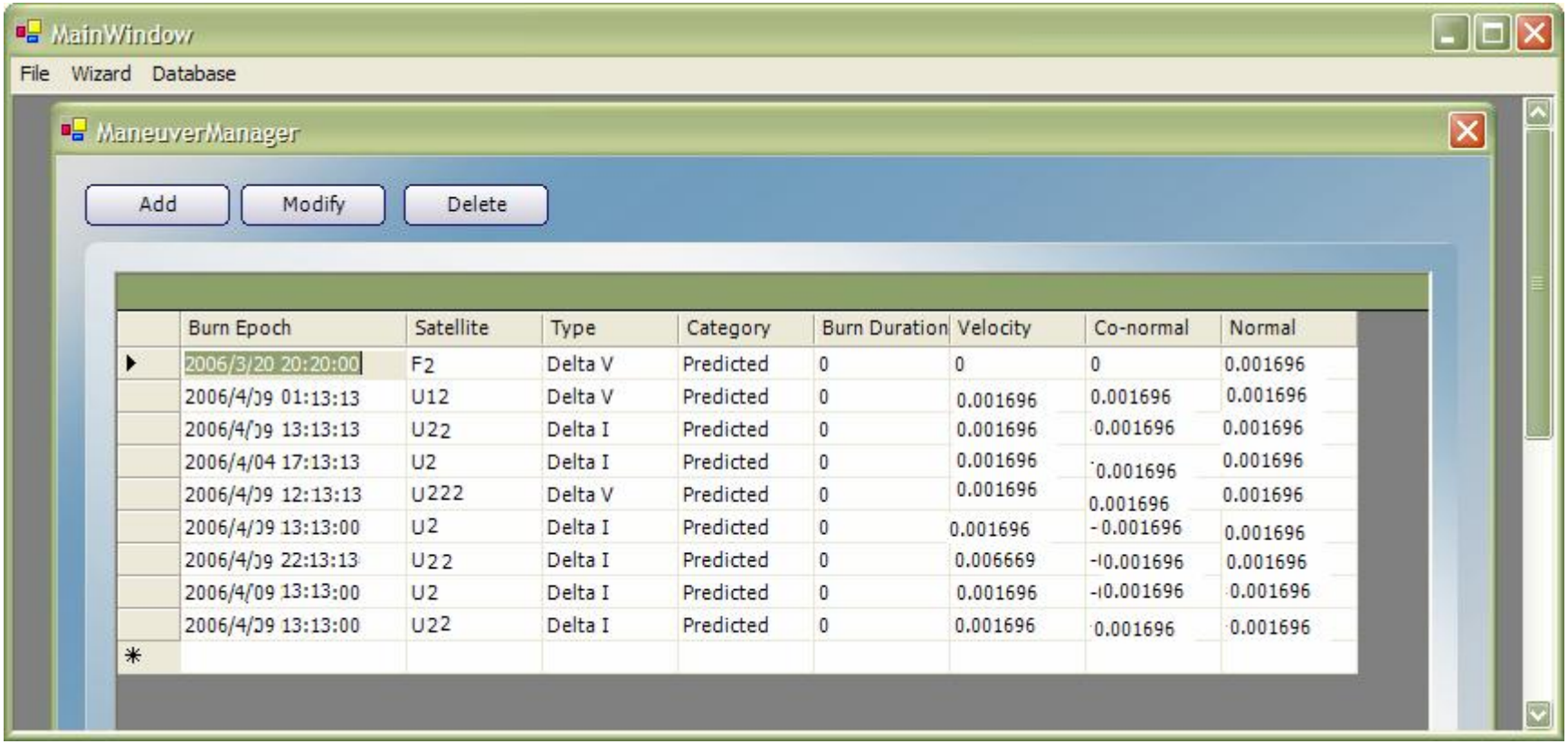
Solution

- AGI software run though custom GUI based on workflows
  - Data read from databases
  - AGI software populated
  - AGI software executed
  - Data products generated
  - Derived data written to databases

OD Database


MainWindow
File Wizard Database
ODRunValidate
Validate
Invalidate
Delete
Run Date
Path
Data Start
Data Stop Time
Vali
Name
2006/8/02 23:43:12
C:\navsoc\ODScen\ODRun_2006_08_02_22_31_
2006/4/18 00:00:00
2006/4/25 00:00:00
Impor
2006/8/02 15:07:36
C:\navsoc\ODScen\15Apr
2006/4/18 00:00:00
1601/1/01 00:00:00
Impor

Maneuver Database



Burn Epoch	Satellite	Type	Category	Burn Duration	Velocity	Co-normal	Normal
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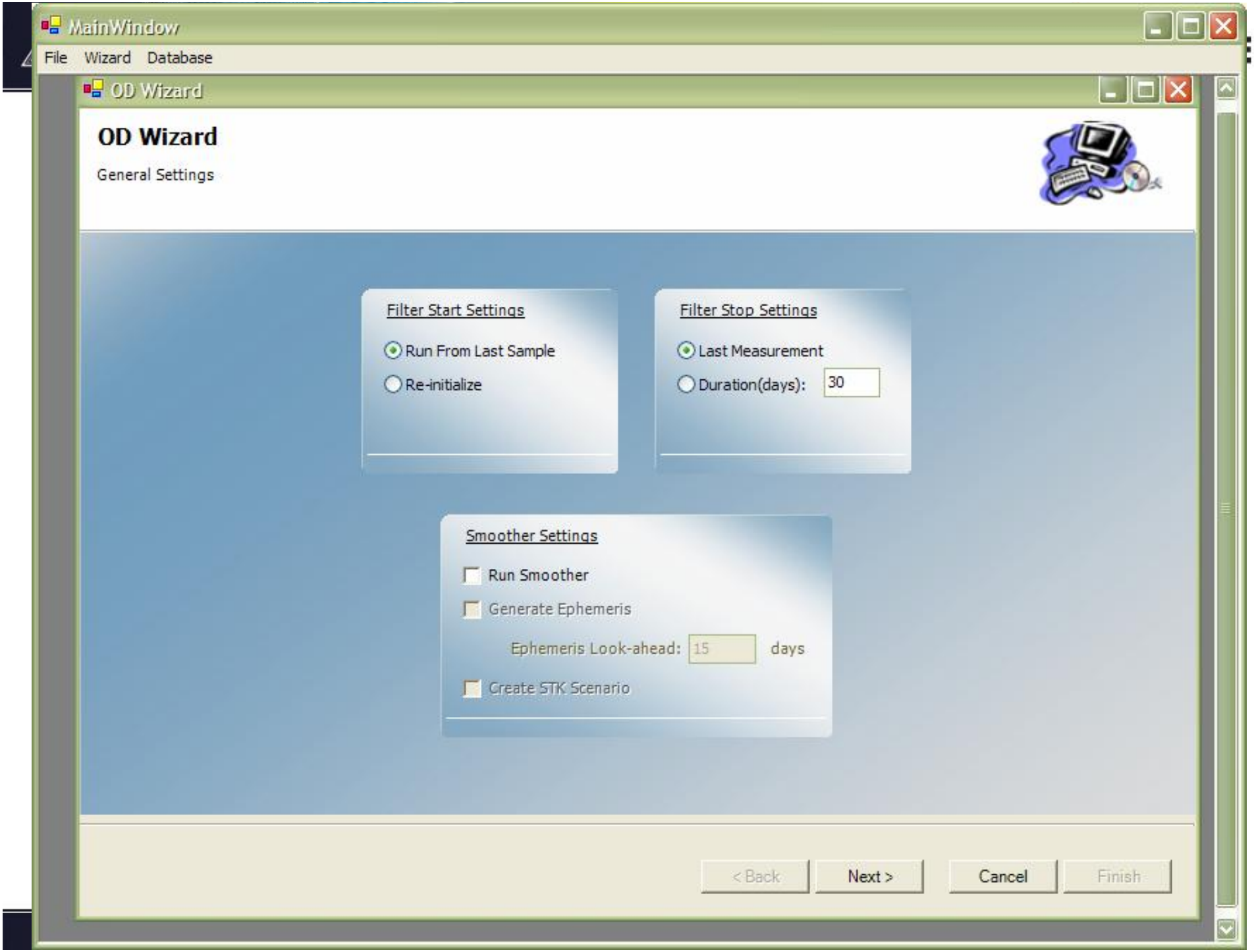
2006/4/09 01:13:13	U12	Delta V	Predicted	0	0.001696	0.001696	0.001696
2006/4/09 13:13:13	U22	Delta I	Predicted	0	0.001696	0.001696	0.001696
2006/4/04 17:13:13	U2	Delta I	Predicted	0	0.001696	0.001696	0.001696
2006/4/09 12:13:13	U222	Delta V	Predicted	0	0.001696	0.001696	0.001696
2006/4/09 13:13:00	U2	Delta I	Predicted	0	0.001696	-0.001696	0.001696
2006/4/09 22:13:13	U22	Delta I	Predicted	0	0.006669	-0.001696	0.001696
2006/4/09 13:13:00	U2	Delta I	Predicted	0	0.001696	-0.001696	0.001696
2006/4/09 13:13:00	U22	Delta I	Predicted	0	0.001696	0.001696	0.001696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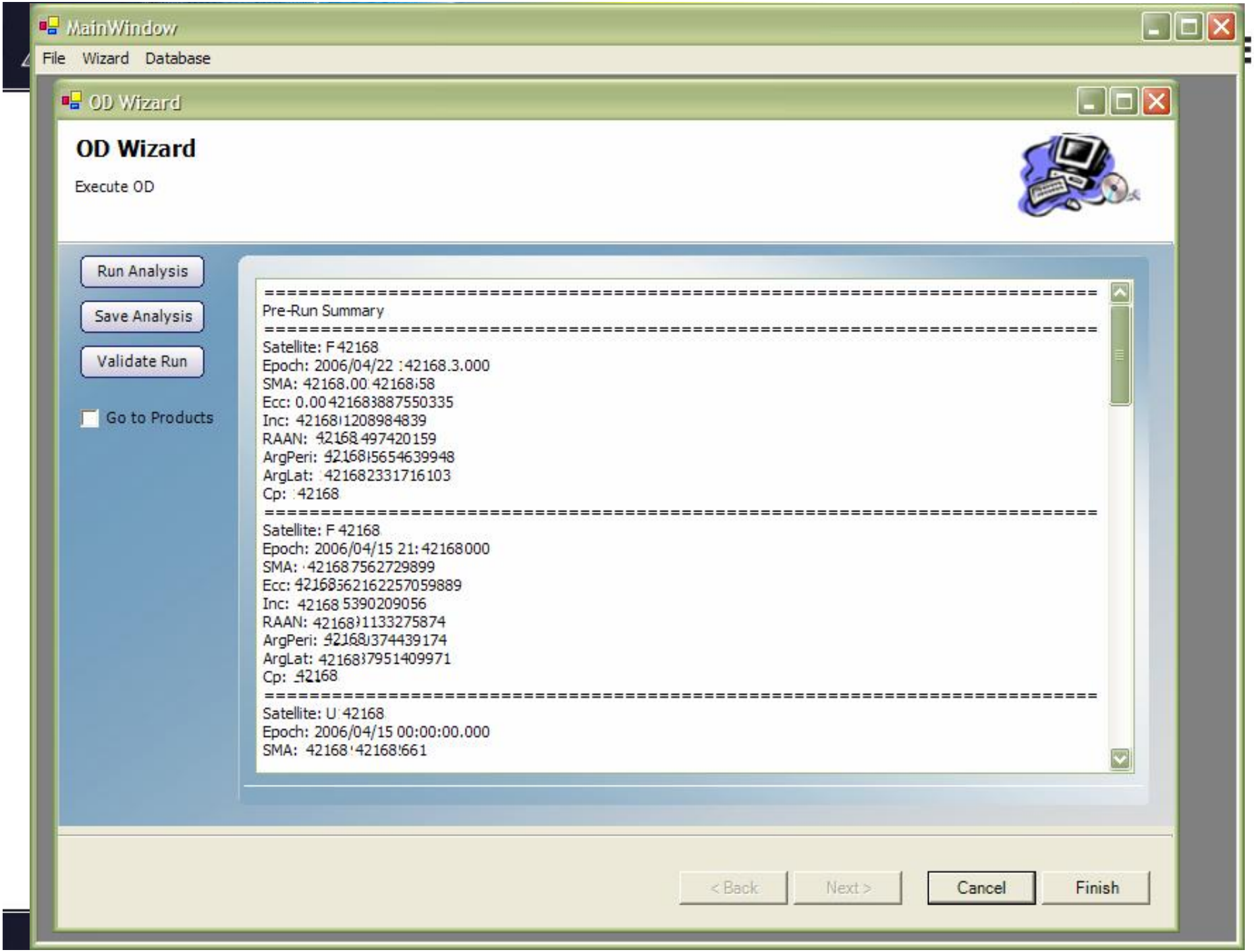
File
Wizard
Database
OD Wizard
OD Wizard
General Settings
Filter Start Settings
Run From Last Sample
Re-initialize
Filter Stop Settings
Last Measurement
Duration(days):
30
Smoother Settings
Run Smoother
Generate Ephemeris
Ephemeris Look-ahead:
15
days
Create STK Scenario
< Back
Next >
Cancel
Finish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File Wizard Database
OD Wizard
OD Wizard
Execute OD
Run Analysis
Save Analysis
Validate Run
Go to Products
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Pre-Run Summary
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Ecc: 0.00421683887550335
Inc: 42168:1208984839
RAAN: 42168 497420159
ArgPeri: 42168:5654639948
ArgLat: 421682331716103
Cp: 42168
==========
Satellite: F 42168
Epoch: 2006/04/15 21:42168000
SMA: 42168 7562729899
Ecc: 42168562162257059889
Inc: 42168 5390209056
RAAN: 42168:1133275874
ArgPeri: 42168:374439174
ArgLat: 42168:7951409971
Cp: 42168
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SMA: 42168 42168:661
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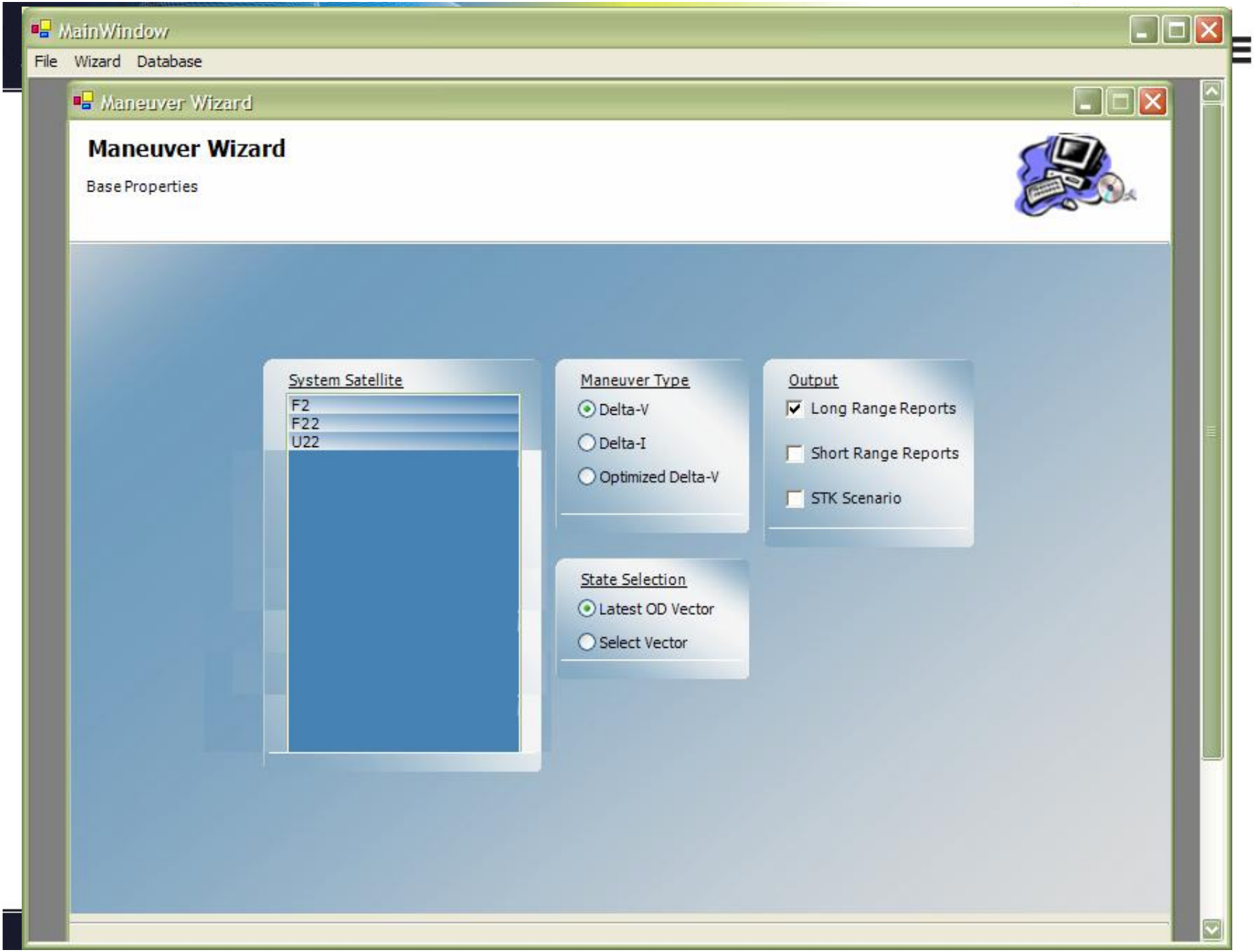
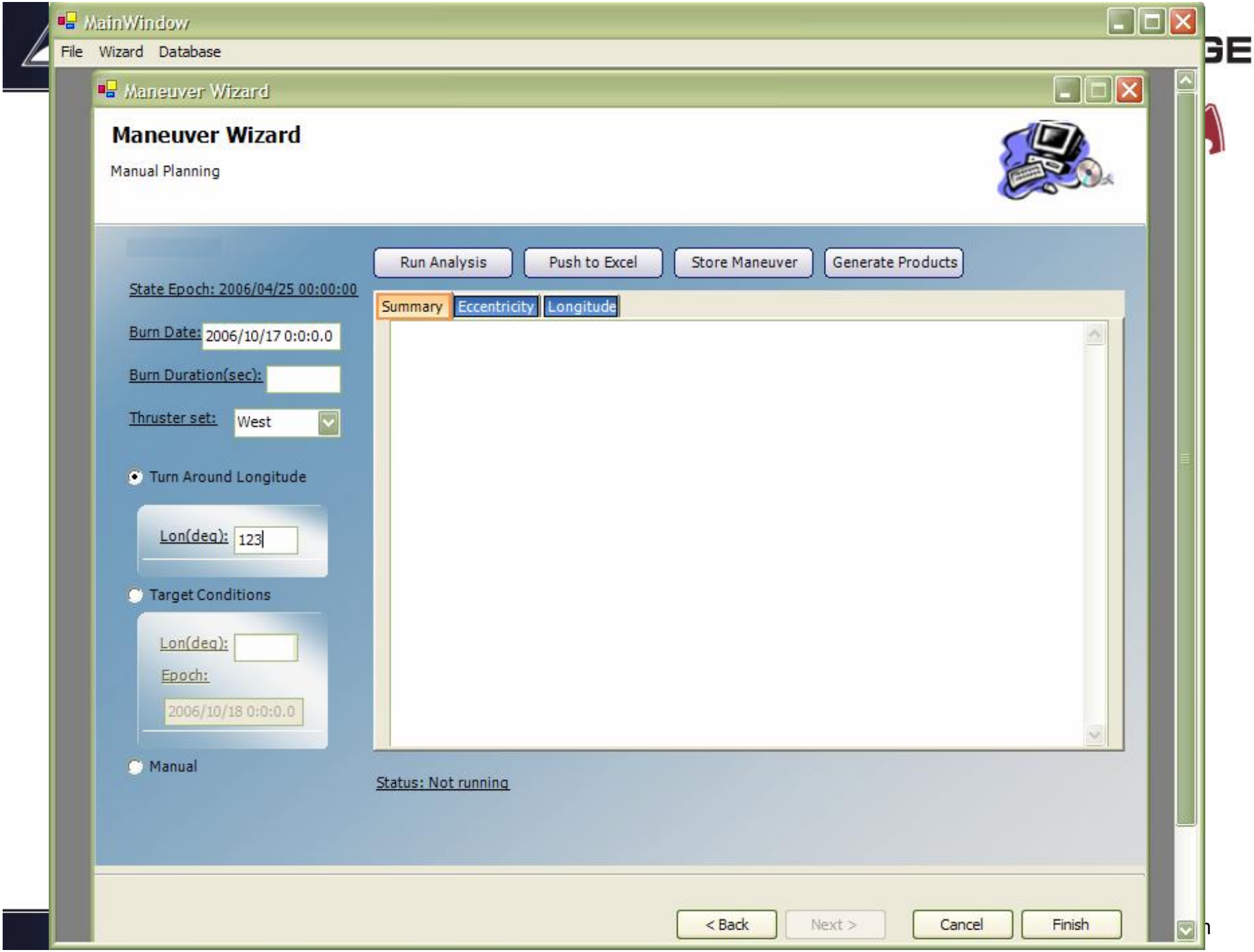
Next >
Cancel
Finish


MainWindow
File
Wizard
Database
Maneuver Wizard
Maneuver Wizard
Base Properties
System Satellite
F2
F22
U22
Maneuver Type
Delta-V
Delta-I
Optimized Delta-V
Output
Long Range Reports
Short Range Reports
STK Scenario
State Selection
Latest OD Vector
Select Vector


MainWindow
File
Wizard
Database
Maneuver Wizard
Maneuver Wizard
Manual Planning
Run Analysis
Push to Excel
Store Maneuver
Generate Products
State Epoch: 2006/04/25 00:00:00
Summary
Eccentricity
Longitude
Burn Date:
2006/10/17 0:0:0.0
Burn Duration(sec):
Thruster set:
West
Turn Around Longitude
Lon(deg):
123
Target Conditions
Lon(deg):
Epoch:
2006/10/18 0:0:0.0
Manual
Status: Not running
< Back
Next >
Cancel
Finish

COLA: Collision Avoidance

- Avoid hitting other spacecraft or debris
- Operations:
  - Monitoring and analyzing objects that may come too close or otherwise interfere with spacecraft
  - Determining how close identified objects may come to a spacecraft
  - Assessing the risk of a collision
  - Planning avoidance maneuvers

COLA: Collision Avoidance

- Response Reactions:
  - Planning avoidance maneuvers such that the risk of collision is reduced for the current and future close approach events
  - Assessing the risk of an avoidance maneuver
  - Perform avoidance maneuver and assess new spacecraft trajectory

COLA: Collision Avoidance

- Must know spacecraft orbit accurately enough to predict collision
- 1SPCS detects possible collision and delivers message and offender's orbit to NAVSOC
- NAVSOC must verify possible collision and plan avoidance maneuver if needed

COLA: Collision Avoidance

- Goals of development
  - Provide new decision making tools to officers
  - Integrate COLA workflow into existing STK and ODTK integration software
  - Leverage capabilities in new STK system to provide decision making tools to NAVSOC:
    - Realistic covariance taking into account maneuver accuracies
    - STK/CAT module to provide COLA analysis

COLA: Collision Avoidance

- Software system capabilities:
  - Extract state data from system database
  - Compare 1SPCS ephemeris data on NAVSOC spacecraft with internal data
  - Calculate suggested avoidance maneuver
- Use 1SPCS propagator run from STK to propagate “other” object
- After maneuver planning deliver trajectory to 1SPCS

Summary

- Operational in June 2007
- New GUI system created that runs AGI product line
  - Maneuver planning with STK/Astrogator
  - Orbit Determination with ODTK
  - Product generation with STK
  - COLA with STK/CAT

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