

# Ohio University NAVAID Performance Prediction Model User Manual

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## **Part I**

# **Preface and Disclaimer**

This is a living document and may be updated frequently. Figures will attempt to be updated between versions, but may reflect a prior version. The information in this document are correct to the best of the authors' abilities, but bugs may be present. Claims which may not be correct and need validated or features marked for further review will be marked with a \*. Known bugs in the code that contradict the description in this manual are marked with a ‡. Intended but incomplete features are marked with a ◇. Deprecated features intended to be removed, which may or may not ever occur, will be marked with a †.

This document is not intended to be a replacement for thorough OUNPPM training, but a supplement and refresher on the skills learned during that class.

# **Part II**

## **Installation Instructions**

# 1 Obtaining the Software

There are three ways to obtain the OUNPPM software.

1. Flash Drive during training
2. Installer .exe from [ounppm.eecs.ohio.edu/ounppm/](http://ounppm.eecs.ohio.edu/ounppm/)
3. .zip from [ounppm.eecs.ohio.edu/ounppm/updates](http://ounppm.eecs.ohio.edu/ounppm/updates)

After installing the software, it is highly recommended (and you should be prompted) to install updates.

## 2 Flash Drive During Training

### 2.1 Begin Installation

The installation file, should be of the format “OUNPPM Installer *DATE*.exe”.

From your flash drive, double click the file as shown in figure 11. Note: the date will change with future updates, and additional files may be present.

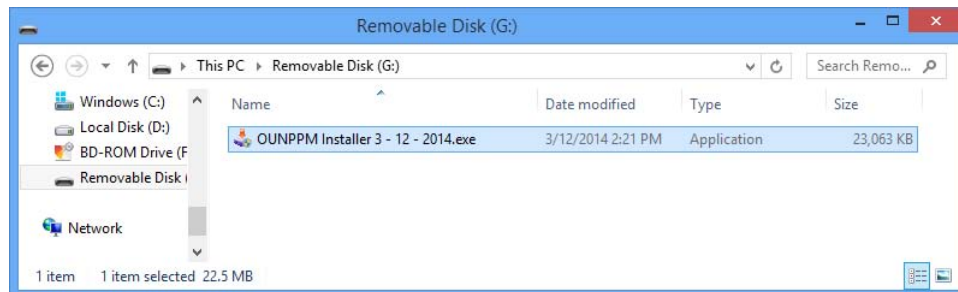


Figure 1: The installation file, as found on your flash drive.

This will launch a standard installer wizard.

### 2.2 Slide One

Click Next to continue, as seen in figure 12.

### 2.3 Slide Two

Here, accept the terms of service, as shown in figure 13, and click next to continue.

### 2.4 Slide Three

Here, as shown in figure 14, browse to choose the installation directory of the software. If you do not have administrator access to your computing device, then you should choose a subdirectory of your user directory, such as My Documents, or your desktop.



Figure 2: Click next to continue.

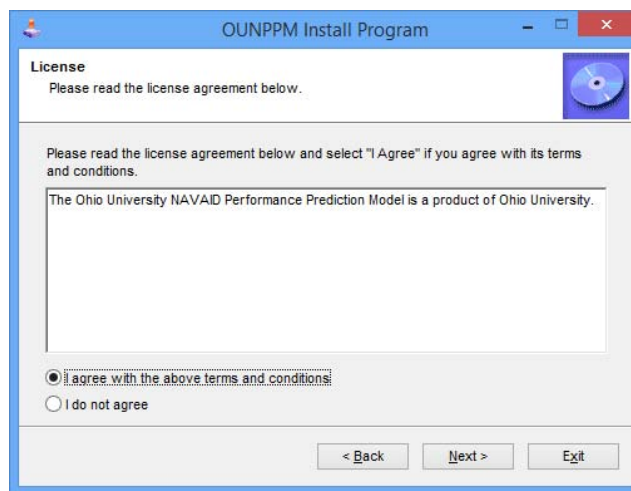


Figure 3: Accept the terms of service.

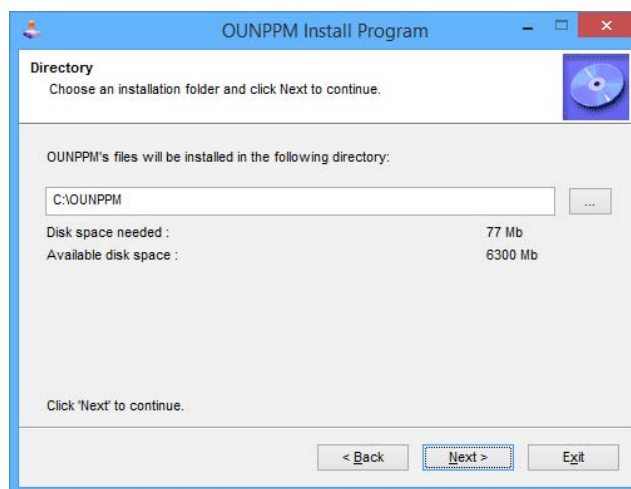


Figure 4: Choose the install location.

## 2.5 Slide Four

This is your last chance to change the install directory, once you click “Start”, as shown in figure 15, the installation will begin.

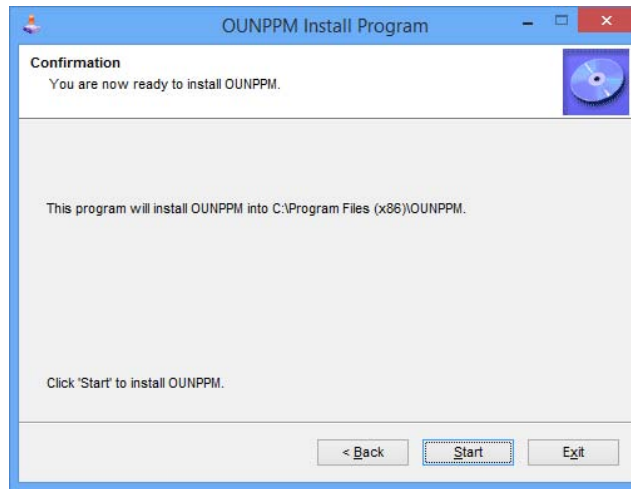


Figure 5: Press start to install.

## 2.6 Slide Five

If you see the screen depicted in figure 16, the installation completed successfully.

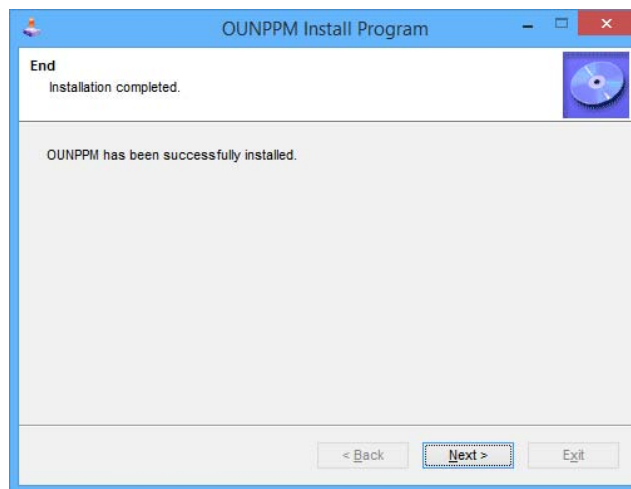


Figure 6: Press start to install.

## 2.7 Slide Six

Click the exist button, as seen in the lower right corner of figure 17, to exit the installer.

## 2.8 Install Complete

Now that the OUNPPM installation is complete, you should be able to run the program. By default, the installer will create a shortcut in your start menu under the

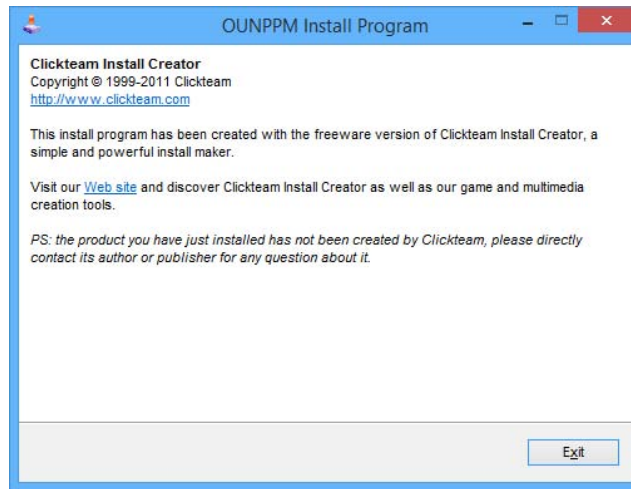


Figure 7: Press start to install.

directory OUNPPM to run the program, as seen in figure ??.

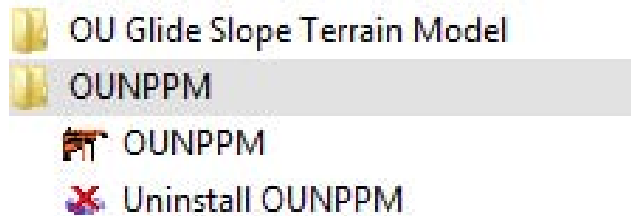


Figure 8: OUNPPM in the start menu.

## 2.9 Running OUNPPM Directly

You can also run the program by browsing to the install directory and running “Run OUNPPM.bat” as seen in figure ??.

## 3 Installer from Website

### 3.1 Acquiring Installer

The executable installers can be acquired from the following url, which looks like figure 10:

<http://ounppm.eecs.ohio.edu/ounppm/install/>

The recommended installer will be called: “Install.exe”.

All other installation files should be of the form, “OUNPPM Installer DATE.exe”.

Installers of various versions will appear on this website. The recommended installer should appear at the top of the list, and the remaining versions will be presented lexicographically.

### 3.2 Begin Installation

The installation file, should be of the format “OUNPPM Installer DATE.exe”.

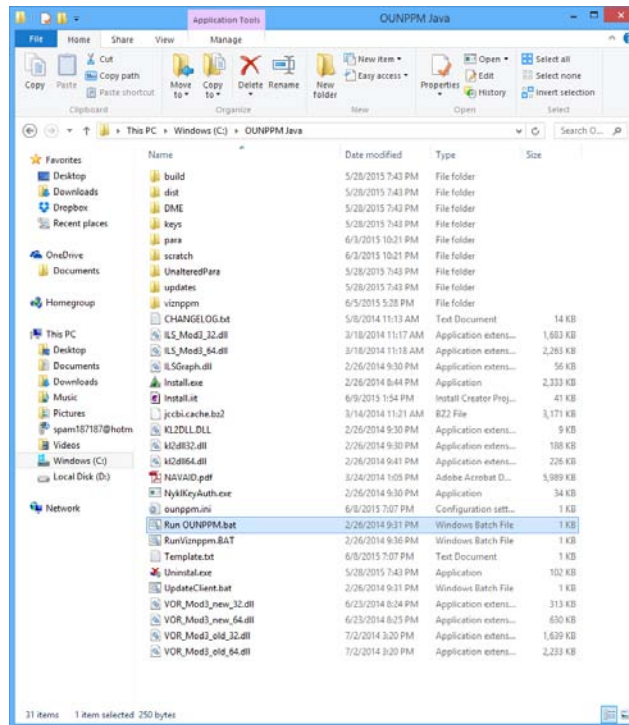


Figure 9: How to run OUNPPM directly.

## Index of /ounppm/install

	<a href="#">Name</a>	<a href="#">Last modified</a>	<a href="#">Size</a>	<a href="#">Description</a>
	<a href="#">Parent Directory</a>		-	
	<a href="#">Install.exe</a>	09-Jun-2015 17:32	37M	
	<a href="#">OUNPPM Installer - 4 - 13 - 2015.exe</a>	14-Apr-2015 12:37	32M	
	<a href="#">OUNPPM Installer - 5 - 28 - 2015.exe</a>	28-May-2015 19:48	36M	
	<a href="#">OUNPPM Installer - 6 - 9 - 2015.exe</a>	09-Jun-2015 17:31	37M	

*Apache/2.2.22 (Ubuntu) Server at ounppm.eecs.ohio.edu Port 80*

Figure 10: The installation file, as found on your flash drive.

From your flash drive, double click the file as shown in figure 11. Note: the date will change with future updates, and additional files may be present.

This will launch a standard installer wizard.

### 3.3 Slide One

Click Next to continue, as seen in figure 12.

### 3.4 Slide Two

Here, accept the terms of service, as shown in figure 13, and click next to continue.



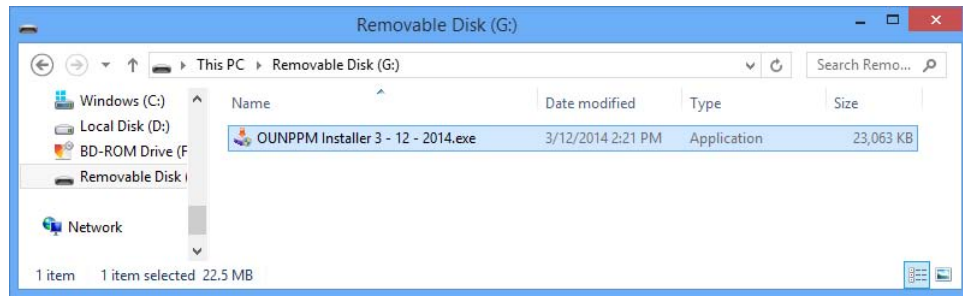


Figure 11: The installation file, as found on your flash drive.



Figure 12: Click next to continue.

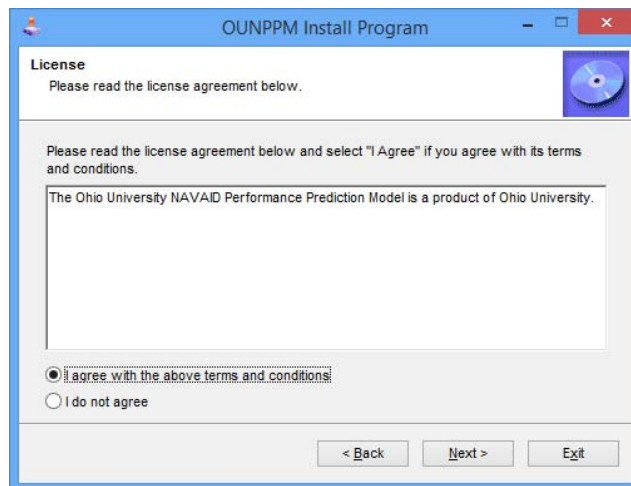


Figure 13: Accept the terms of service.

### 3.5 Slide Three

Here, as shown in figure 14, browse to choose the installation directory of the software. If you do not have administrator access to your computing device, then you should chose a subdirectory of your user directory, such as My Documents, or your desktop.

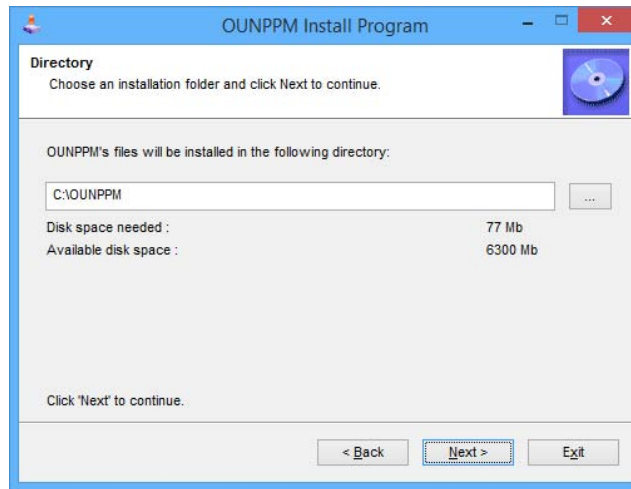


Figure 14: Choose the install location.

### 3.6 Slide Four

This is your last chance to change the install directory, once you click “Start”, as shown in figure 15, the installation will begin.

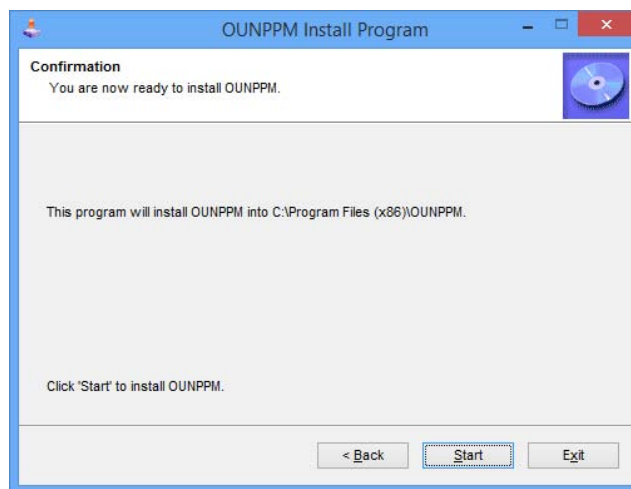


Figure 15: Press start to install.

### 3.7 Slide Five

If you see the screen depicted in figure 16, the installation completed successfully.

### 3.8 Slide Six

Click the exist button, as seen in the lower right corner of figure 17, to exit the installer.

### 3.9 Install Complete

Now that the install is complete, a new folder, “OUNPPM”, should appear in your Start Menu, with two items, as shown in figure 16. Click the “OUNPPM” item to

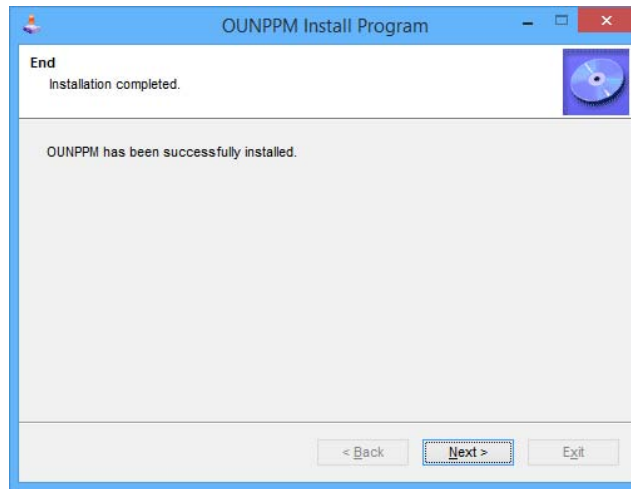


Figure 16: Press start to install.



Figure 17: Press start to install.

start the application.

### 3.10 Running OUNPPM Directly

You can also run the program by browsing to the install directory and running “Run OUNPPM.bat” as seen in figure ??.

## 4 .zip from Website

### 4.1 Acquiring .zip

Ohio University hosts all previous version of OUNPPM at:

<http://ounppm.eecs.ohio.edu/ounppm/updates>

A user can select any of the versions of the software by downloading a .zip from this website, as seen in figure 20. The highest build number and date are the recommended version. Download the .zip of your choosing, and continue to the next section.

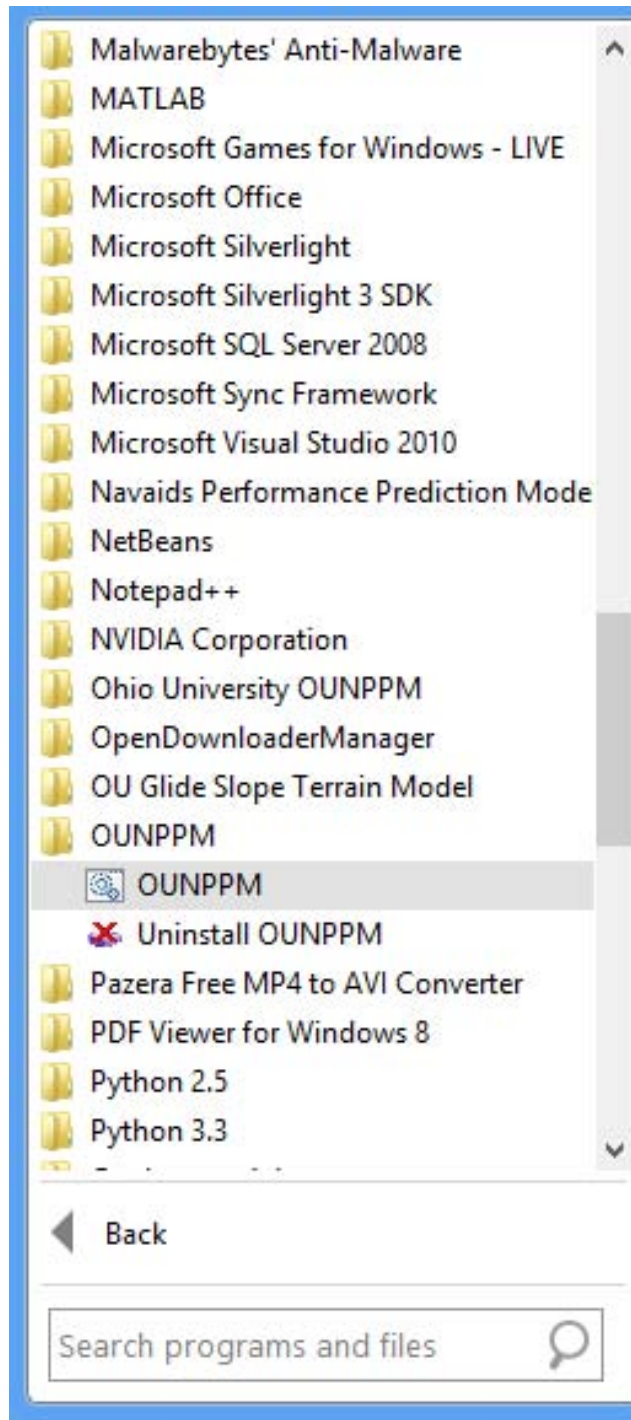


Figure 18: OUNPPM in the start menu.

## 4.2 Begin Extraction

The next step is to extract the .zip file. Windows 7 and above include ways to extract .zip files automatically. An example using Windows 8.1 is shown below in figure 21.

## 4.3 Choose Location

You will be prompted to chose a location for where extracted files should be placed, as seen in figure 22. This will default to a subdirectory in the directory where the file presently is.

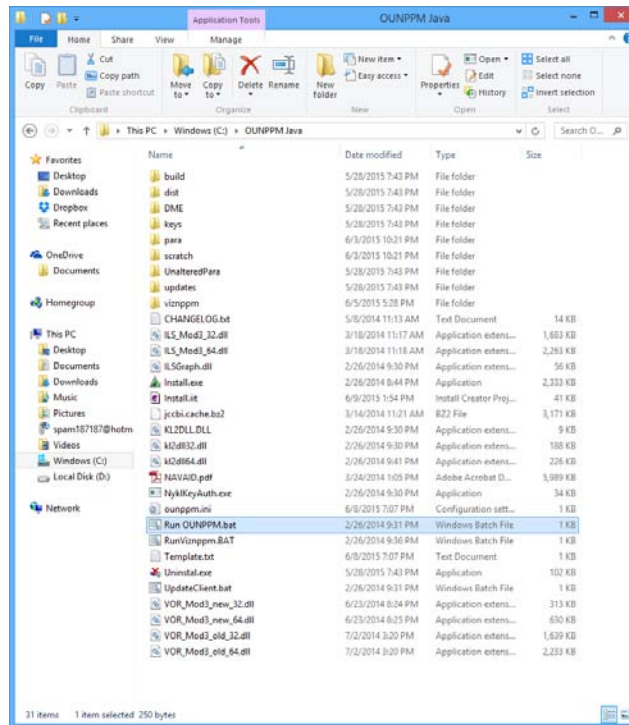


Figure 19: How to run OUNPPM directly.

## Index of /ounppm/updates

Name	Last modified	Size
<a href="#">Parent Directory</a>	-	-
<a href="#">OUNPPMsvn1335.2013.Jun.25.13.36.07.EDT.zip</a>	26-Feb-2014 15:54	23M
<a href="#">OUNPPMsvn1342.2013.Jun.26.02.15.53.EDT.zip</a>	26-Feb-2014 15:54	23M
<a href="#">OUNPPMsvn1347.2013.Jun.26.17.30.13.EDT.zip</a>	26-Feb-2014 15:54	25M
<a href="#">OUNPPMsvn1349.2013.Jun.26.18.02.25.EDT.zip</a>	26-Feb-2014 15:54	21M
<a href="#">OUNPPMsvn1350.2013.Jun.26.18.30.56.EDT.zip</a>	26-Feb-2014 15:54	22M
<a href="#">OUNPPMsvn1352.2013.Jun.27.13.15.28.EDT.zip</a>	26-Feb-2014 15:54	22M
<a href="#">OUNPPMsvn1357.2013.Jun.28.01.09.25.EDT.zip</a>	26-Feb-2014 15:54	22M
<a href="#">OUNPPMsvn1363.2013.Jul.02.15.48.41.EDT.zip</a>	26-Feb-2014 15:54	22M
<a href="#">OUNPPMsvn1366.2013.Jul.03.14.57.19.EDT.zip</a>	26-Feb-2014 15:54	22M
<a href="#">OUNPPMsvn1377.2013.Jul.17.16.40.10.EDT.zip</a>	26-Feb-2014 15:54	22M

Figure 20: The version repository containing .zips of all versions.

### 4.4 Extraction Compete

When the extraction is complete, the files should look similar to the layout in figure 23.

Note: this method does not make a shortcut in the start menu like the installer does. The user can add one themselves.

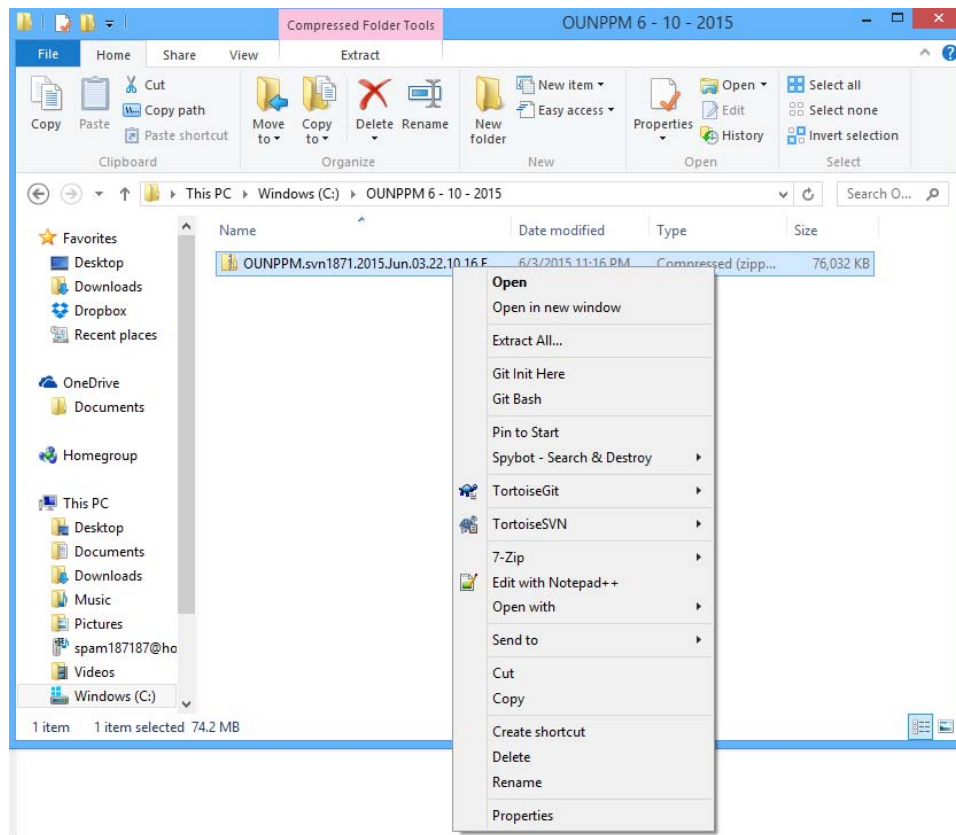


Figure 21: How to extract a .zip.

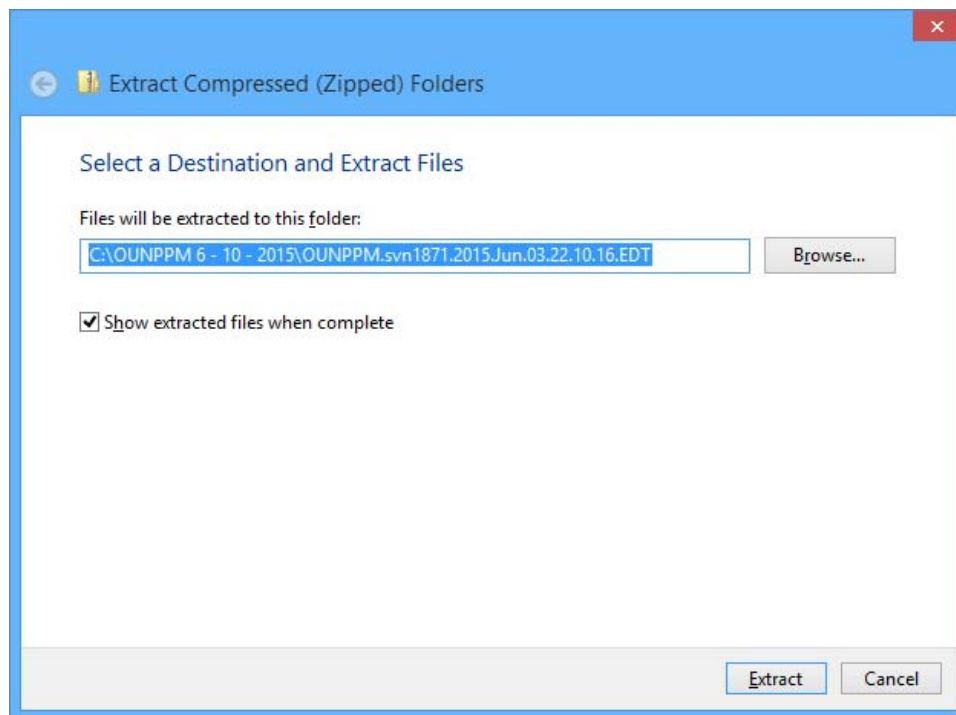


Figure 22: How to chose a location for the contents of the .zip.



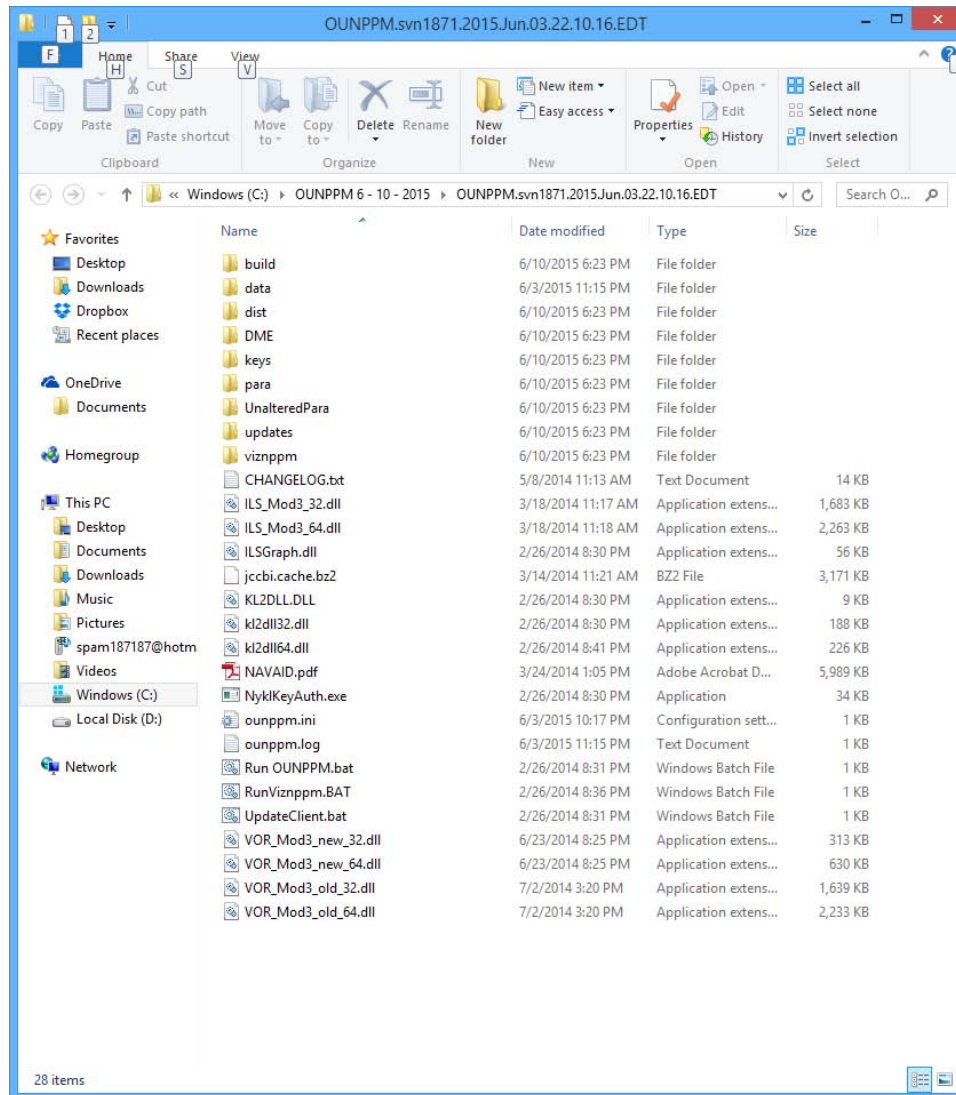


Figure 23: The files extracted from the .zip.

**Part III**

**Preliminaries**



## 5 OUNPPM Overview

Ohio University Navais Performance Prediction Model (OUNPPM) can simulate three types of systems:

- Localizer
- Glideslope
- VHF Omnidirectional Ranging system (VOR)

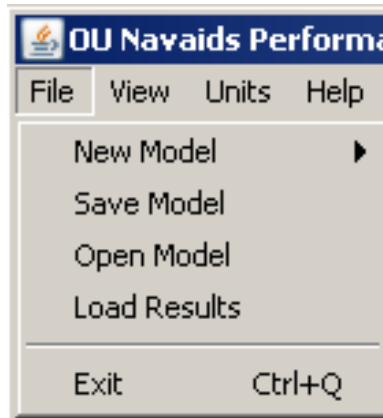


Figure 24: The available models supported by OUNPPM.

One type of system may be modeled at anytime. Figure 24 shows how one creates a new Model. The state of a simulation can be saved at any time to a data file, referred to in this document as the *.dat*. The current *.dat* file being referenced, or the lack of one is shown at the bottom of the application, as seen in figure 25.

Current Data File: [NEW MODEL NOT SAVED] | Current Data File: C:\OUNPPM\trunk\NAVAID\data\temp.dat

Figure 25: Examples of the *.dat* file indicator. Left) the default, Right) a file saved as temp.dat.

## 6 System Requirements

- Windows 32-bit/64-bit OS: Windows XP SP3, Vista, 7, 8, or 8.1
- Java SE Runtime Environment (JRE) 1.7.0 or greater. Free Download at: <http://www.oracle.com/technetwork/java/javase/downloads/index.html>
- 1GB RAM
- 100MB Disk space

## 7 Coordinate Frames

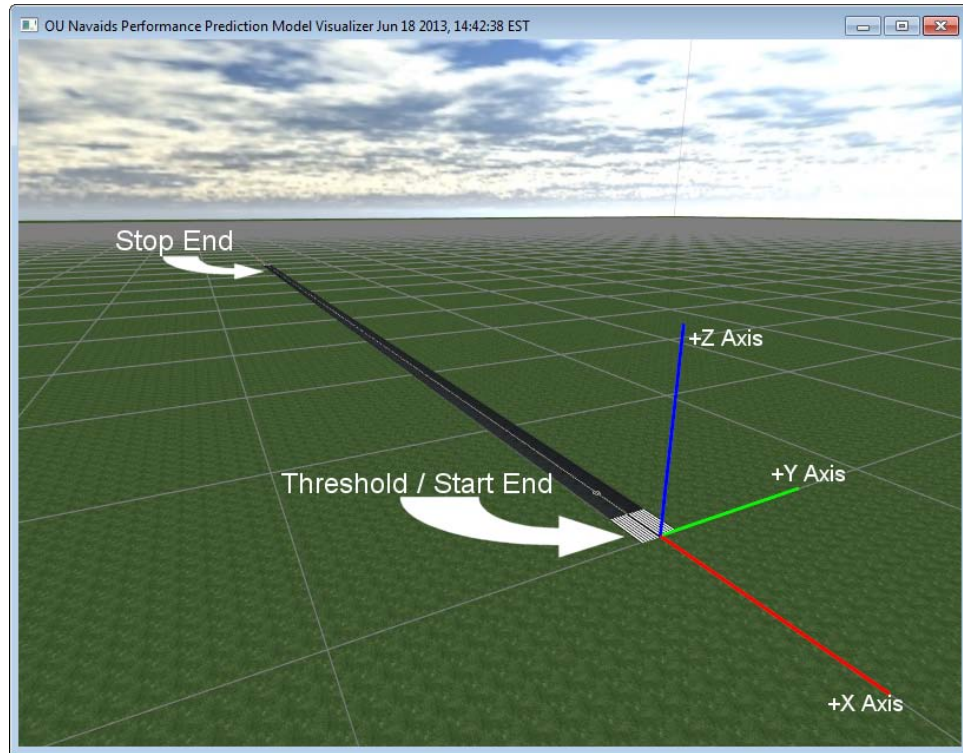


Figure 26: The Localizer / Glideslope reference frame used by OUNPPM.

### 7.1 Localizer / Glideslope

See Fig. 26 for illustration.

Origin is located at *threshold*, also called *start end*. The positive x-direction extends from threshold away from stop end. This means an aircraft with a front approach will start at some positive x value and proceed in a decreasing x-direction. The positive z-direction is upwards out of the earth. We use a right-hand coordinate system, so the y-direction can be derived from these two vectors. Positive rotations (as viewed looking in a negative z-direction, i.e. top-down), are counter-clockwise.

## 7.2 VOR

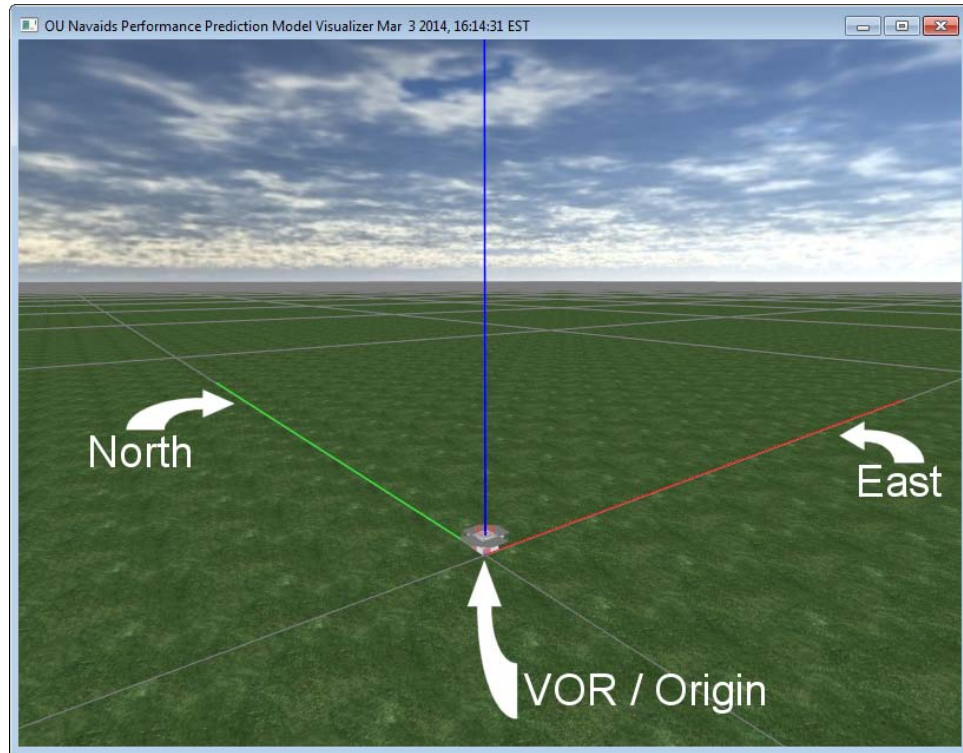


Figure 27: The VOR reference frame used by OUNPPM. The Green Axis is North and the Red Axis is East.

The VOR does not need to have a runway, it simply is positioned relative to some origin, shown in Fig. 27, where the red, green, and blue axes intersect. The VOR uses a *Left handed* coordinate frame where positive rotations are clockwise. The Green Axis points North and the Red Axis points East.

## 7.3 DME

The DME does not need to have a runway, it simply is positioned relative to some origin, shown in Fig. 26, where the red, green, and blue axes intersect. The DME uses a right-handed coordinate system.

**Part IV**

**Graphical User Interface (The  
Inputs)**

This section will discuss the input to the model via the graphical user interface (GUI). It will first cover how to use the input forms, followed by features unique to each model type, followed by the remaining features that are the same across all types.

## 8 General Input

Figure 28 shows a common input box. An input box is typically a numeric value followed by a unit. For example, the Runway Length is set to 10000.0 ft. Some input boxes require a distance or length argument, some require an angular argument, some require a decibel argument, some require a unitless ratio, etc. When a user enters an argument with no unit, the input will be automatically converted to the *Default* unit. The *Default* unit may either be set to *Feet* or *Meters*. One may enter an argument with *any desired unit* (see list below) and OUNPPM will automatically convert this value to the *Default* units. For example, if the *Default* unit is 'Feet' a user may enter '1000m' or '1000 m' or '1km' or '1 km', and the corresponding box will change to '3280.84 ft'. Figure 29 shows how to change the *Default* unit type.

For distance inputs, one may choose to enter any valid numeric value followed by optional white space and then an optional unit. Valid distance types are feet, meters, kilometers, nautical miles, and wavelengths. The following list denotes valid unit suffixes:

- Feet: 'ft', 'f', 'foot', 'feet'
- Meters: 'm', 'meter', 'meters'
- Kilometer: 'km', 'kilometer', 'kilometers'
- Wavelengths: 'w', 'wavelength', 'wavelengths'
- Nautical Miles: 'nm', 'nmi', 'NM', 'nautical mile', 'nautical miles'

Similarly, for other unit types, valid suffixes include:

- Micro Amperes: 'ua', 'uA', 'microamp', 'microamps', 'uAmps', 'uamps'
- Degrees: 'deg', 'degs', 'degree', 'degrees'

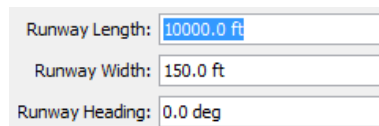


Figure 28: A typical input box.

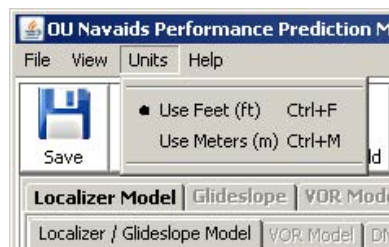


Figure 29: Default Units are either English or Metric.

## 9 Localizer Model

This section discusses the localizer tab, as seen in figure 30. This tab is only enabled for Localizer models; therefore, it is mutually exclusive with glide slope, VOR, and DME models. This chapter will be divided into three sections matching the 3 panels of the localizer tab seen in figure 30: Facility Parameters, Modeling Parameters, and Array Parameters.

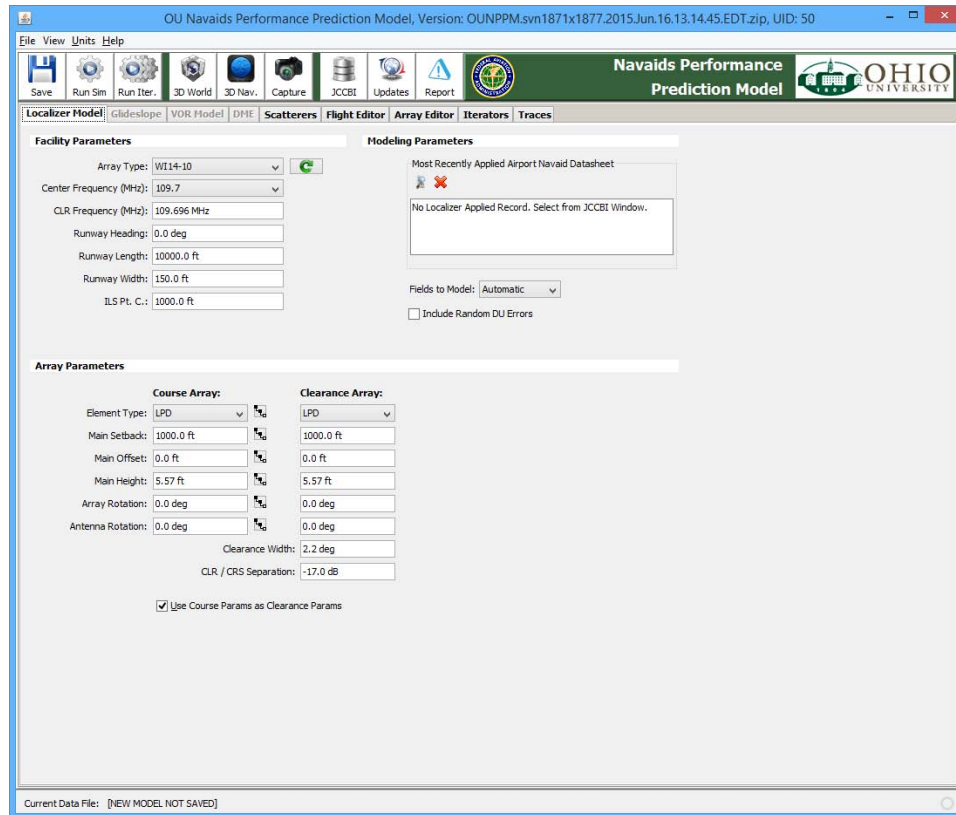


Figure 30: The localizer tab.

### 9.1 Facility Parameters

This section discusses the *facility parameters*, as shown in figure 55. This section is divided into 6 subsections describing the component groups found in figure 55: Array Type, Center Frequency, CLR Frequency, Runway Heading, Runway Length, and Runway Width.

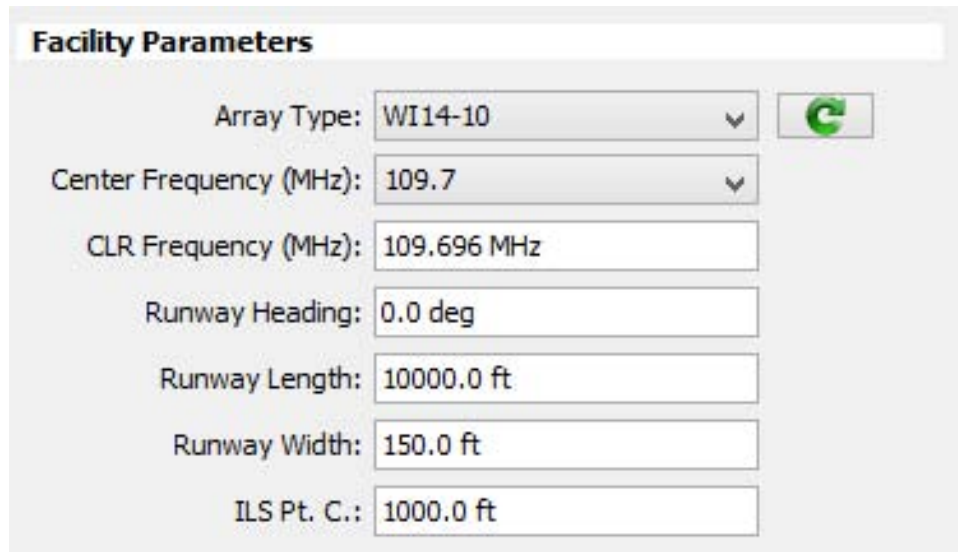
#### Array Type

##### Overview


The array type selection consists of two main components, as seen in figure 56: the combo (drop down) box, and the refresh button. The combo box for the localizer array type facility parameter is populated from the list of all *.ldu* files in the *para* folder.

##### Effect on the Model

Selecting an array from this drop down list will update the internal state of the model for subsequent runs to use the array defined by the *.ldu* file. In general, arrays with



**Facility Parameters**

Array Type: WI14-10 

Center Frequency (MHz): 109.7

CLR Frequency (MHz): 109.696 MHz

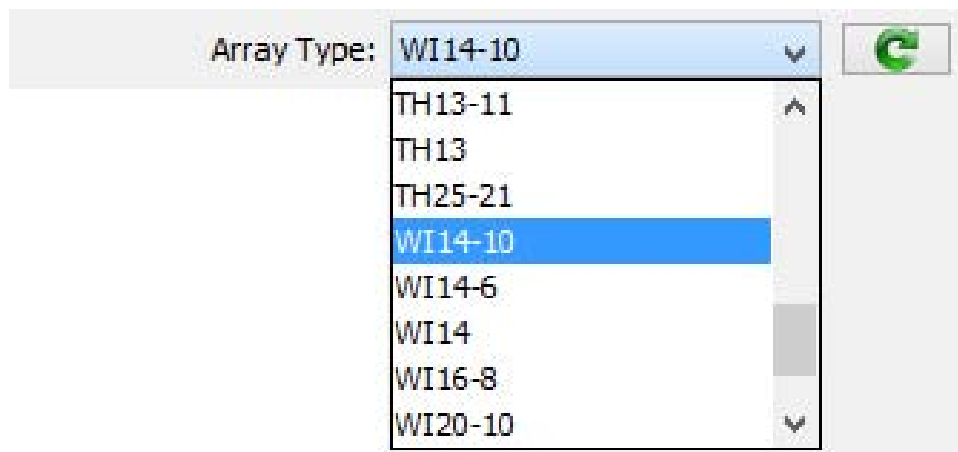
Runway Heading: 0.0 deg


Runway Length: 10000.0 ft

Runway Width: 150.0 ft

ILS Pt. C.: 1000.0 ft


Figure 31: The facility parameters component group.



Array Type: WI14-10 

- TH13-11
- TH13
- TH25-21
- WI14-10**
- WI14-6
- WI14
- WI16-8
- WI20-10

Figure 32: The array type components.

more elements have lower error. The refresh  button, assigns the previous state of the run to the array parameters. This is either the default values, or the values stored in the .dat file indicated in the current data file indicator, as seen in figure 25.

### Effect on the GUI

Selecting a new array from this drop down list might also modify the enabled array modeling components, as described in section 9.3. If an array is selected containing only one (1) set of elements, the clearance components will become deactivated, as seen in figure 52; if an array is selected containing both sets of elements all components will be active, as seen in figure 67. Similarly, the CLR Frequency component will also be deactivated when only the course array is used, as seen in figure 60; if an array is selected containing both sets of elements all the CLR Frequency will be active, as seen in figure 59.

### Effect on the Virtual World

The depiction of the array in the virtual world is shown in figure 57. The elements of the course and clearance arrays are represented by vertical hexagons of the array



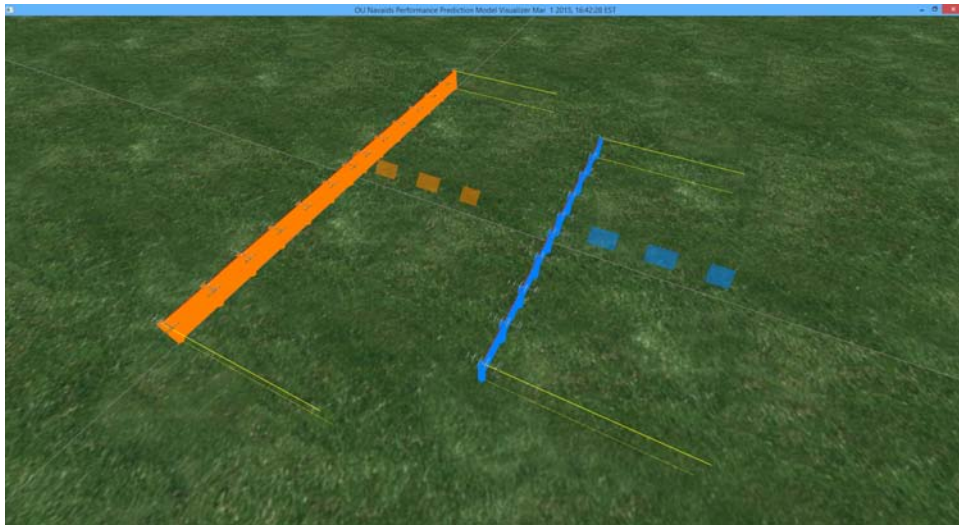


Figure 33: The array in the virtual world.

element height; there will be one hexagon for each element. The direction of propagation of the arrays are represented by yellow normal lines and an animated propagation pattern. The course array is connected through its local origin by an orange plane perpendicular to its propagation direction. The clearance array is connected through its local origin by a blue plane perpendicular to its propagation direction.

## Center Frequency

### Overview

When a course and clearance array are both present their frequencies are separated by 8kHz. The frequency they are centered around can be selected from the combo box as seen in figure 58.

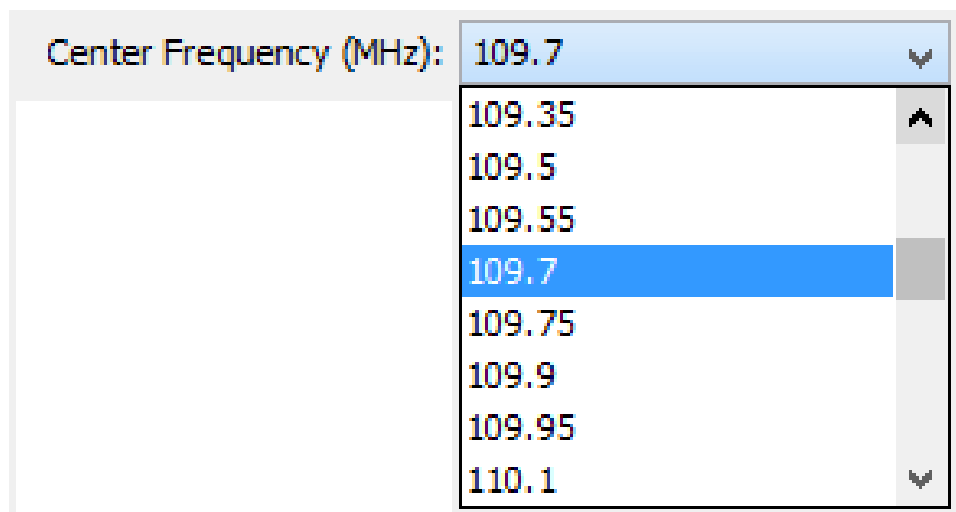


Figure 34: The center frequency component.

### Effect on the Model

Selecting a frequency from this drop down list will update the internal state of the model for subsequent runs.



### Effect on the GUI

If the course and clearance arrays are locked, as indicated by the checkbox in the array parameters, as described in section 9.3, as seen in figure ??, then the CLR frequency as described in section 10.1 will be updated to be 4kHz less than the center frequency.

### Effect on the Virtual World

This component has no effect on the virtual world.

## CLR Frequency

### Overview

By default, a course and clearance array are both present their frequencies are separated by 8kHz. This separation is adjustable within the model using the CLR Frequency component. This component is only editable

A screenshot of a software interface showing a label "CLR Frequency (MHz):" followed by a text input field containing the value "109.696 MHz".

Figure 35: The clearance frequency component.

Figure 59 shows the CLR Frequency component when it is active. Figure 60 shows the CLR Frequency component when it is deactivated.

A screenshot of a software interface showing a label "CLR Frequency (MHz):" followed by a text input field containing the value "109.696 MHz".

Figure 36: The clearance frequency component deactivated.

If the course and clearance arrays are locked, as indicated by the checkbox in the array parameters, as described in section 9.3, as seen in figure ??, then the CLR frequency cannot be set manually. If the arrays are not locked any value can be entered.

Note: Values entered into this component are always treated as MHz, no matter the extension.‡

### Effect on the Model

Setting this component implicitly increase the separation of the course and clearance arrays. The center frequency,  $v_c$ , is specified by the value in the center frequency component, as described in section 9.1. The clearance frequency,  $v_-$  is specified by the value in this component. Equations (3) and (4) provide two (2) separate derivations for the course frequency,  $v_+$ .

$$v_+ = v_c + (v_c - v_-) \quad (1)$$

$$v_+ = 2v_c - v_- \quad (2)$$

### Effect on the GUI

This component has no effect on the other GUI widgets.

### Effect on the Virtual World

This component has no effect on the virtual world.

## Runway Heading

### Overview

The runway heading component, as seen in figure 37, is used to update the heading of the runway.

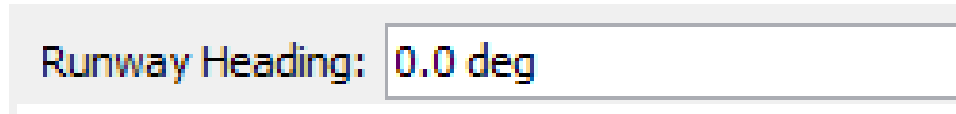


Figure 37: The runway heading component.

Because the localizer coordinate system, as described in section 7.1, and shown in figure 26 is based on the runway direction, very few parameters are affected by this setting. Any data referenced *from north* would necessarily be affected by this value.

### Effect on the Model

This has no known effect on the model.

### Effect on the GUI

This has no effect on other GUI components.

### Effect on the Virtual World

The runway number will change to reflect the new heading, as seen in figures 38 and ???. Figure 41 shows a runway with a heading of 40°; figure 42 shows a runway with a heading of 120°.

## Runway Length

### Overview

The runway heading component, as seen in figure 40, is used to update the length of the runway.

### Effect on the Model

The length of the runway will affect the default values of some flight approaches effecting the domain of some output plots. Runway length also affects the calculation of the default course width.

### Effect on the GUI

The component should not have any effect on other components.

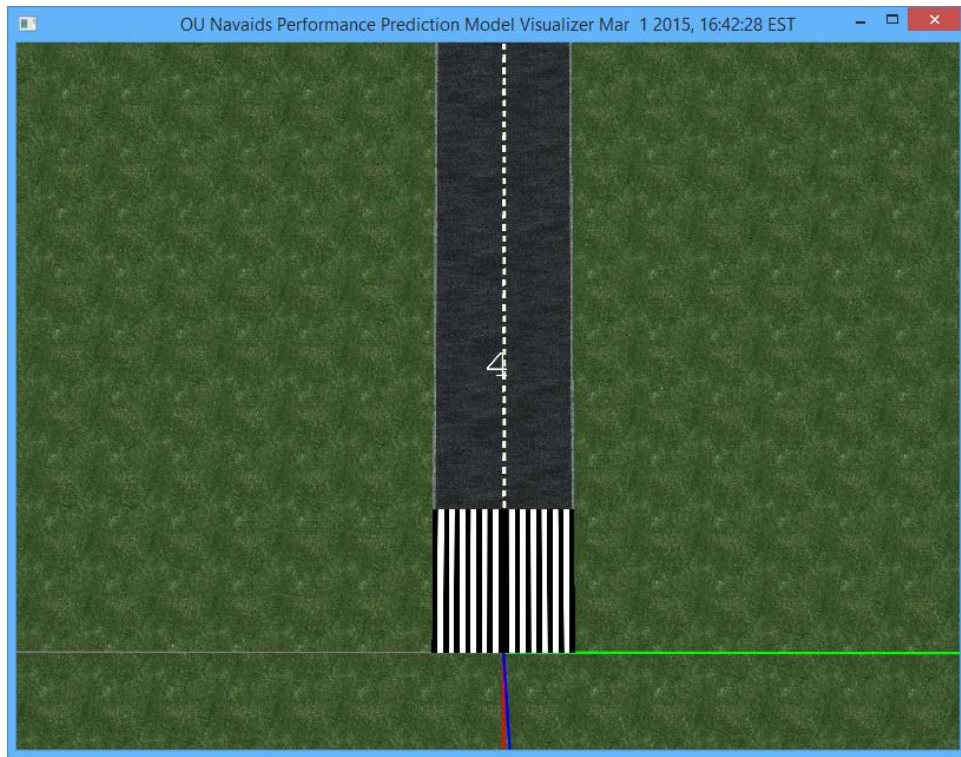


Figure 38: The runway with a heading of 40 degrees.

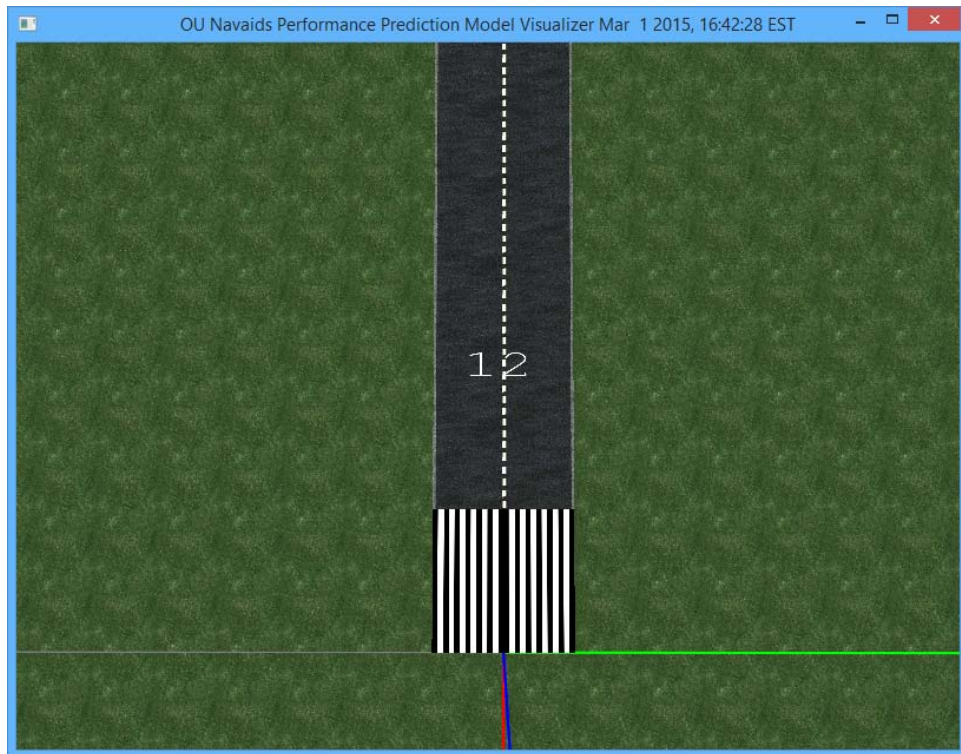


Figure 39: The runway with a heading of 120 degrees.

### Effect on the Virtual World

This component effects the runway model in the virtual world. Figure 41 shows a runway with a length of 10000 feet; figure 42 shows an 8500 foot runway. One should notice that the runway in figure 41 extends the length of 10 grid units exactly,

Runway Length: 10000.0 ft

Figure 40: The runway length component.

whereas the runway in figure 42 ends in the center of a grid cell.

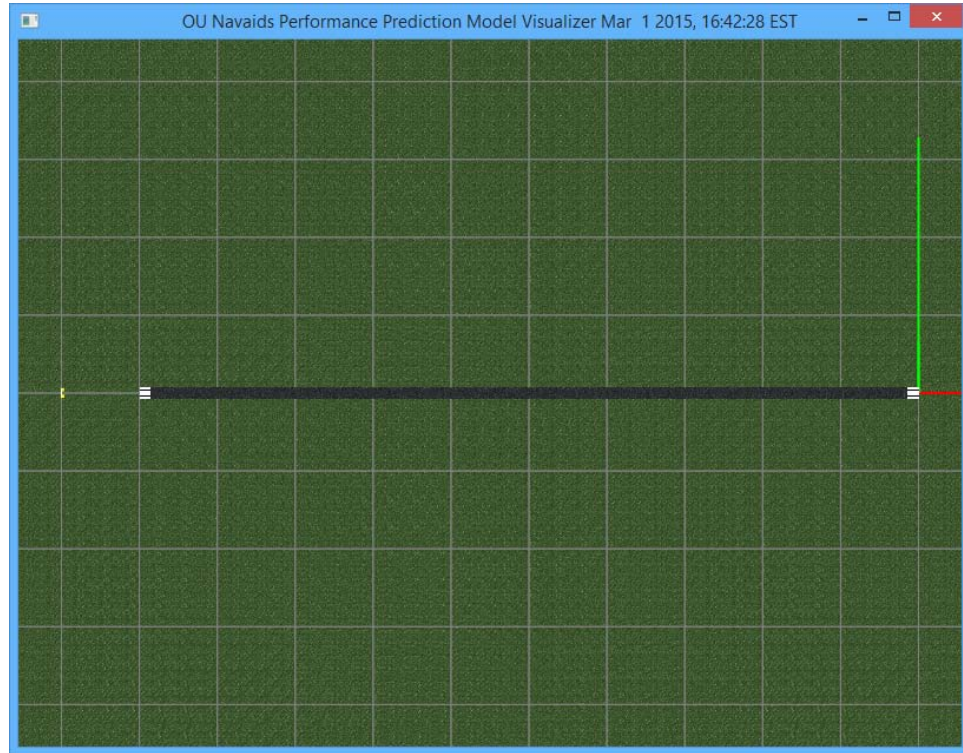


Figure 41: A runway with length 10000ft.

## Runway Width

### Overview

The runway heading component, as seen in figure 43, is used to update the width of the runway.

### Effect on the Model

This component has no effect on the model.

### Effect on the GUI

This component has no effect on other components.

### Effect on the Virtual World

This component effects the runway model in the virtual world. Figure 41 shows a runway with a width of 150 feet; figure 42 shows a runway with a width of 450 feet.



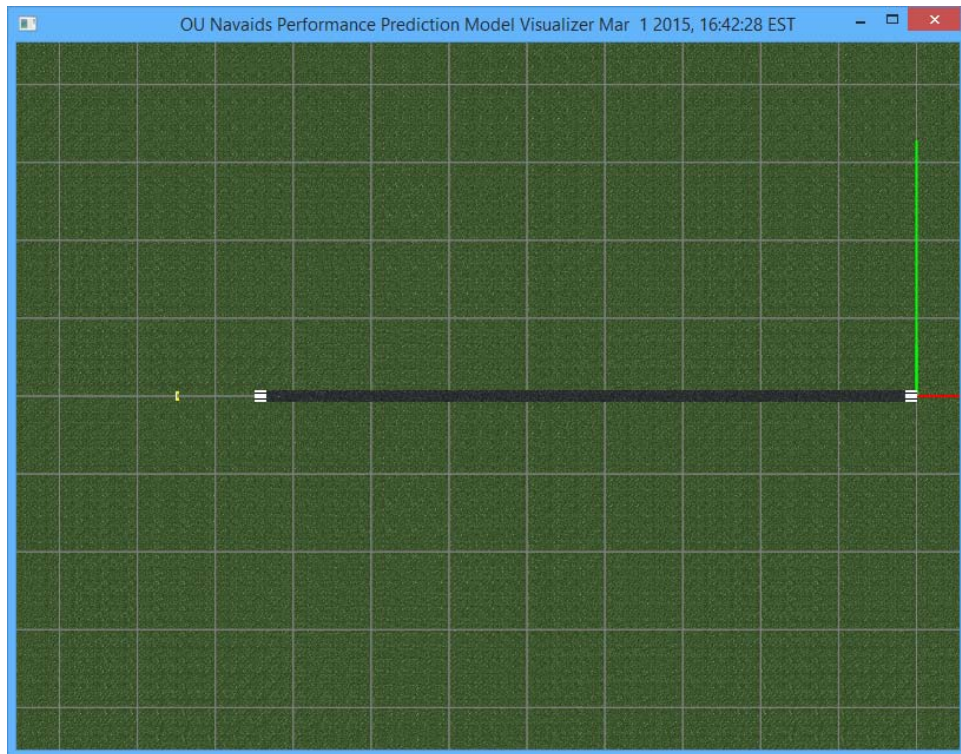


Figure 42: A runway with length of 8500ft.

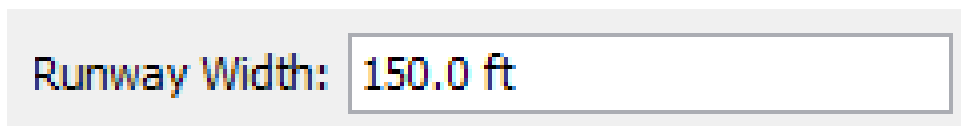


Figure 43: The runway width component.

## 9.2 Modeling Parameters


This section discusses the *modeling parameters*, as shown in figures 61 and 62. Figure 61 shows the modeling parameters group if no JCCBI datasheet is loaded; figure 62 shows the modeling parameters group if a JCCBI datasheet has been loaded. See chapter 18 for more information about OUNPPM's interface to the JCCBI. This section is divided into 3 subsections describing the component groups found in figure 55: Datasheet, Field, and DU Error.

### Datasheet

#### Overview

The JCCBI datasheet display consists of three main components, as seen in figures 66 and 64: the view button, cancel button, and the summary box. Figure 66 shows the summary box if a no datasheet has been loaded.

Figure 64 shows an example summary box if a databox had been loaded with the KUNI JCCBI datasheet.

The view button  opens the datasheet for the currently loaded JCCBI entry in a new window, as seen in figure ???. If no JCCBI entry is currently loaded this button has no effect.

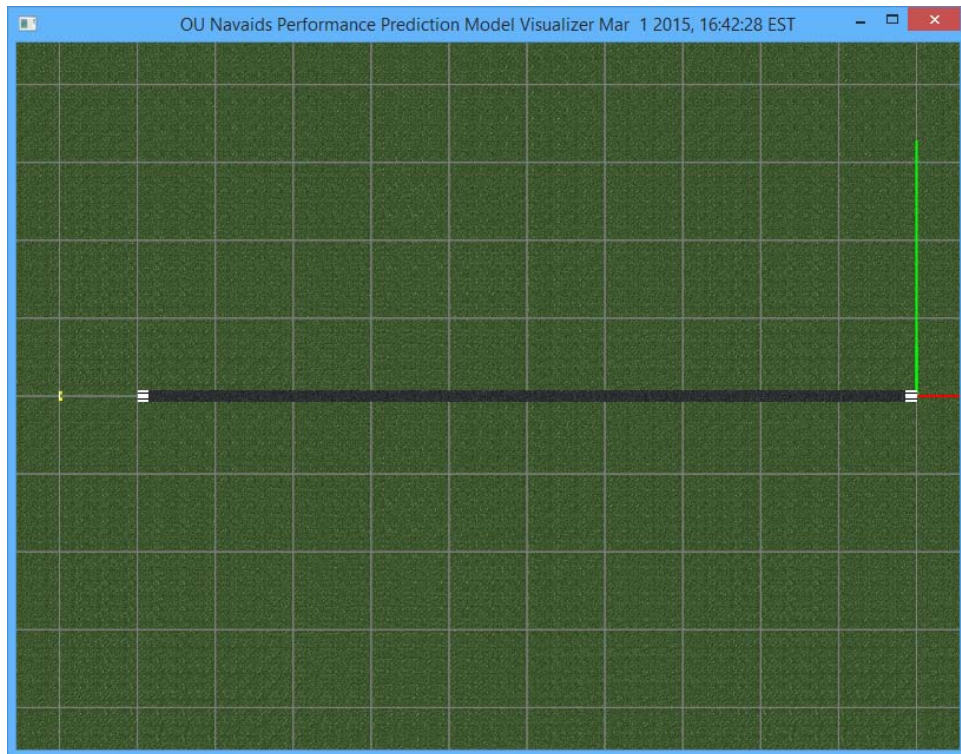


Figure 44: A runway with width 150ft.

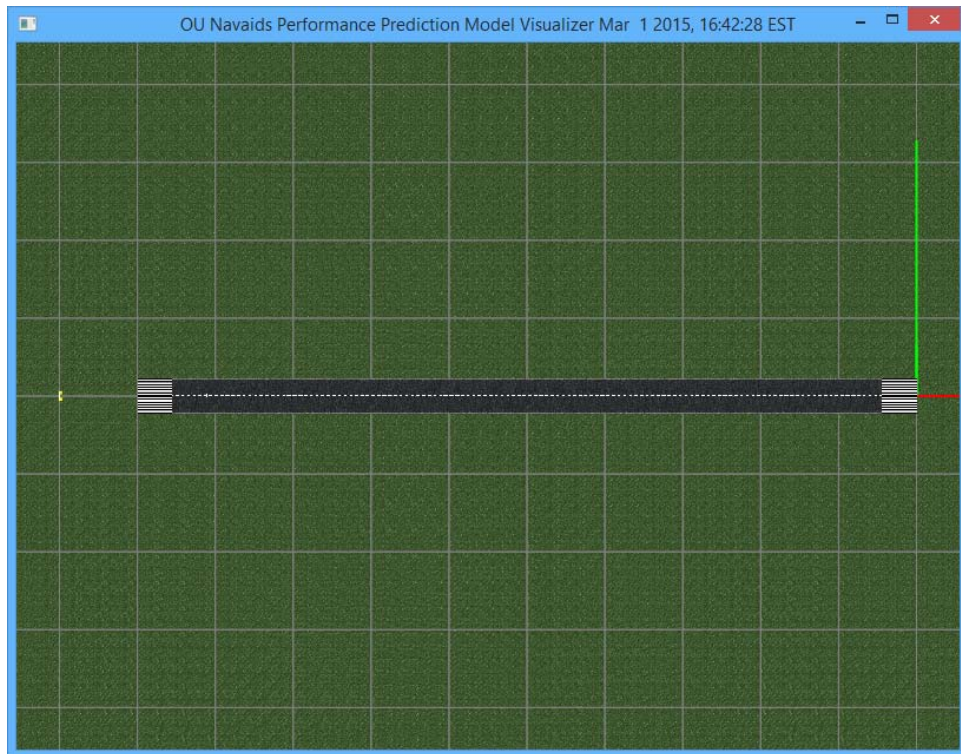



Figure 45: A runway with width of 450ft.

The cancel button  unloads the currently selected JCCBI entry. Note: This currently has a side effect of resetting the center frequency.

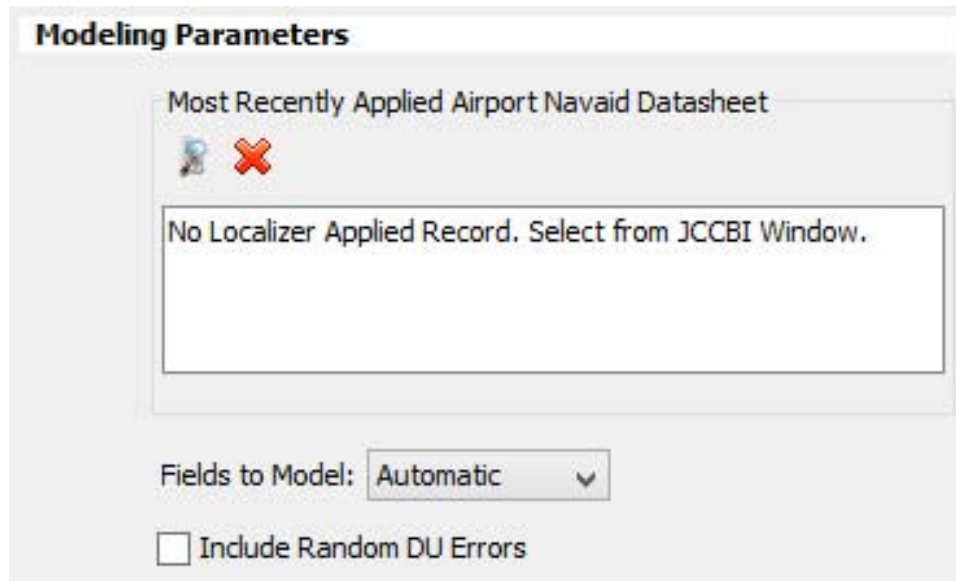


Figure 46: The localizer tab.

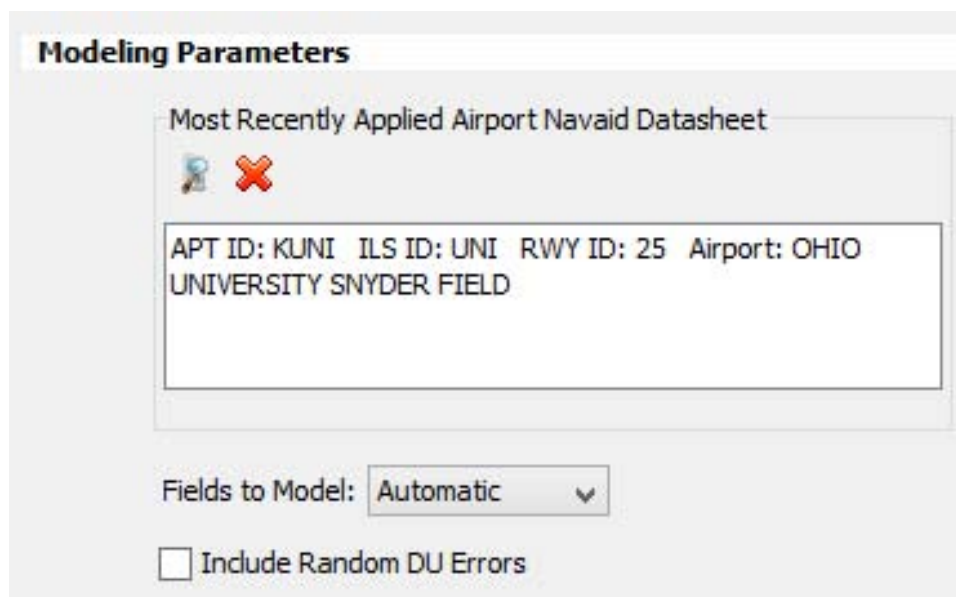


Figure 47: The localizer tab.

### Effect on the Model

The JCCBI interface itself, as described in chapter 18, will affect many aspects of the model, but these components are intended to simply view that data, not manipulate it. Note: “cancel” currently has a side effect of resetting the center frequency, which does effect the model.

### Effect on the GUI

Viewing the existing JCCBI state through this summary should not affect other components.

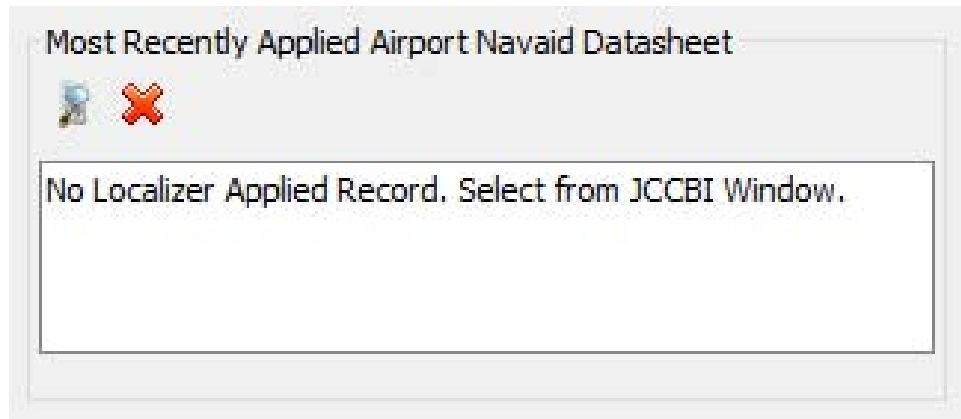


Figure 48: The datasheet group without a JCCBI datasheet loaded.

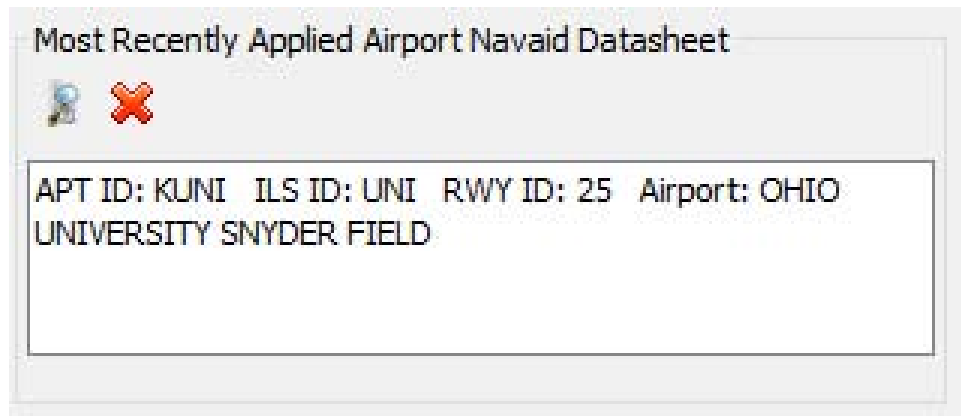


Figure 49: The datasheet group with a JCCBI datasheet loaded.

### Effect on the Virtual World

Altering the attached datasheet via The JCCBI interface itself, as described in chapter 18, will have several possible changes on the virtual world state, but viewing the JCCBI summary through these components should have no effect.

### Field

#### Overview

There are two different models of scatterer field interaction: near and far. The combo box shown in figure ?? has three options: near, far, and automatic. It defaults to automatic, which will use the nearfield equations when less than some fixed number of wavelengths from the NAVAID, and uses the far field equations beyond that distance. However, a user may choose to always use the near or far field equations.

#### Effect on the Model

Near field takes longer.

#### Effect on the GUI

This component has no effect on other GUI components.



NAVAID Viewer - /pls/datasheet\_prd/pkg\_ils.pro\_ils\_rpt?v\_cntl\_num=71718&v\_driver\_use=LOC&v\_format=F

http://avnwww.jcabi.gov/pls/datasheet\_prd/pkg\_ils.pro\_ils\_rpt?v\_cntl\_num=71718&v\_driver\_use=LOC&v\_format=F

Date: 03/12/14 16:50pm

\*\*\* ILS INQUIRY - ACTIVE \*\*\*

DATUMS: Horiz: NAD83 Vert: NAVD83 CTRY: US

AIRPORT: OHIO UNIVERSITY SNYDER FIELD ARPT-ID: KUNI RWY: 25 LCTN: ATHENS/ALBANY ST: OH REG: GL FIFO: BTL OWN: S

AL# 5861

*** AFIS DATA ***								*** AIRPORT DATA ***			
ILS-ID	UNI	OS-ALN	3.00	OM-DES	28996	FC-ALN	1.5 - 0.5	ARP-LAT	N39-12-42.81		
APT-ID	KUNI	OS-WID	0.70	RW-BRG	240.73	BC-ALN		ARP-LON	W082-13-45.32		
TH-HGT	761	TH-DES	932	RW-LEN	5600	UPDATE-DES	4700	FIELD-ELEV	765.7		
RE HGT	765	TH-LAT	N39-12-56.35	COUNTRY-CODE	US	UPDATE-ELV_MLS	762.9	FLD-ELIP-ELEV	653.8 E		
RWY-ID	25	TH-LON	W082-13-14.29	ACTIVE-FLAG	A	TH-ELIP-HOT	648.6	TH-LAT	N39-12-56.35		
CAT	I	DME-DES		LC-OFF		QBOD-SEP	111.9	TH-LON	W082-13-14.29		
GS-LAT	N39-12-49.61	DME-OFF		LC-DES	4773			TH-ELEV	760.5		
GS-LON	W082-13-23.01	DME HGT		LC-FCB	240.73			TH-ELIP-ELEV	648.6 E		
GS-HGT	757	FREQ	108.750	LC-BCB	60.72			RE-LAT	N39-12-29.28		
GS-OFF	L259	MVAR	1995/W06	LC-WID	6.00			RE-LON	W082-14-16.35		
								RE-ELEV	765.4		
								RE-ELIP-ELEV	653.5 E		
								RWY-LGTH/WIDT	5600/100		
*** LOCALIZER ***								*** AIRPORT DATA ***			
(DFI CODE - ILS I)								DSPLCD-TH-DIST			
ANT LAT	N39-12-28.76	XMTR	SINGLE	LOC-RE	105/ 0.017	LCW-TAIL	NO	DSPLCD-TH-LAT			
ANT LON	W082-14-17.51	EQUIP-TYPE	MK20A	LOC-TH	5705/ 0.939	LCW-FT-TH	598	DSPLCD-TH-LON			
ELEV	760.2	STBY-POWER		LOC-IM		DATE-COMM	10/30/87	DSPLCD-TH-ELEV			
ANT-TYPE	LOG-PER	ESV	N	LOC-MM		DATE-RECON	05/15/03	DISP-TH-ELIP-ELEV			
DUAL-FREQ	NO	RESTRICTED	Y	LOC-OM		SURVEY-ACCY	8T	RWY-LDG-LGTH	5600		
US-DIST: FC	5260/ 18.0	BC		LOC-FAF	36500/ 6.007	VOICE	NONE	TDZ-ELEV	764.7		
CLRNC-CVG:FC	90/35 150/35	BC		MON-AL-WID	W 7.02 N 4.98	REC TYPE		FAR PART 139	No		
CKPT-DESC: FC	UGS NDB			BC				DECISION HEIGHTS:			
LOC-WIDTH-MX-ALERT:	6.61/ 5.39			LOC-AL-MX-ALERT:	9uA	ROLLOUT:	NR	DH	DIST/ALT		
LOC-WIDTH-INITIAL:	6.84/ 5.16							(100)	0 0		
								(150)	0 0		

\*\*\* CLUE SLOPE \*\*\*

DFI CODE - ILS I

Figure 50: The datasheet for KUNI loaded view the datasheet view button.

Fields to Model: Automatic

Automatic

Near

Far

Figure 51: The field combo box options.

## Effect on the Virtual World

This selection has no effect on the virtual world.

## DU Error

### Overview

### Effect on the Model

### Effect on the GUI

### Effect on the Virtual World

## 9.3 Array Parameters

This section discusses the *array parameters*, as shown in figure 52. This section is divided into 9 subsections describing the component groups found in figure 55: Array Type, Center Frequency, CLR Frequency, Runway Heading, Runway Length, and Runway Width.

The screenshot displays the 'Array Parameters' window, which is divided into two main sections: 'Course Array' and 'Clearance Array'. Each section contains a series of input fields for various parameters. The 'Course Array' section includes fields for Element Type (set to LPD), Main Setback (500.0 ft), Main Offset (0.0 ft), Main Height (5.57 ft), Array Rotation (0.0 deg), and Antenna Rotation (0.0 deg). The 'Clearance Array' section includes fields for Element Type (set to LPD), Main Setback (500.0 ft), Main Offset (0.0 ft), Main Height (5.57 ft), Array Rotation (0.0 deg), and Antenna Rotation (0.0 deg). Additionally, there are fields for Clearance Width (11.5 deg) and CLR / CRS Separation (-10.0 dB). At the bottom, there is a checkbox labeled 'Use Course Params as Clearance Params' which is checked.

Course Array:		Clearance Array:	
Element Type:	LPD	Element Type:	LPD
Main Setback:	500.0 ft	Main Setback:	500.0 ft
Main Offset:	0.0 ft	Main Offset:	0.0 ft
Main Height:	5.57 ft	Main Height:	5.57 ft
Array Rotation:	0.0 deg	Array Rotation:	0.0 deg
Antenna Rotation:	0.0 deg	Antenna Rotation:	0.0 deg
		Clearance Width:	11.5 deg
		CLR / CRS Separation:	-10.0 dB
<input checked="" type="checkbox"/> Use Course Params as Clearance Params			

Figure 52: The array parameters components with course array components activated only.

Array Parameters

Course Array:

Element Type: LPD

Main Setback: 1000.0 ft

Main Offset: 0.0 ft

Main Height: 5.57 ft

Array Rotation: 0.0 deg

Antenna Rotation: 0.0 deg

Clearance Array:

LPD

1000.0 ft

0.0 ft

5.57 ft

0.0 deg

0.0 deg

Clearance Width: 2.2 deg

CLR / CRS Separation: -17.0 dB

☒ Use Course Params as Clearance Params

Figure 53: The array parameters components fully activated.

## Element Type

### Overview

### Effect on the Model

### Effect on the GUI

### Effect on the Virtual World

## Main Setback

### Overview

### Effect on the Model

### Effect on the GUI

### Effect on the Virtual World

## Main Offset

### Overview

### Effect on the Model

### Effect on the GUI

### Effect on the Virtual World

## Main Height

### Overview

### Effect on the Model

### Effect on the GUI

### Effect on the Virtual World

## Array Rotation

### Overview

DME models. This chapter will be divided into four sections matching the 4 panels of the glideslope tab: Facility Parameters, Modeling Parameters, Array Parameters, and Array Auto-Adjust.

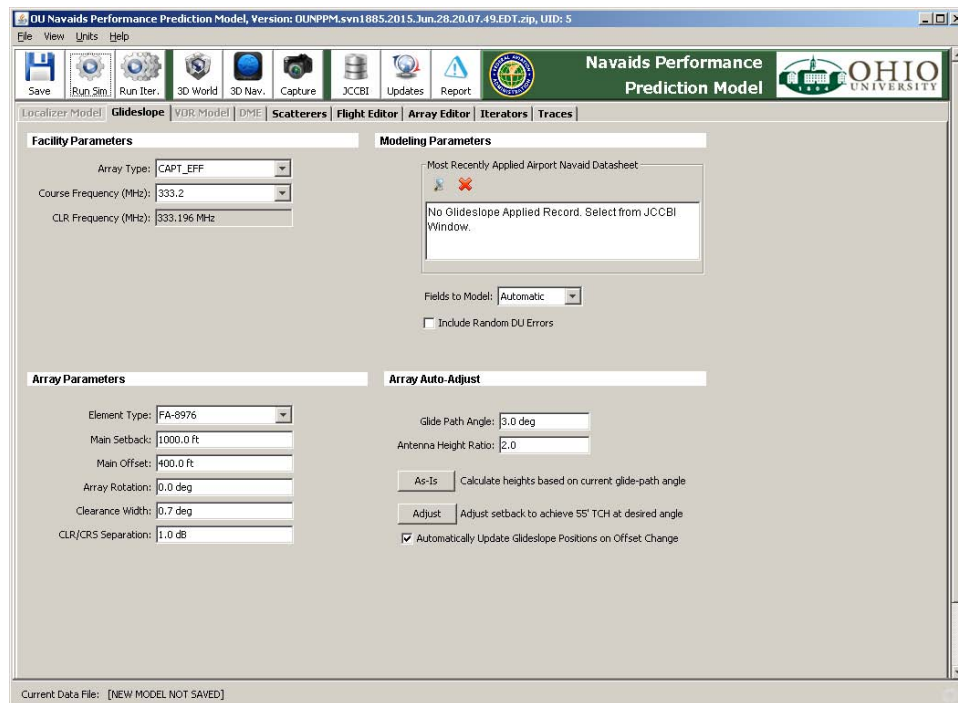


Figure 54: The glideslope tab.

## 10.1 Facility Parameters

This section discusses the *facility parameters*, as shown in figure 55. This section is divided into 3 subsections describing the component groups found in figure 55: Array Type, Course Frequency, and CLR Frequency.

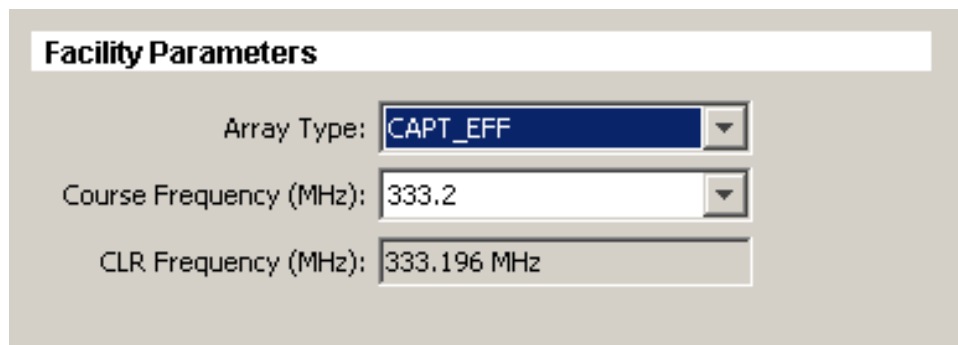


Figure 55: The facility parameters component group.

### Array Type

#### Overview

The array type selection consists of two main components, as seen in figure 56: the combo (drop down) box, and the refresh button. The combo box for the glideslope

array type facility parameter is populated from the list of all *.gdu* files in the *para* folder.

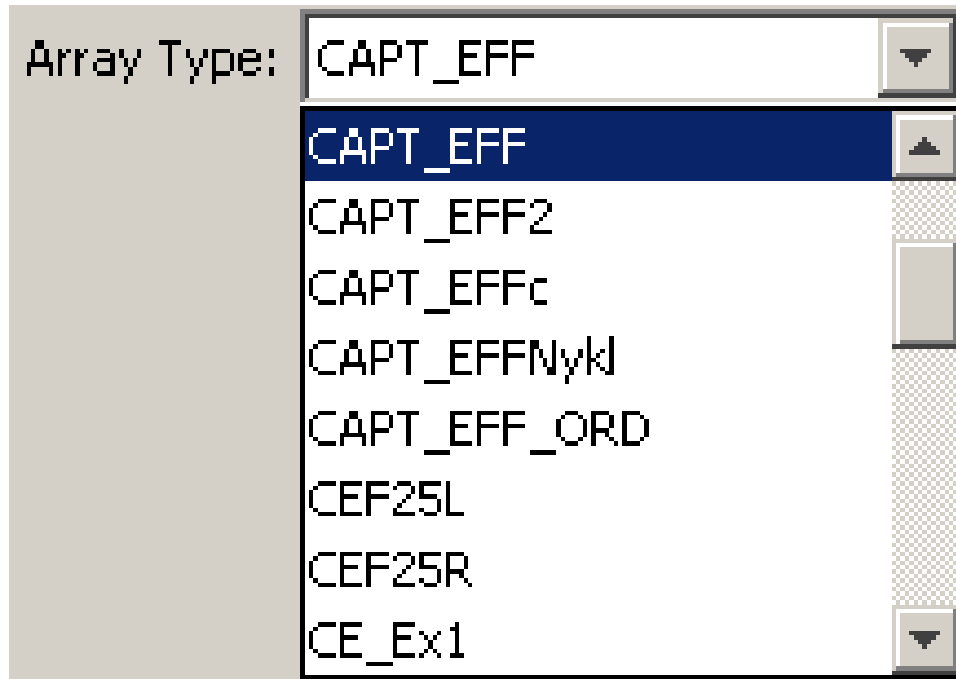



Figure 56: The array type components.

### Effect on the Model

Selecting an array from this drop down list will update the internal state of the model for subsequent runs to use the array defined by the *.gdu* file. In general, arrays with more elements have lower error. The refresh  button, assigns the previous state of the run to the array parameters. This is either the default values, or the values stored in the *.dat* file indicated in the current data file indicator, as seen in figure 25.

### Effect on the GUI

Selecting a new array from this drop down list might also modify the enabled array modeling components, as described in section 10.3. If an array is selected containing only one (1) set of elements, the clearance components will become deactivated, as seen in figure 52; if an array is selected containing both sets of elements all components will be active, as seen in figure 67. Similarly, the CLR Frequency component will also be deactivated when only the course array is used, as seen in figure 60; if an array is selected containing both sets of elements all the CLR Frequency will be active, as seen in figure 59.

### Effect on the Virtual World

The depiction of the array in the virtual world is shown in figure 57. The antennae are drawn as orange rectangles on a grey rectangle depicting the tower. The direction of propagation of the glideslope signal is represented by an animated red propagation pattern.

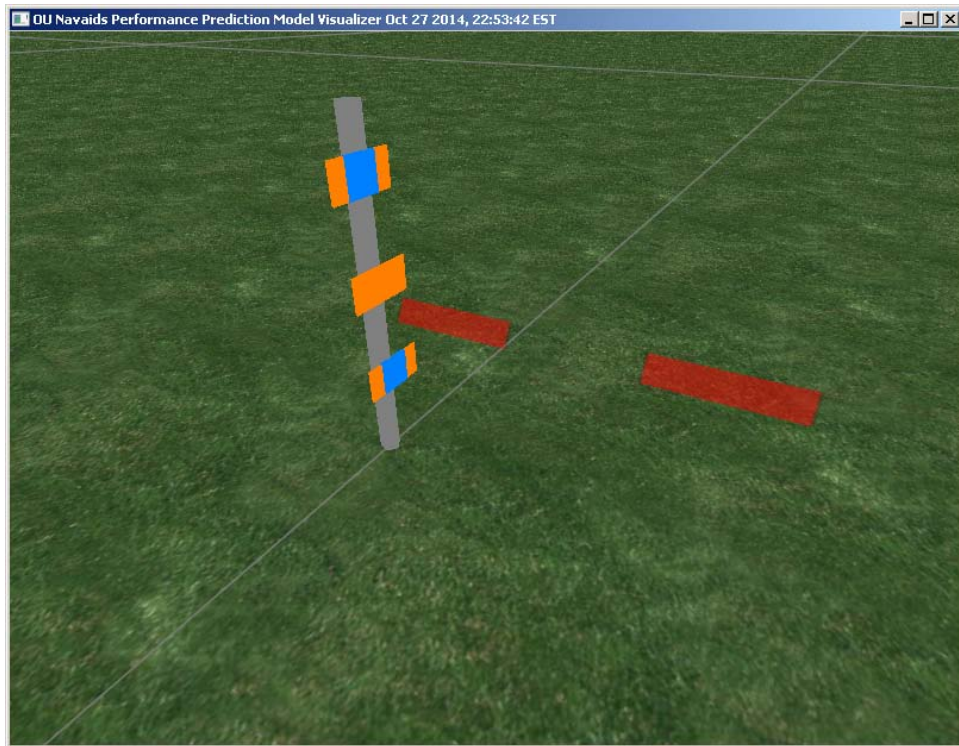


Figure 57: The array in the virtual world.

## Center Frequency

### Overview

When a course and clearance array are both present their frequencies are separated by 4kHz. The frequency they are centered around can be selected from the combo box as seen in figure 58.

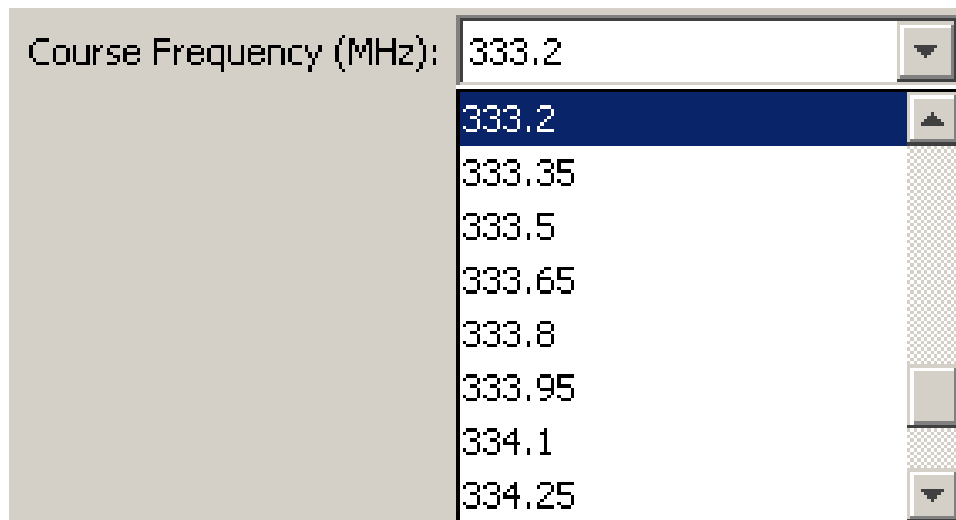


Figure 58: The center frequency component.

### Effect on the Model

Selecting a frequency from this drop down list will update the internal state of the model for subsequent runs.

### Effect on the GUI

When the course frequency is changed, the clearance frequency will be updated to be 4kHz less than the course frequency.

### Effect on the Virtual World

This component has no effect on the virtual world.

## CLR Frequency

### Overview

By default, a course and clearance array are both present their frequencies are separated by 8kHz. This separation is adjustable within the model using the CLR Frequency component. This component is only editable



Figure 59: The clearance frequency component.

Figure 59 shows the CLR Frequency component when it is active. Figure 60 shows the CLR Frequency component when it is deactivated.



Figure 60: The clearance frequency component deactivated.

If the course and clearance arrays are locked, as indicated by the checkbox in the array parameters, as described in section 9.3, as seen in figure ??, then the CLR frequency cannot be set manually. If the arrays are not locked any value can be entered.

Note: Values entered into this component are always treated as MHz, no matter the extension.‡

### Effect on the Model

Setting this component implicitly increase the separation of the course and clearance arrays. The center frequency,  $v_c$ , is specified by the value in the center frequency component, as described in section 9.1. The clearance frequency,  $v_-$  is specified by the value in this component. Equations (3) and (4) provide two (2) separate derivations for the course frequency,  $v_+$ .

$$v_+ = v_c + (v_c - v_-) \quad (3)$$

$$v_+ = 2v_c - v_- \quad (4)$$

### Effect on the GUI

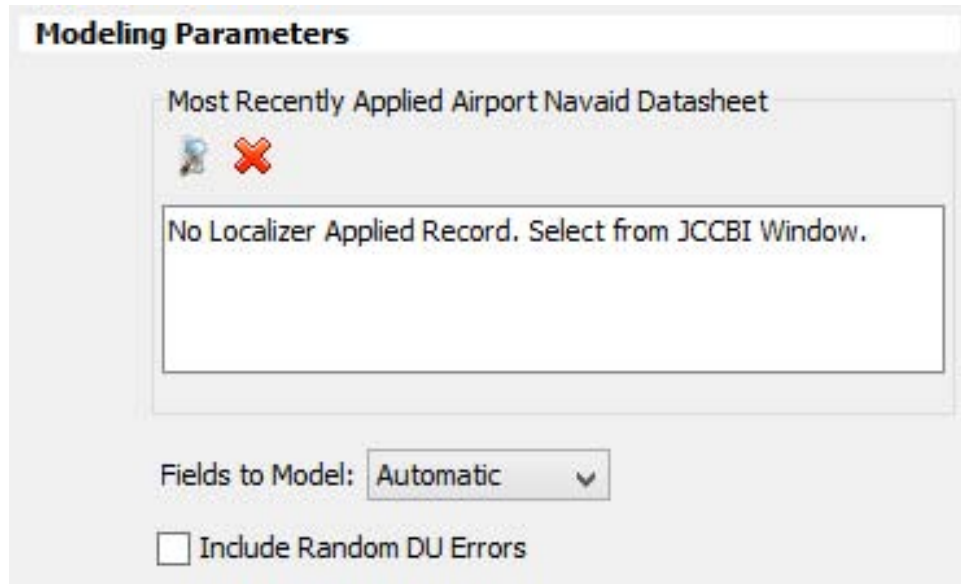
This component has no effect on the other GUI widgets.

## Effect on the Virtual World

This component has no effect on the virtual world. s

## 10.2 Modeling Parameters

This section discusses the *modeling parameters*, as shown in figures 61 and 62. Figure 61 shows the modeling parameters group if no JCCBI datasheet is loaded; figure 62 shows the modeling parameters group if a JCCBI datasheet has been loaded. See chapter 18 for more information about OUNPPM's interface to the JCCBI. This section is divided into 3 subsections describing the component groups found in figure 55: Datasheet, Field, and DU Error.



**Modeling Parameters**

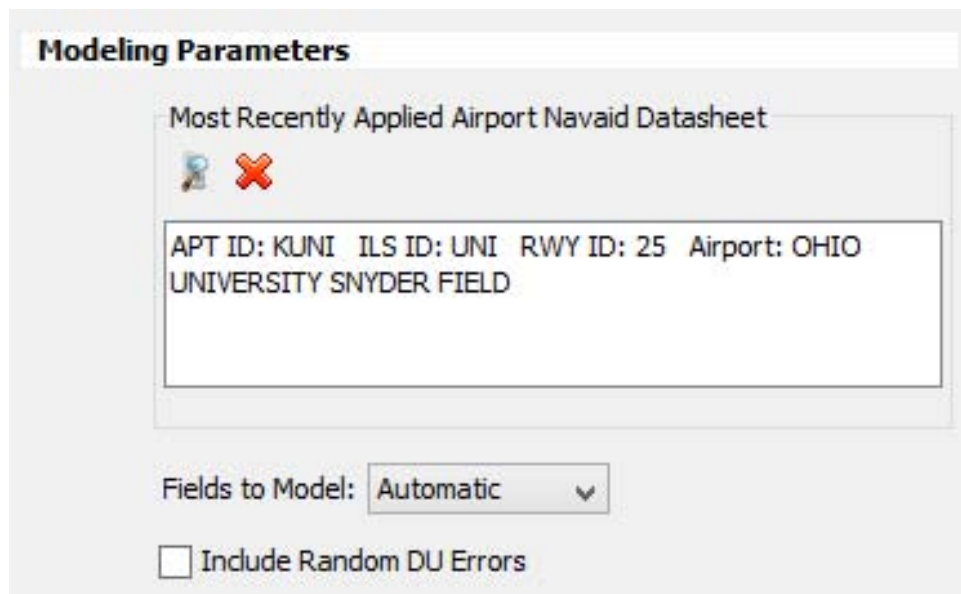
Most Recently Applied Airport Navaid Datasheet

No Localizer Applied Record. Select from JCCBI Window.

Fields to Model: Automatic

☐ Include Random DU Errors

Figure 61: The localizer tab.



**Modeling Parameters**

Most Recently Applied Airport Navaid Datasheet

APT ID: KUNI ILS ID: UNI RWY ID: 25 Airport: OHIO  
UNIVERSITY SNYDER FIELD

Fields to Model: Automatic

☐ Include Random DU Errors

Figure 62: The localizer tab.



## Datasheet

### Overview

The JCCBI datasheet display consists of three main components, as seen in figures 66 and 64: the view button, cancel button, and the summary box. Figure 66 shows the summary box if a no datasheet has been loaded.

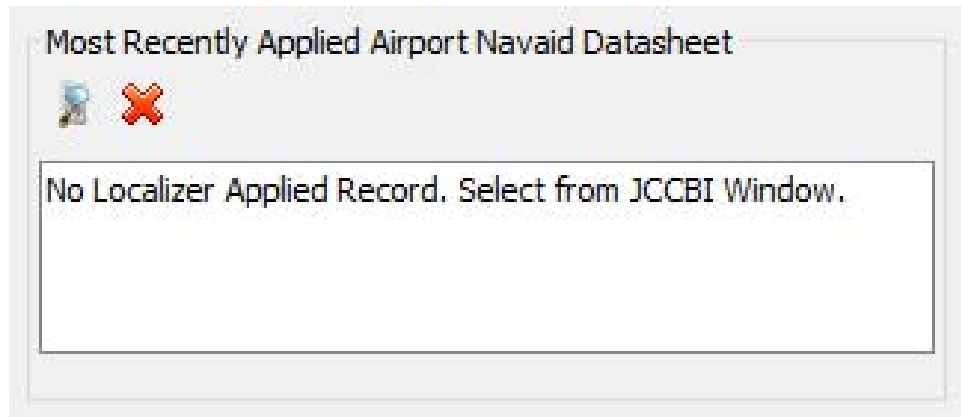


Figure 63: The datasheet group without a JCCBI datasheet loaded.

Figure 64 shows an example summary box if a databox had been loaded with the KUNI JCCBI datasheet.

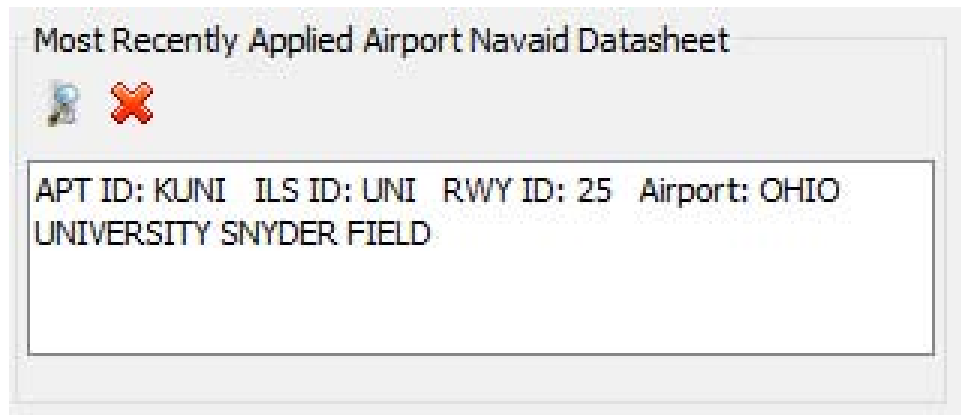




Figure 64: The datasheet group with a JCCBI datasheet loaded.

The view button  opens the datasheet for the currently loaded JCCBI entry in a new window, as seen in figure ???. If no JCCBI entry is currently loaded this button has no effect.

The cancel button  unloads the currently selected JCCBI entry. Note: This currently has a side effect of resetting the center frequency.

### Effect on the Model

The JCCBI interface itself, as described in chapter 18, will affect many aspects of the model, but these components are intended to simply view that data, not manipulate it. Note: “cancel” currently has a side effect of resetting the center frequency, which does effect the model.

NAVAID Viewer - /pls/datasheet\_prd/pkg\_ils.pro\_ils\_rpt?v\_cntl\_num=71718&v\_driver\_use=LOC&v\_format=F

http://avnwww.jccbi.gov/pls/datasheet\_prd/pkg\_ils.pro\_ils\_rpt?v\_cntl\_num=71718&v\_driver\_use=LOC&v\_format=F

Date: 03/12/14 16:50pm

\*\*\* ILS INQUIRY - ACTIVE \*\*\*

DATUMS: Horiz: NAD83 Vert: NAVD83 CTRY: US

AIRPORT: OHIO UNIVERSITY SNYDER FIELD ARPT-ID: KUNI RWY: 25 LCTN: ATHENS/ALBANY ST: OH REG: GL FIFO: BTL OWN: S

AL# 5861

*** AFIS DATA ***								*** AIRPORT DATA ***			
ILS-ID	UNI	OS-ALN	3.00	OM-DES	28996	FC-ALN	1.5 - 0.5	ARP-LAT	N39-12-42.81		
APT-ID	KUNI	OS-WID	0.70	RW-BRG	240.73	BC-ALN		ARP-LON	W082-13-45.32		
TH-HGT	761	TH-DES	932	RW-LEN	5600	UPDATE-DES	4700	FIELD-ELEV	765.7		
RE HGT	765	TH-LAT	N39-12-56.35	COUNTRY-CODE	US	UPDATE-ELV_MLS	762.9	FLD-ELIP-ELEV	653.8 E		
RWY-ID	25	TH-LON	W82-13-14.29	ACTIVE-FLAG	A	TH-ELIP-HOT	648.6	TH-LAT	N39-12-56.35		
CAT	I	DME-DES		LC-OFF		QBOD-SEP	111.9	TH-LON	W082-13-14.29		
GS-LAT	N39-12-49.61	DME-OFF		LC-DES	4773			TH-ELEV	760.5		
GS-LON	W082-13-23.01	DME HGT		LC-FCB	240.73			TH-ELIP-ELEV	648.6 E		
GS-HGT	757	FREQ	108.750	LC-BCB	60.72			RE-LAT	N39-12-29.28		
GS-OFF	L259	MVAR	1995/W06	LC-WID	6.00			RE-LON	W082-14-16.35		
								RE-ELEV	765.4		
								RE-ELIP-ELEV	653.5 E		
								RWY-LGTH/WIDT	5600/100		
*** LOCALIZER ***											
(DFI CODE - ILS I)											
ANT LAT	N39-12-28.76	XMTR	SINGLE	LOC-RE	105/ 0.017	LCW-TAIL	NO	DSPLCD-TH-DIST			
ANT LON	W082-14-17.51	EQUIP-TYPE	MK20A	LOC-TH	5705/ 0.939	LCW-FT-TH	598	DSPLCD-TH-LAT			
ELEV	760.2	STBY-POWER		LOC-IM		DATE-COMM	10/30/87	DSPLCD-TH-LON			
ANT-TYPE	LOG-PER	ESV	N	LOC-MM		DATE-RECON	05/15/03	DSPLCD-TH-ELEV			
DUAL-FREQ	NO	RESTRICTED	Y	LOC-OM		SURVEY-ACCY	8T	DISP-TH-ELIP-ELEV			
US-DIST: FC	5260/ 18.0	BC		LOC-FAF	36500/ 6.007	VOICE	NONE	RWY-LDG-LGTH	5600		
CLRNC-CVG:FC	90/35 150/35	BC		MON-AL-WID	W 7.02 N 4.98	REC TYPE		TDZ-ELEV	764.7		
CKPT-DESC: FC	UGS NDB							FAR PART 139	No		
*** CLUE SLOPE ***											
(DFI CODE - ILS I)											
LOC-WIDTH-MX-ALERT:	6.61/ 5.39	LOC-AL-MX-ALERT:	9uA	ROLLOUT:	NR						
LOC-WIDTH-INITIAL:	6.84/ 5.16										
								DECISION-HEIGHTS:			
								DH DIST/ALT			
								(100) 0 0			
								(150) 0 0			

Figure 65: The datasheet for KUNI loaded view the datasheet view button.

## Effect on the GUI

Viewing the existing JCCBI state through this summary should not affect other components.

## Effect on the Virtual World

Altering the attached datasheet via The JCCBI interface itself, as described in chapter 18, will have several possible changes on the virtual world state, but viewing the JCCBI summary through these components should have no effect.

## Field

### Overview

There are two different models of scatterer field interaction: near and far. The combo box shown in figure ?? has three options: near, far, and automatic. It defaults to automatic, which will use the nearfield equations when less than some fixed number of wavelengths from the NAVAID, and uses the far field equations beyond that distance. However, a user may choose to always use the near or far field equations.

### Effect on the Model

Near field takes longer.

### Effect on the GUI

This component has no effect on other GUI components.

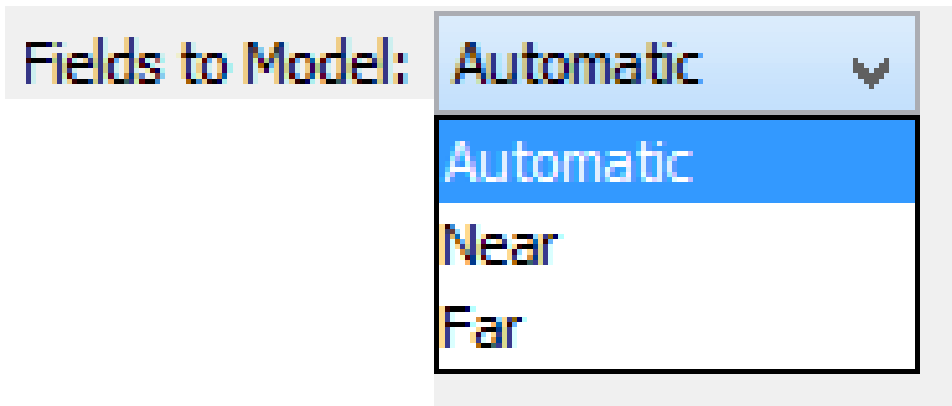


Figure 66: The field combo box options.

### Effect on the Virtual World

This selection has no effect on the virtual world.

## 10.3 Array Parameters

This section discusses the *array parameters*, as shown in figure 67. This section is divided into 6 subsections describing the component groups found in figure 55: Element Type, Main Setback, Main Offset, Array Rotation, Clearance Width, CLR/CRS Separation.

Figure 67: The array parameters components.

### Element Type

#### Overview

Select the glideslope element type to be used for all glideslope antennas from the drop-down list as shown in figure 68.

#### Effect on the Model

The element type chosen can drastically affect the shape of the glideslope signal. Elements with wider apertures can be chosen to reduce the lateral beam width of the

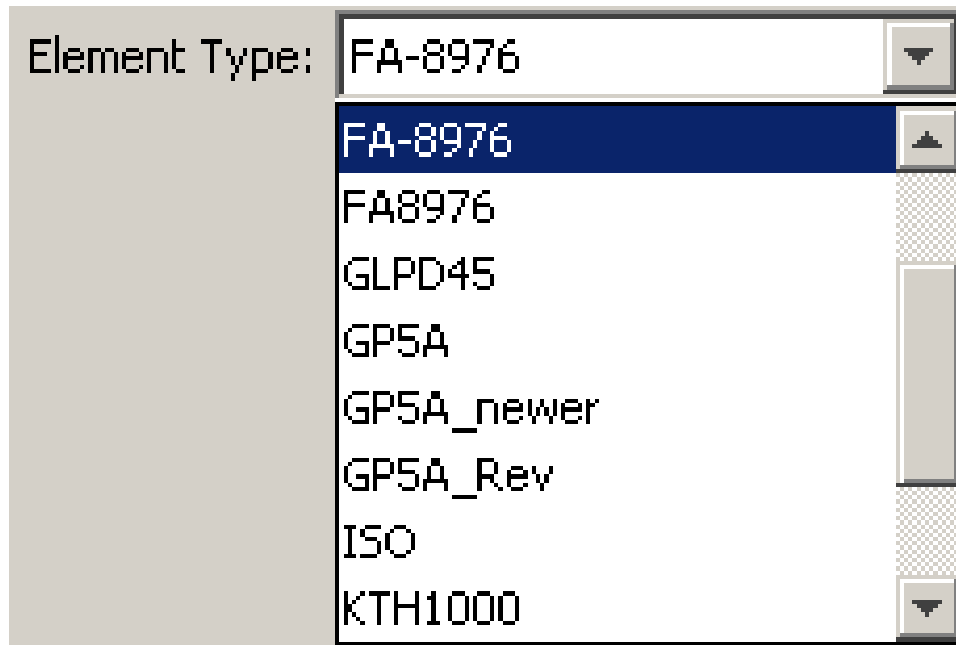


Figure 68: The Element Type component.

glideslope signal.

#### **Effect on the GUI**

This component has no effect on other GUI components.

#### **Effect on the Virtual World**

This component has no effect on the virtual world.

#### **Main Setback**

##### **Overview**

The Main Setback is the setback of the base of the glideslope mast (or phase center for Endfire arrays) from the runway threshold

##### **Effect on the Model**

The setback of the glideslope can be used to modify the runway Threshold Crossing Height (TCH).

#### **Effect on the GUI**

This component has no effect on other GUI components.

#### **Effect on the Virtual World**

A change in the main setback will be noticeable in the graphic representation of the glideslope mast

## **Main Offset**

### **Overview**

The Main Offset is the offset of the base of the glideslope mast (or phase center (PC) for Endfire arrays) from the runway centerline. The offset of the glideslope must be chosen properly to ensure that the mast stays within obstacle clearance limits for the runway.

### **Effect on the Model**

Setting the main offset to be too far off the runway centerline can have derogatory effects on the approach within Zone 3.

### **Effect on the GUI**

This component has no effect on other GUI components.

### **Effect on the Virtual World**

A change in the main offset will be noticeable in the graphic representation of the glideslope mast.

## **Array Rotation**

### **Overview**

Array rotation is the angular rotation of the glideslope propagation direction from being parallel to the runway centerline.

### **Effect on the Model**

A positive value for the Array Rotation will rotate the entire array counter-clockwise, while a negative value will rotate the array clockwise.

### **Effect on the GUI**

This component has no effect on other GUI components.

### **Effect on the Virtual World**

A change in the array rotation will be noticeable in the graphic representation of the glideslope mast

## **Clearance Width**

### **Overview**

This box sets the width for the clearance portion of the array.

### **Effect on the Model**

Initial value for the clearance width is 0.7deg.

### **Effect on the GUI**

This component has no effect on other GUI components.

### Effect on the Virtual World

This component has no effect on the virtual world.

### CLR / CRS Separation

#### Overview

This box sets the power separation between the course and the clearance signals. A positive value indicates that the clearance signal should be that much weaker than the course signal.

#### Effect on the Model

Changing the power separation between the two arrays can change the points at which the clearance signal is captured over the course signal. Reducing the CLR power can cause weak signal and 'holes' in the CDI beyond the capture points.

#### Effect on the GUI

This component has no effect on other GUI components.

### Effect on the Virtual World

This component has no effect on the virtual world.

## 10.4 Array Auto-Adjust

This section discusses the *array auto-adjust*. This section is divided into 6 subsections describing the component groups found in figure 55: Element Type, Main Setback, Main Offset, Array Rotation, Clearance Width, CLR/CRS Separation.

This section discusses the Array Auto-Adjustment feature of the model, as shown in figure ???. This feature is used to automatically adjust certain array parameters based on certain others

**Array Auto-Adjust**

Glide Path Angle:

Antenna Height Ratio:

Calculate heights based on current glide-path angle

Adjust setback to achieve 55' TCH at desired angle

☒ Automatically Update Glideslope Positions on Offset Change

Figure 69: The array auto-adjust components.

## **Glide Path Angle**

### **Overview**

This box sets the desired glide path angle to be used in the array adjustment calculations.

### **Effect on the Model**

Changes the glide path angle used in the auto-adjustment calculations.

### **Effect on the GUI**

This component has no effect on other GUI components.

### **Effect on the Virtual World**

Changes to this field will only be obvious in the VirtualWorld if they are applied using the As-Is or Adjust buttons.

## **Antenna Height Ratio**

### **Overview**

This box sets the antenna height ratio to be used in the array adjustment calculations.

### **Effect on the Model**

This value is the desired ratio between the Upper and Lower antennae in two-antenna systems (ex. SRGS), and between the Middle and Lower antennae in three-antenna systems (ex. CEGS). In the latter case, The Upper antenna height  $H_{ua}$  will be set based on the Lower antenna height  $H_{la}$  and the Antenna Height Ratio  $R_{ah}$  according to the following formula:

$$H_{ua} = H_{la} * (3 * \frac{R_{ah}}{2}) \quad (5)$$

### **Effect on the GUI**

This component has no effect on other GUI components.

### **Effect on the Virtual World**

Changes to this field will only be obvious in the VirtualWorld if they are applied using the As-Is or Adjust buttons.

## **'As-Is' Button**

### **Overview**

This button will cause the heights of the glideslope antennae to be adjusted given the Glide Path Angle and Antenna Height Ratio entered above the button, as well as the array setback and offset from the Array Parameters section.

### Effect on the Model

The height of the lower antenna is set to achieve the desired path angle and then the rest of the the antennae are set depending on the type of glideslope array chosen.

For a Null-Reference, or Sideband-Reference system, the Upper antenna height  $H_{ua}$  will be set as follows:

$$H_{ua} = H_{la} * R_{ah} \quad (6)$$

For a Capture-Effect system, the Middle  $H_{ma}$  and Upper  $H_{ua}$  antenna heights will be set as follows:

$$H_{ma} = H_{la} * R_{ah} \quad (7)$$

$$H_{ua} = H_{la} * (3 * \frac{R_{ah}}{2}) \quad (8)$$

### Effect on the GUI

This component has no effect on other GUI components.

### Effect on the Virtual World

Changes to the Antenna heights will be visible in the VirtualWorld after clicking this button

## 'Adjust' Button

### Overview

This button will cause the main setback of the entire array to be moved to ensure a 55 TCH given the default heights of the glideslope antennae, and the Glide Path Angle and Antenna Height Ratio entered above the button.

### Effect on the Model

The new glideslope tower location is calculated as follows:

$$SB = \frac{55'}{\tan(\theta_{gp})} \quad (9)$$

(Where SB = Array Setback, and  $\theta_{gp}$  = Glide Path Angle)

### Effect on the GUI

This component has no effect on other GUI components.

### Effect on the Virtual World

Changes to the antenna locations will be visible in the VirtualWorld after clicking this button

## Automatically Adjust Antenna Offsets for Main Offset Button

### Overview

This checkbox will ensure that when the As-Is or Adjust buttons are pressed, the model will set the correct offset values for each individual antenna based on the current array Main Offset from centerline.



### **Effect on the Model**

For two-antenna systems, the lower antenna will be set at an offset of 0 while the upper antenna will be offset closer to runway centerline. For three-antenna systems, the middle antenna offset will be set at an offset of 0 while the upper antenna will be offset closer to antenna centerline and the lower antenna will be offset further from runway centerline.

### **Effect on the GUI**

This component has no effect on other GUI components.

### **Effect on the Virtual World**

Changes to the antenna offsets will be visible in the VirtualWorld after clicking the 'As-Is' or 'Adjust' button.

Things specific to the glide slope model. This tab is only enabled for Glide slope models; therefore, it is mutually exclusive with localizer, VOR, and DME models.

## **11 VOR Model**

Things specific to the VOR model. This tab is only enabled for VOR models; therefore, it is mutually exclusive with localizer, glide slope, and DME models.

## 12 Scatterers

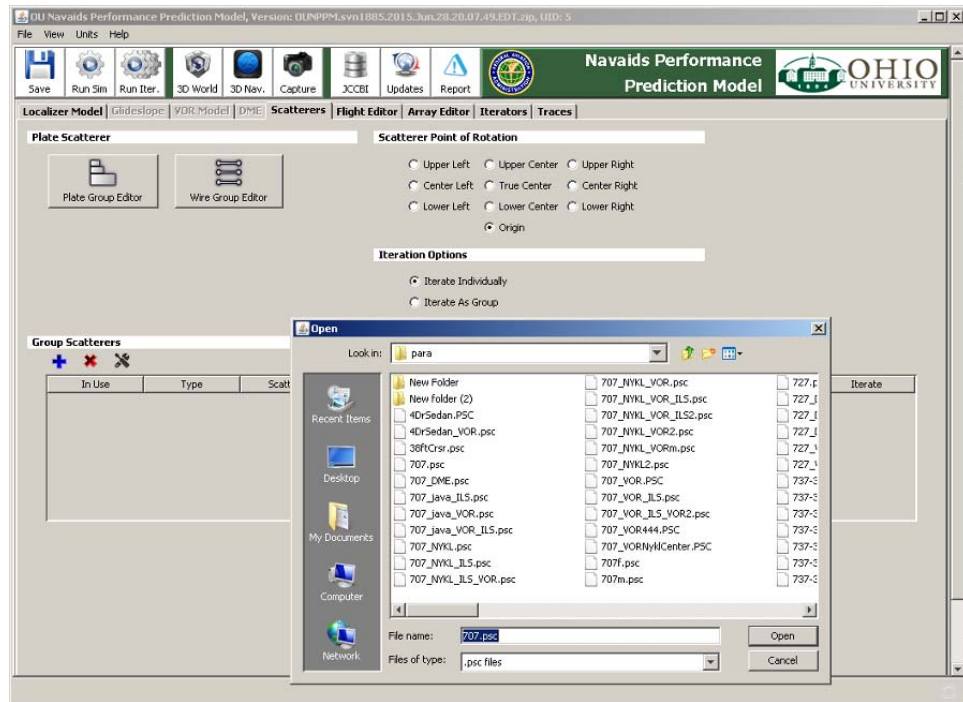


Figure 70: The main scatterer editor window. Groups of scatterer plates are loaded here.

Figure 70 shows how to insert a scatterer group into the model. In this case a Boeing 707 is being loaded.

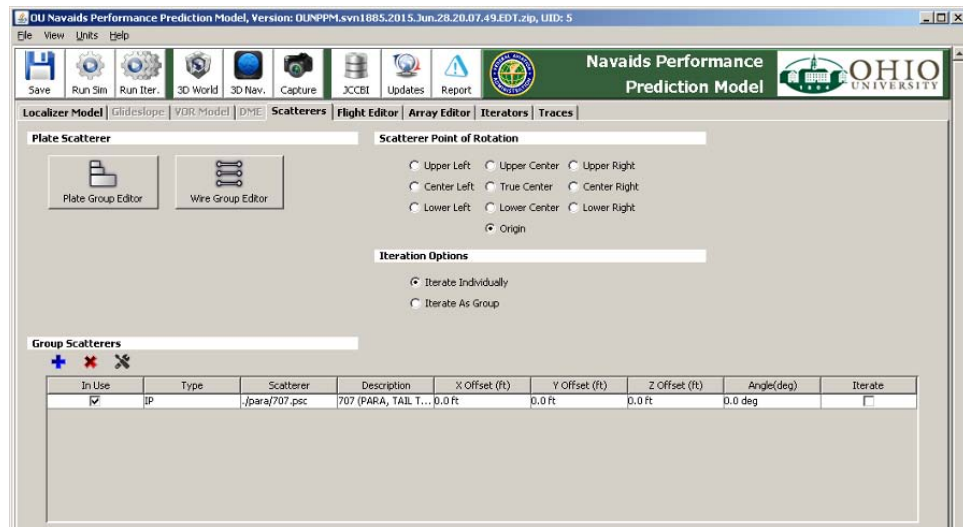


Figure 71: A Boeing 707 has been loaded and positioned at  $(0, 200, 50)$  with a rotation of  $45^\circ$ .

Figure 72 shows a Boeing 707 has been loaded and positioned at  $(0, 200, 50)$  with a rotation of  $45^\circ$ .

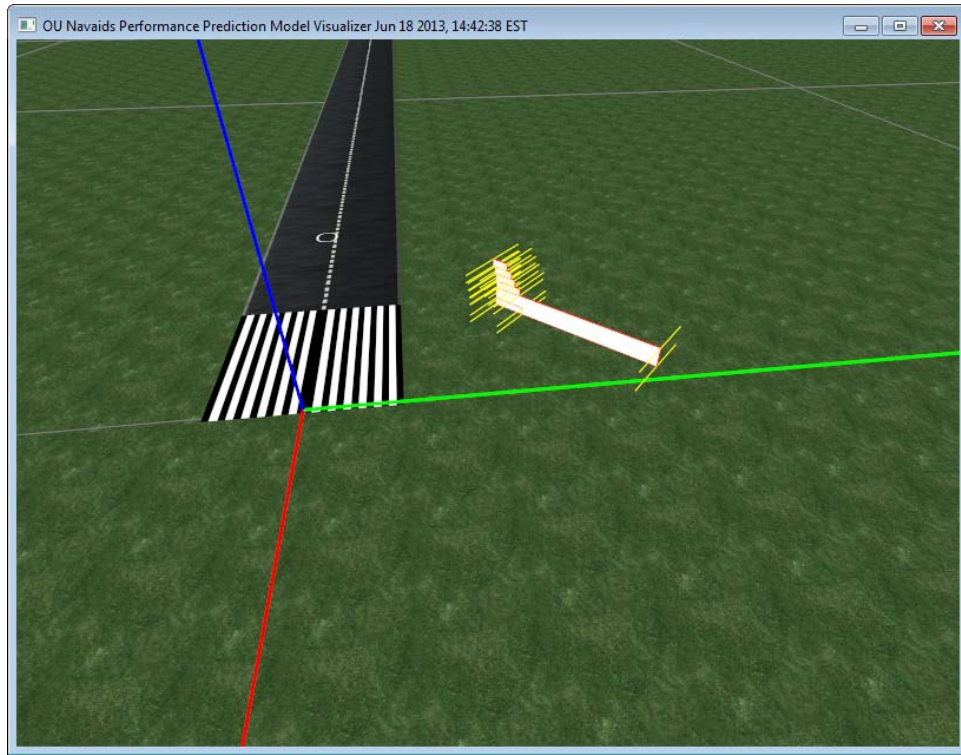


Figure 72: The 3D Visualization of the Boeing 707 positioned at  $(0, 200, 50)$  with a rotation of  $45^\circ$ . Notice its position relative to the *threshold / start end / origin*.

Figure 72 shows the 3D Visualization of the Boeing 707 positioned at  $(0, 200, 50)$  with a rotation of  $45^\circ$ . Notice its position relative to the *threshold / start end / origin*.

## 12.1 Scatterer Group Editor

To edit a scatterer group, such as the Boeing 707, one may click the *Scatterer Group Editor* Button located under the *Scatterers Tab*. See Fig.73. Alternatively, one may click the *Edit Selected* button when the desired scatterer group is selected within the main table, see Fig.73.

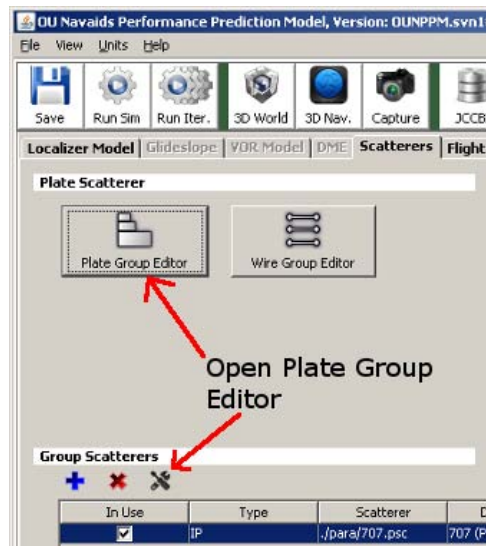


Figure 73: The *Scatterer Group Editor* opens a window enabling creation/modification of Scatterer groups.

One may manually create a set of plates or choose to Open an existing file. Figure 74 shows a Boeing 707 loaded in the editor. Each plate composing each part of the 707 is shown. Each plate may be modified. The desired *reference frame* may also be selected. Any Scatterer Type, be it, ILS (Localizer/Glideslope), VOR, or DME, may be converted to any other Scatterer Type using the *Scatterer Type* radio buttons.

NOTE: When loading a plate file that was saved as an alternative Scatterer Type, the user will be prompted to automatically save the newly converted Scatterer Type to the native version. For example, if “707.psc” was originally a LOC/GS plate, and a user chooses to open that while running a VOR model, a popup box will automatically appear asking the user to resave the file as a VOR scatterer such as “707\_VOR.psc”. *Take care not to accidentally overwrite existing scatterers. Saving each scatterer using a unique filename will ensure this.*

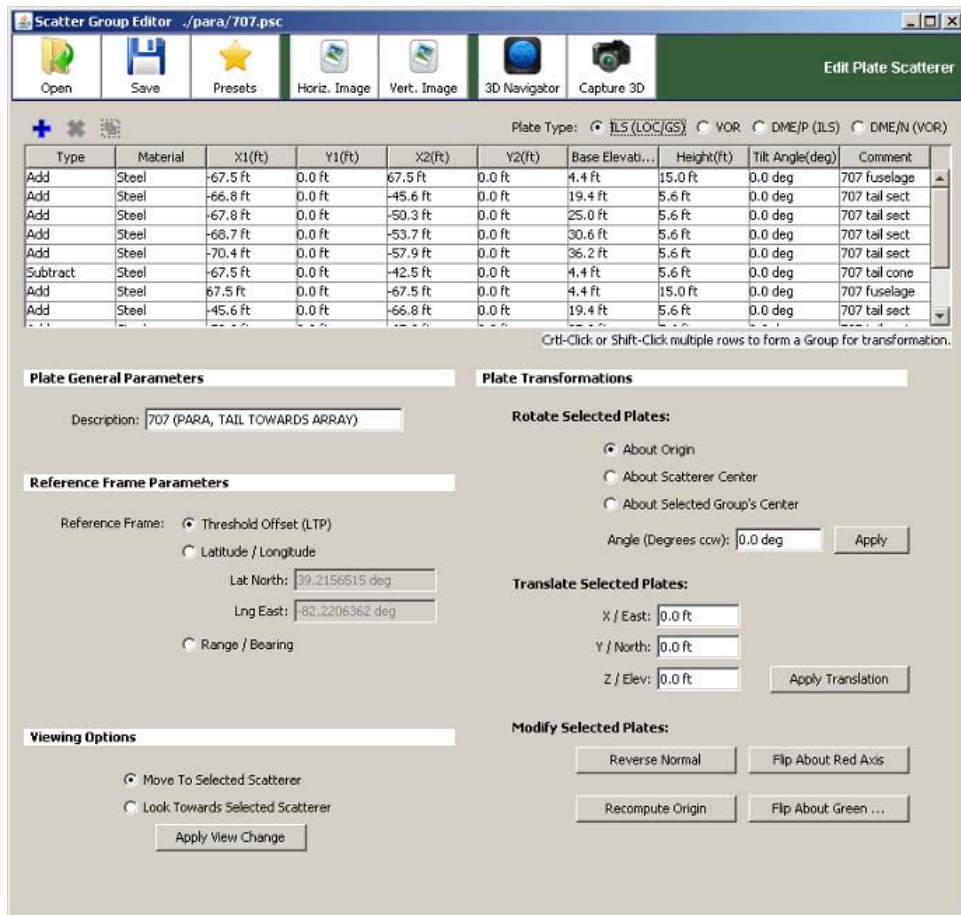


Figure 74: The *Scatterer Group Editor* opens a window enabling creation/modification of Scatterer groups.

Once inside the *Scatterer Group Editor*, the 3D Visualization changes to show only the currently edited Scatterer Group. The default 3D view is a top-down view as shown in Fig.75.



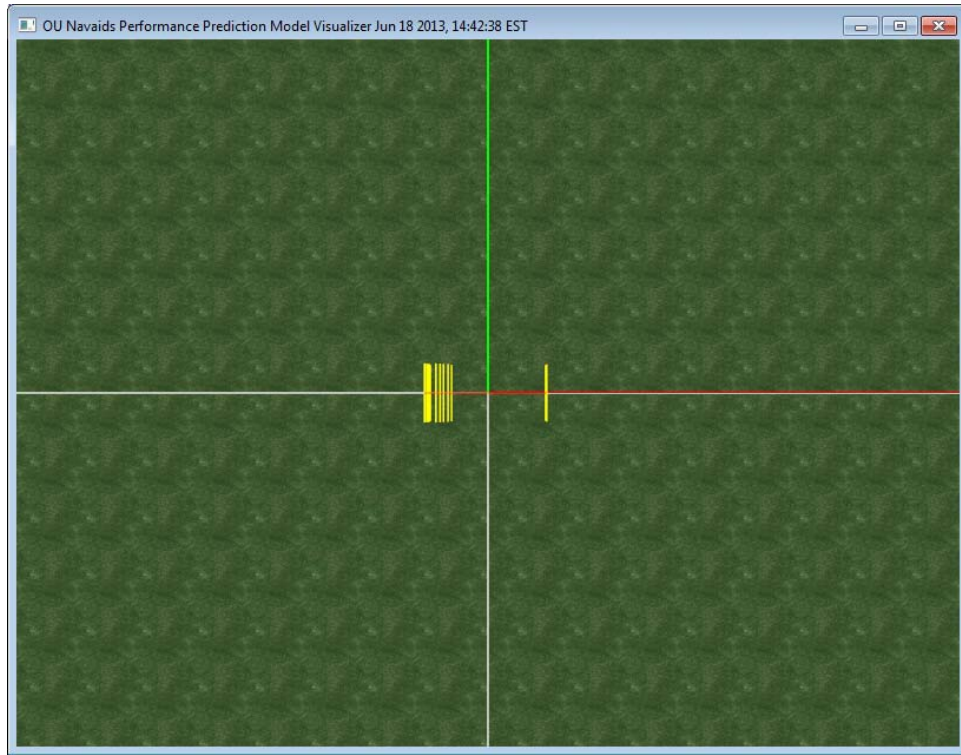


Figure 75: The default top-down *Scatterer Group Editor* 3D Visualization. The user may navigate the camera to any desired orientation.

The user may navigate the 3D Visualization to place the camera at any desired position. See Fig.76. See Chapter VI for a description about using and navigating the 3D Virtual World.

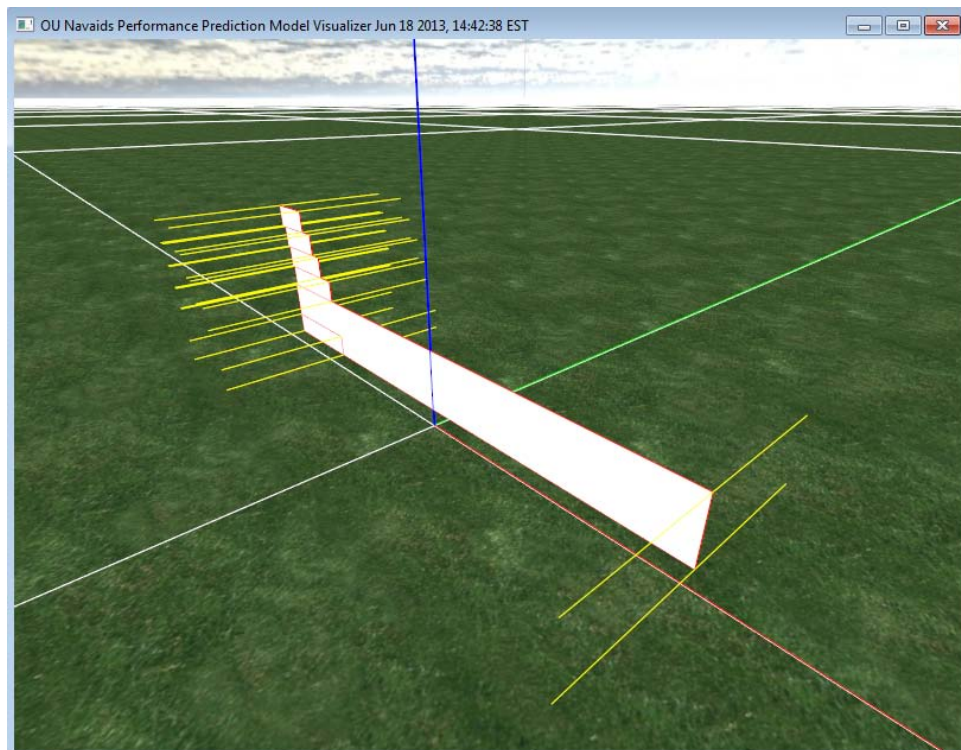
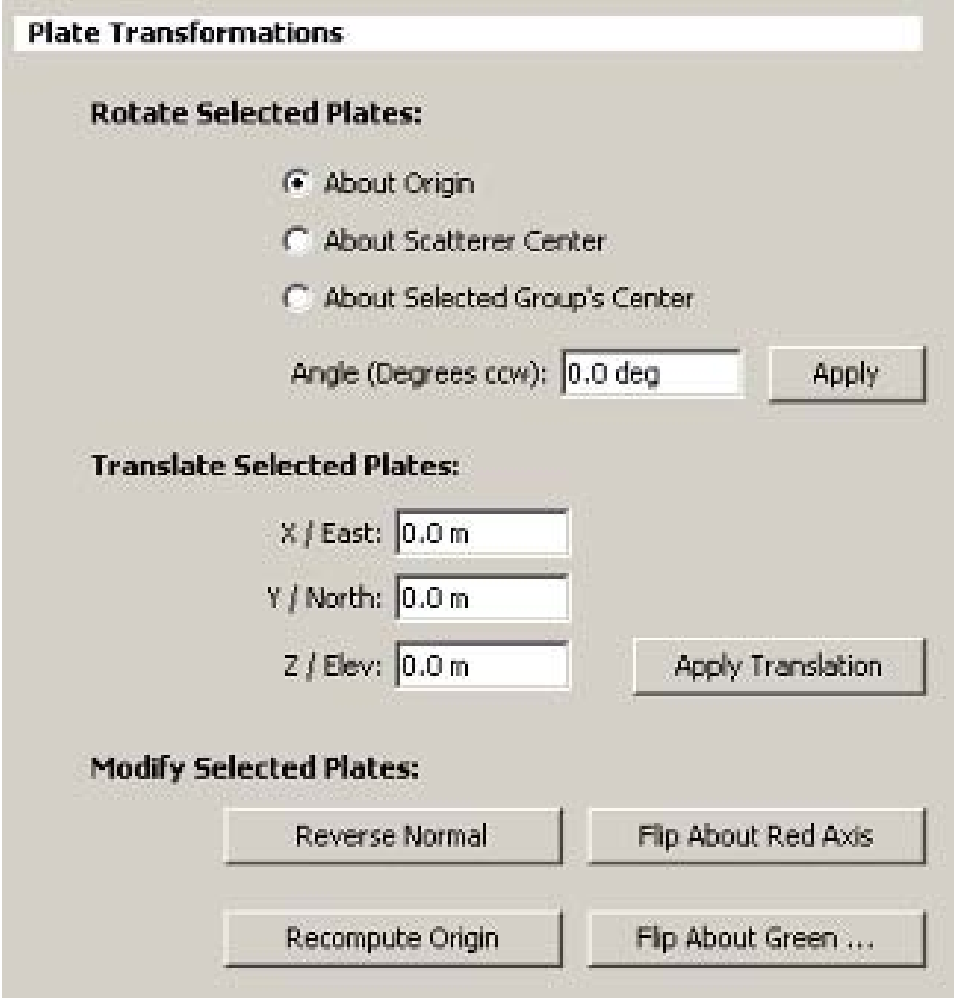


Figure 76: The user has navigated from the top-down view to a different view. Exact same Scatterer Group as shown in Fig.75.

## Local Plate Operations



The image shows a software dialog box titled "Plate Transformations". It is divided into three sections: "Rotate Selected Plates:", "Translate Selected Plates:", and "Modify Selected Plates:". The "Rotate" section has three radio buttons: "About Origin" (selected), "About Scatterer Center", and "About Selected Group's Center". Below them is a text field for "Angle (Degrees cwi):" with the value "0.0 deg" and an "Apply" button. The "Translate" section has three text fields for "X / East:", "Y / North:", and "Z / Elev:", all with the value "0.0 m", and an "Apply Translation" button. The "Modify" section has four buttons: "Reverse Normal", "Flip About Red Axis", "Recompute Origin", and "Flip About Green ...".

Figure 77: The operations that may be applied to a plate or group of plates.

Figure 77 shows the operations that may be applied to any single plate or group of selected plates. A group of scatterer plates may be formed by CTRL-clicking or SHIFT-clicking the desired plates in the Editor List. Once selected, clicking on operation button will perform that operation on all selected plates.

Rotation enables a clockwise rotation, specified in degrees, of a specific scatterer plate or group of scatterer plates about one of the following points: 1) The origin, 2) The center of the scatterer, 3) The center of the group of selected plates.

Rotation *About Origin* will rotate all selected plates about the origin.

Rotation *About Scatterer Center* will rotate each selected plates about its own center point.

Rotation *About Selected Group's Center* will rotate each selected plate about the point computed to be the center of all selected plates.

1. *Reverse Normal* will invert the direction of the normals of the selected plates; this is achieved by swapping the X1,Y1 and X2,Y2 values for the selected plates.
2. *Flip About Red Axis* will flip each selected plate about an axis parallel to the global red axis, but passing through each plate's center. This is achieved by swapping the X1 and X2 values for each selected plate.

3. *Flip About Green Axis* will flip each selected plate about an axis parallel to the global green axis, but passing through each plate's center. This is achieved by swapping the Y1 and Y2 values for each selected plate.
4. *Look At Selected Center* will move the camera such that it is looking at the selected plate (*Look Towards Selected Scatterer*) or move the camera such that it travels to and looks at the selected plate (*Move To Selected Scatterer*).
5. *Recompute Origin* will compute the center point of the volume generated by any selected plates and recenter the plates about that local origin. This is useful, for example, if a scatterer was created but centered about (100, 100, 0); pressing *Recompute Origin* will then adjust the corresponding scatterer group points such that they are centered about 0, 0, 0. Another way of thinking about this is that after pressing *Recompute Origin*, performing a rotation about the origin will be equivalent to performing a rotation about the Selected Group's Center. Multiple rows / plates may be selected by CTRL-clicking or SHIFT-clicking on multiple rows within the Scatterer Group Editor.

Once editing of a Scatterer Group is complete, click the *Save* button and type a unique filename to save the scatterer. Then from the main Scatterer Editor window, see Fig. 70, one may choose to *Open* the newly created/modified Scatterer Group.

## 12.2 Presets

There are two “cookie cutter” scatterers that can be created to model advanced objects: the ellipse and the wind turbine.

## 12.3 Ellipse

The lefthand tab, as seen in Figure 78, controls the creations of ellipses. Like other scatterer groups this group does not have to be centered around its local origin. This preset has support for both simple and complex ellipses. As indicated by the following figure:

A is the length of the semimajor axis, and B is the length of the semiminor axis. If A2 is non-zero then a complex ellipse will be used. The plate height, elevation, tilt, and rotation fields function analogously to the plate scatterer counterparts. Incomplete ellipses are created by setting an interval other than 0..360 in the angle start and angle stop fields. Ellipses are approximated by a series of plates. The default value is 2, fidelity can be increased by increasing this number. There are three additional checkboxes that alter the plate configuration. “Height is vertical regardless of angle” – normally the plate height is the length of the plate in the vertical direction before rotation. In this case the height represents the vertical distance the plate will cover, i.e. the closer the tilt is to 90 degrees, the longer the plate will become for a fixed height.

“Illuminate outside” – This is checked by default. Since the normal of the plate affects whether or not it is included in the model calculation, it is important to note whether the inner faces or outer faces of the cylinder is illuminated.

“Make Horizontal Cylinder” – Effectively rotates the entire cylinder 90 degrees.

## 12.4 Windmill

The righthand tab, as seen in Figure 79,



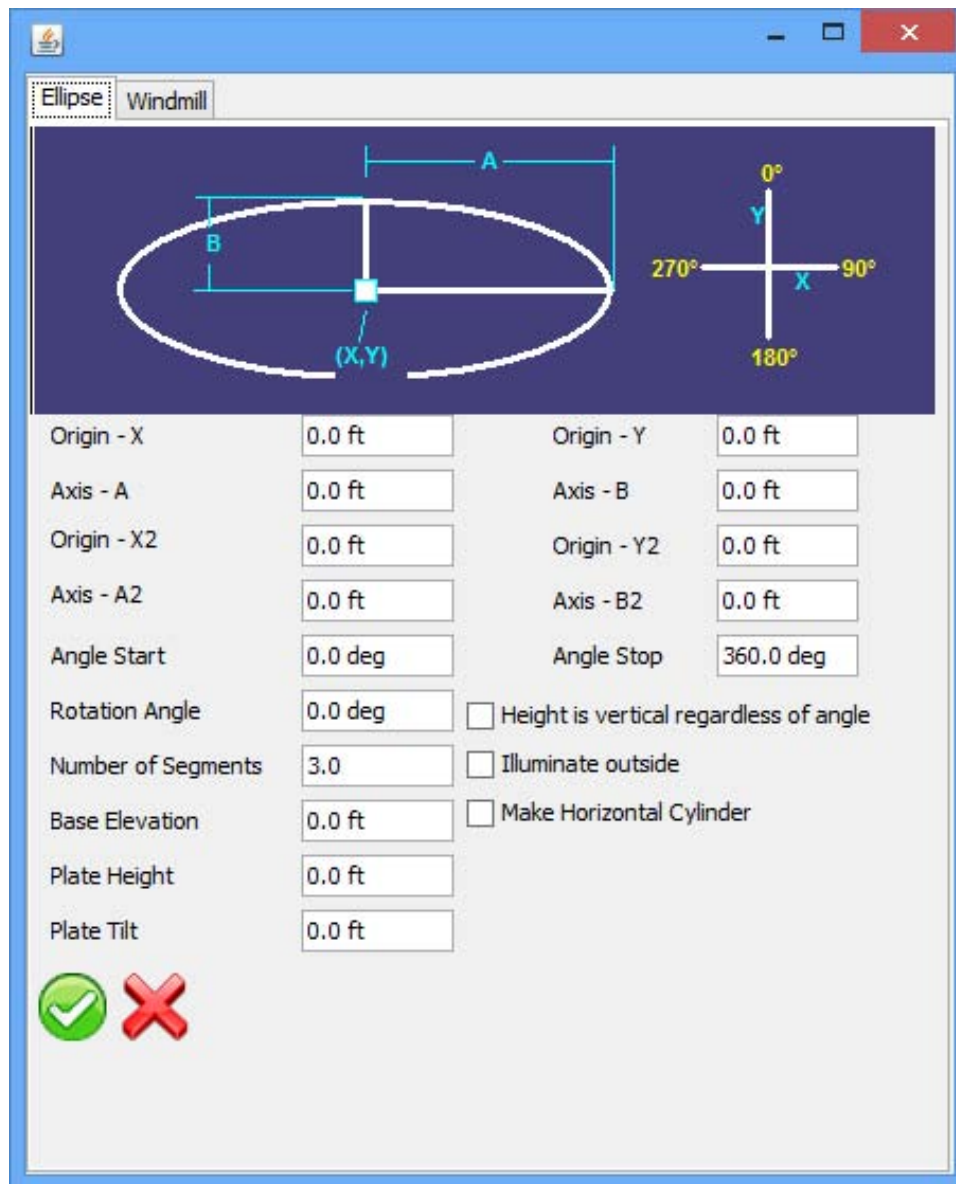


Figure 78: The ellipse preset window.

“Draw both sides of rotor blades” – Recall that plates are directional. Only one side illuminated, hence if you want to ensure that a blade is taken into account for the model, this box should be checked. It is selected by default.

“Use cylindrical base” – If this is checked a cylindrical base is used, otherwise it is rectangular.

The next two check boxes are mutually exclusive, and will ignore the heading field if either is selected:

“Facing Array” – Rotates the windmill such that the nacelle point along the vector from the antenna array towards the windmill offset.

“Parallel to flight path” – Rotates the windmill such that the blades are parallel with the flight path. This only includes “straight” flight paths; ILS2 & 3 for localizer & glideslopes and radial for VOR.

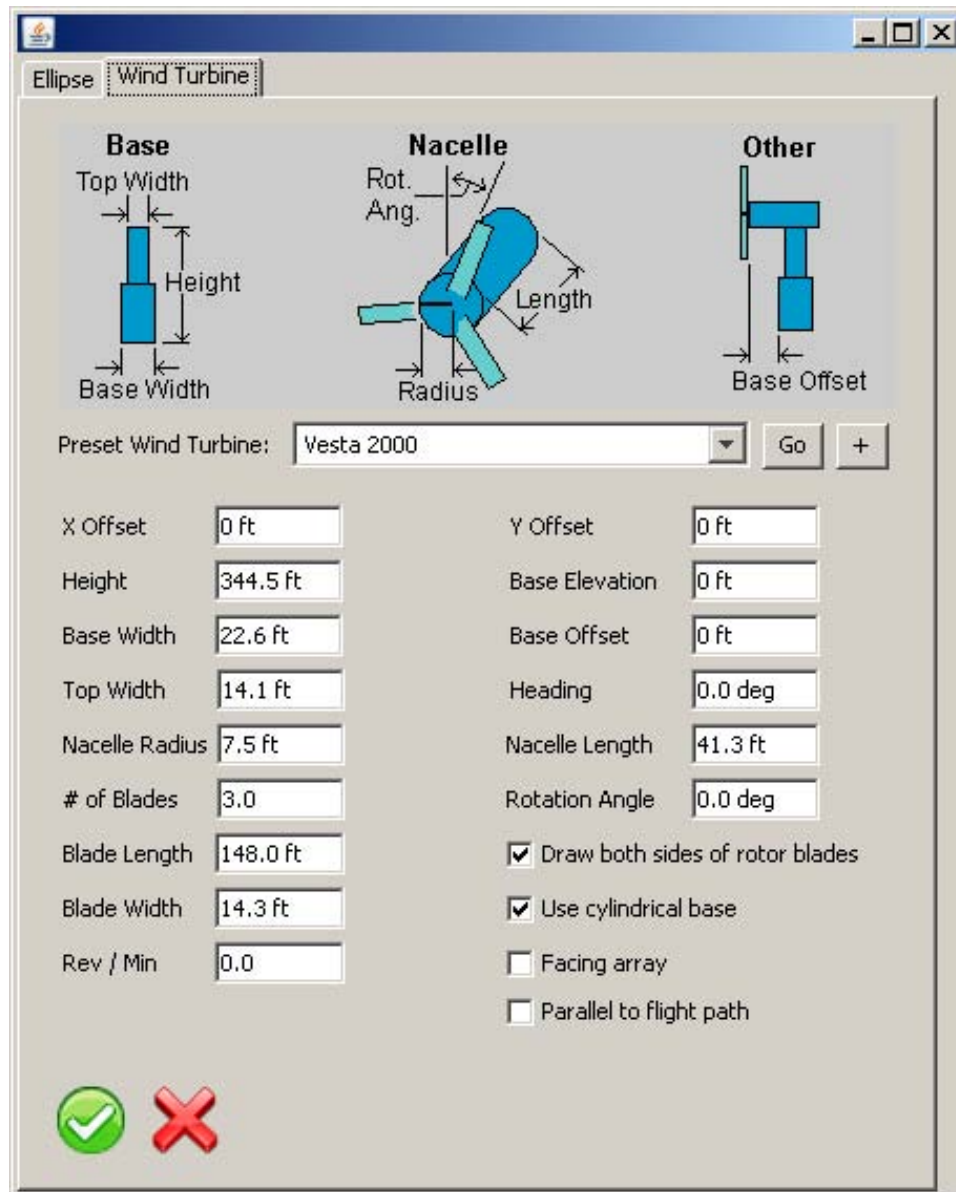


Figure 79: The windmill preset window.

## Built-in Windmills

The model contains several built-in windmills based on publicly released specifications. Not all specifications were complete and this section contains notes on assumptions made for each model.

- Vestas V110-2.0MW - Missing tower width, uses width of Vestas V100-1.8MW. 4 published hub heights, uses 50Hz low profile height.
- Vestas V100-2.6MW - Missing tower width, uses width of Vestas V100-1.8MW. Missing hub height, uses height of Vestas V110-2.0MW 50Hz low profile.
- Vestas V100-2.0MW - Missing tower width, uses width of Vestas V100-1.8MW. 3 published hub heights, uses lowest.
- Vestas V100-1.8MW - 2 published hub heights, uses lowest.
- Vestas V90-3.0MW - 3 published hub heights: 65, 80, and 105m (wind class). Uses 60m.

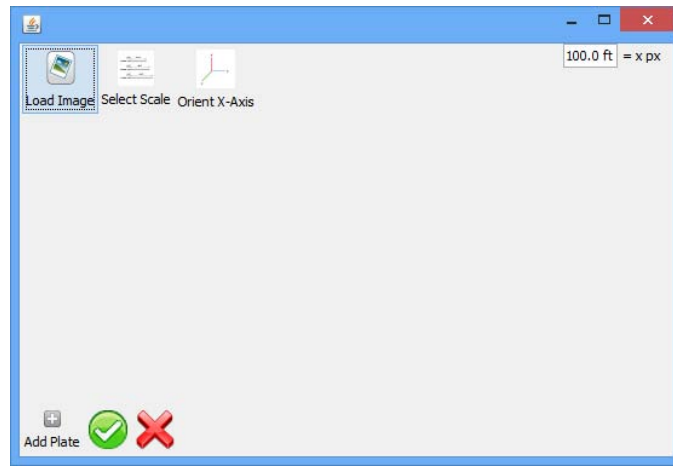


Figure 80: Add plates by pulling from image.

- Vestas V90-2.0MW - 12 published hub heights, uses lowest.
- Goldwind S70/1500 - Missing tower width, uses width of Vestas V100-1.8MW. Hub height 65-80m, uses 65. Missing blade width, uses width of Vestas V90-2.0MW (probably too big).
- Enercon E-48 / 800kW - Missing tower width, uses width of Vestas V100-1.8MW. Hub heights 50, 55, 60, 76m, uses 50. Missing Nacelle sizes, uses Vestas V110-2.0MW.
- Siemens SWT-2.3-108 - Missing tower width, uses width of Vestas V100-1.8MW. Missing hub height, uses 50m. Missing Nacelle sizes, uses Vestas V110-2.0MW. Missing blade width, uses width of Vestas V90-2.0MW (probably too small).

## 12.5 Pull from image

A scatterer group can also be created based on positions relative to an image. This is a 4 step process.

1. Load image - most image types are supported. When you click this button you will be prompted to select an image file which will then be opened and displayed on the panel. It will maintain its original size in pixels.
2. Set scale - Enter a length into the field and then click and drag a length you intend to represent that length. The label next to the length field should now be populated with that number of pixels.
3. Orient x-axis - in order to get a coherent reference frame, the user will define the positive x-axis. We use a right-handed coordinate system, and the y-axis will also fall in the plane of the image, so it is defined.
4. Now that we have a complete system in which to define the plates, you can add plates by using the add plate button and selecting the two end points.

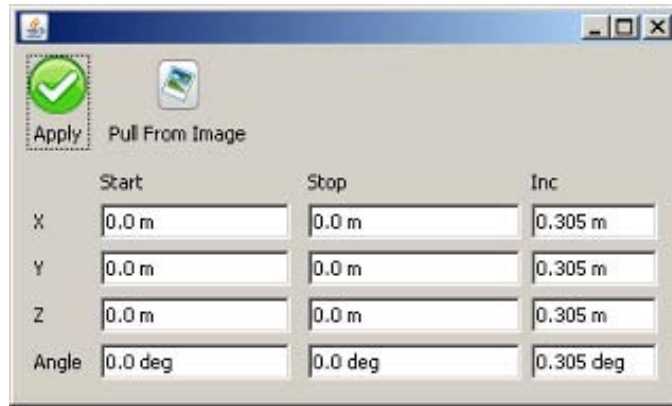


Figure 81: A panel that lets the user set the start, stop, and increment for iteration for scatterers.

## 12.6 Iteration

The scatterer group table has a column that allows the user to iterate the positions and rotation of a scatterer group. When the column is checked a window will appear, as seen in Figure 81

Each of the three position coordinates (X, Y, and Z) and the rotation of a scatterer can have a minimum and maximum bound set for their iteration. The user will also set a non-zero increment value. Iterators with a zero increment value are ignored. The iterators will start with the lower bound and increase to the upper bound by units of increment. When the current value surpasses the maximum value, iteration will cease.

Pressing the “pull from image” button 

Pressing the apply button  will save these changes.

If the box is unchecked, iteration will not be applied during the run, but the values should be “remembered” next time the box is checked.

## 13 Flight Parameters

### 13.1 Localizer Flight Paths

The section describes the supported Localizer Flight Paths.

#### Localizer ILS 3 / Approach

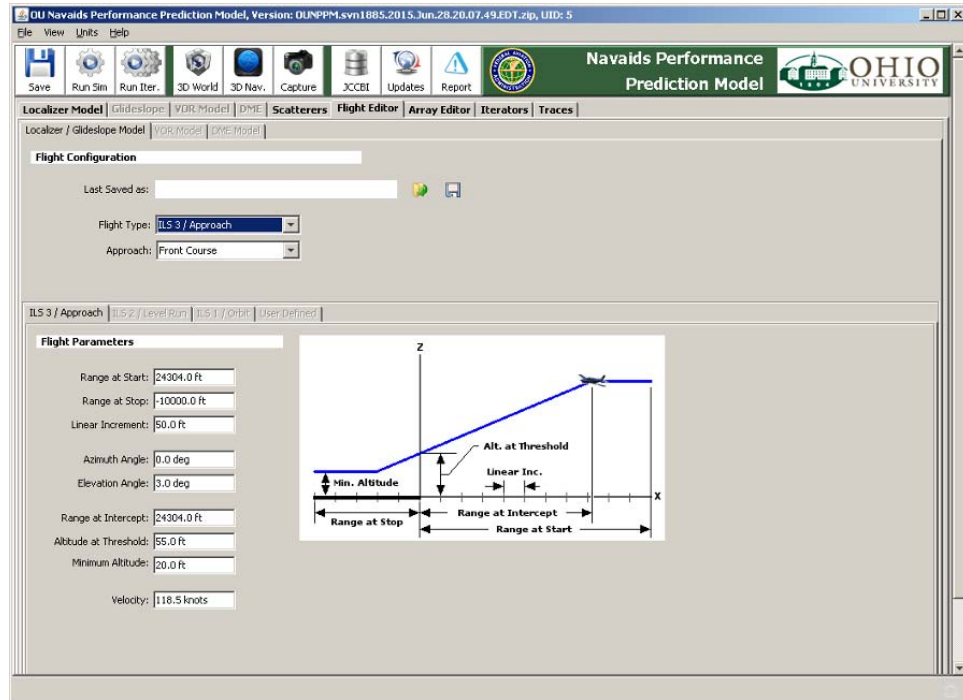


Figure 82: The default ILS 3 / Approach Flight Path for a Localizer.



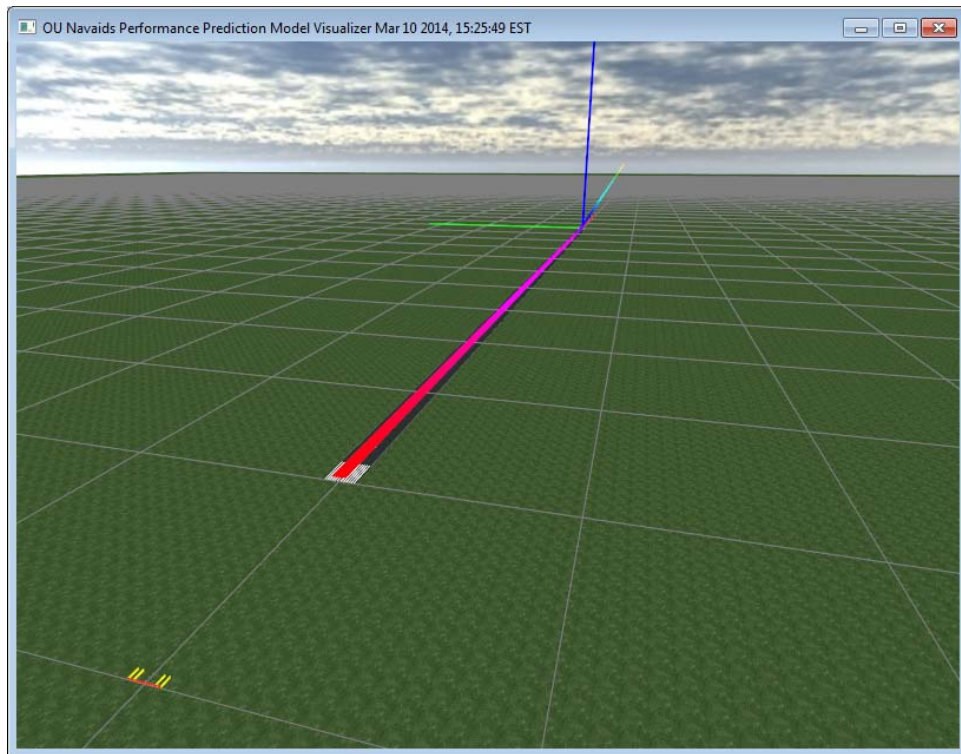


Figure 83: The 3D Virtual World depicting the ILS 3 / Approach Flight Path in Fig.82.

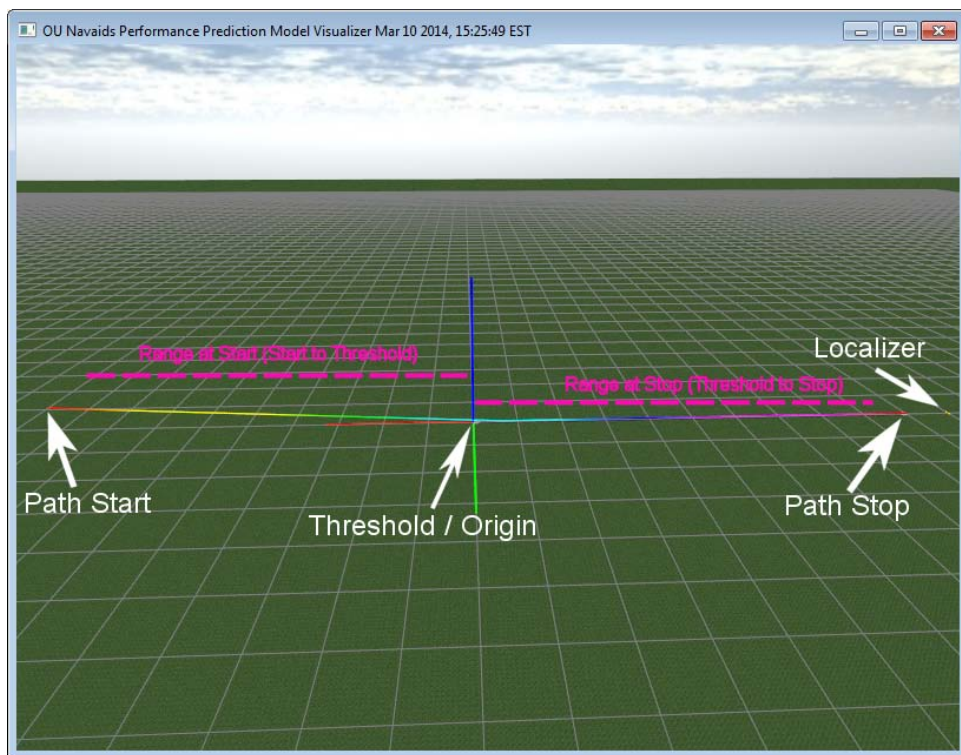


Figure 84: ILS 3 / Approach Flight Path Nomenclature.

The Localizer's ILS 3 approach is a straight flight path specified by the following inputs: 1) *Elevation Angle* (defaulting to  $3^\circ$ ), 2) *Altitude at Threshold*, 3) *Minimum Altitude*, 4) *Azimuth Angle*, 5) *Range at Start*, and 6) *Range at Stop*. As shown

in Fig.84, the flight path begins at a distance *Range at Start* from Threshold along the  $+X$  (red axis) direction towards Threshold. The flight path's slope is *Elevation Angle* with an initial altitude such that the path's altitude as it intersects Threshold is *Altitude at Threshold*. After reaching Threshold, the flight path's slope remains constant at *Elevation Angle* until *Minimum Altitude* is reached. At this point the flight path's slope becomes  $0^\circ$  and it continues until it is *Range at Stop* distance from Threshold along the  $-X$  (red axis) direction.

The *Azimuth Angle* will simply rotate the above described path about the localizer's position by *Azimuth Angle* $^\circ$  in a counter-clockwise direction. The flight path is also aligned to the localizer when the localizer is offset along the  $\pm Y$  axis (green axis). Figure 85 shows a rotated ILS 3 Approach.

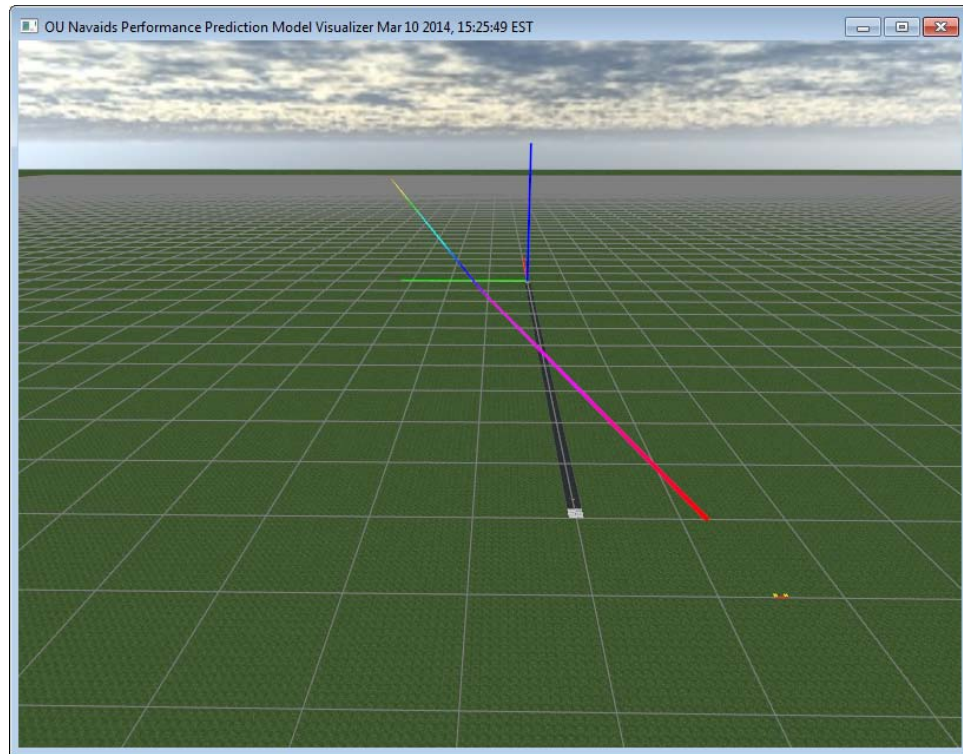


Figure 85: ILS 3 Flight Path with an *Azimuth Angle* of  $15^\circ$  and a Localizer *Main Offset* of  $-1500ft$  and an *Ant. Setback* of  $1000ft$ .



## Localizer ILS 2 / Level Run

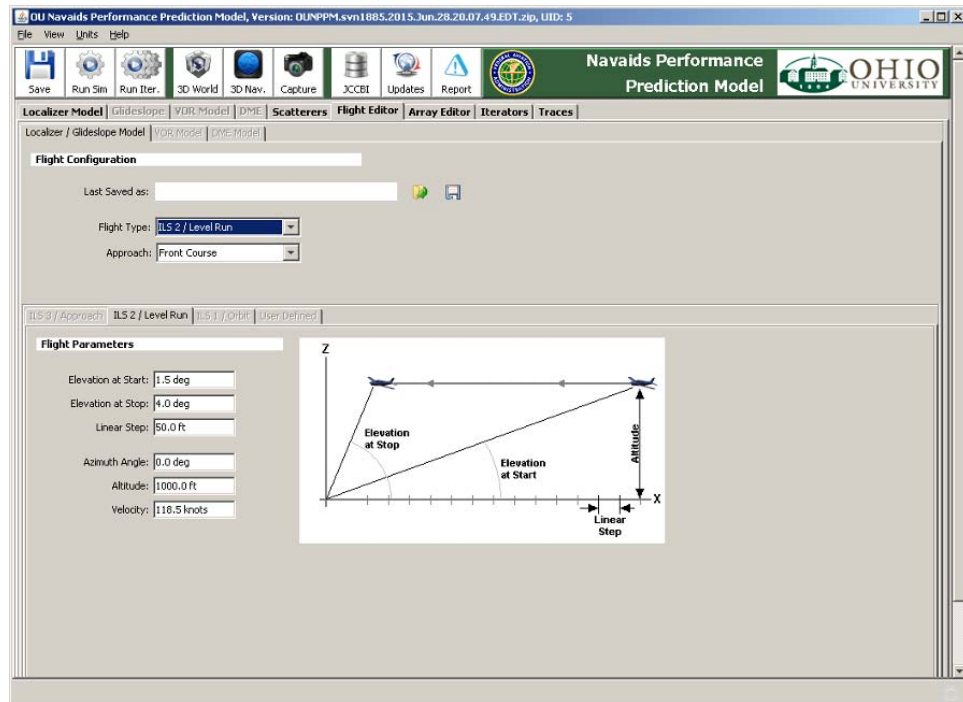


Figure 86: ILS 2 / Level Run Flight Path for a Localizer.

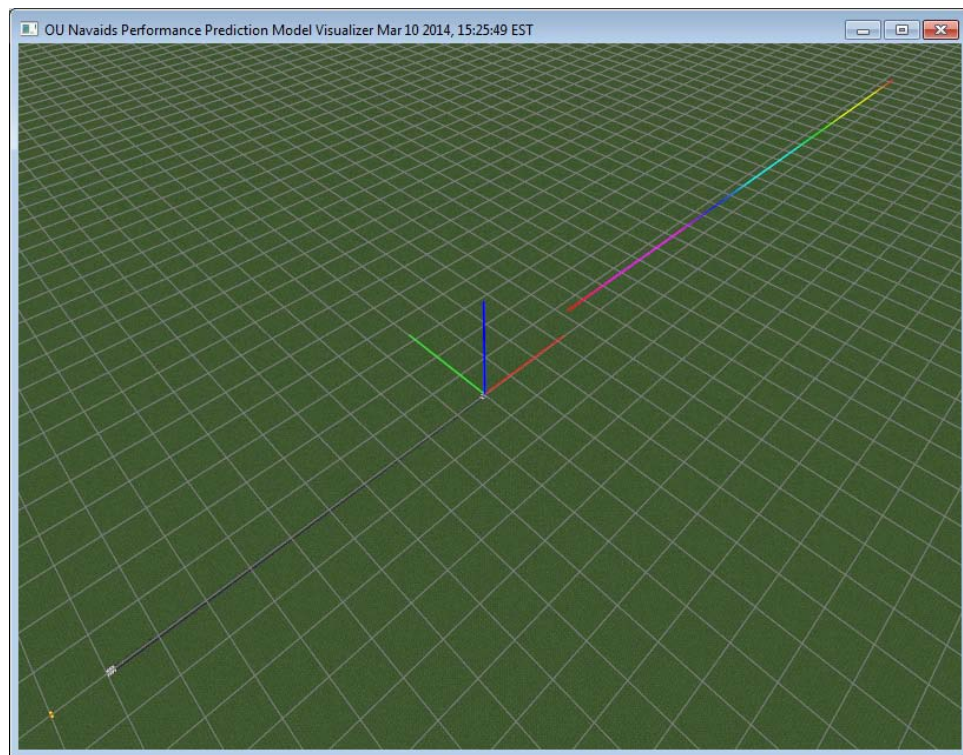


Figure 87: ILS 2 / Level Run Flight Path visualizing the parameter from Fig.86.

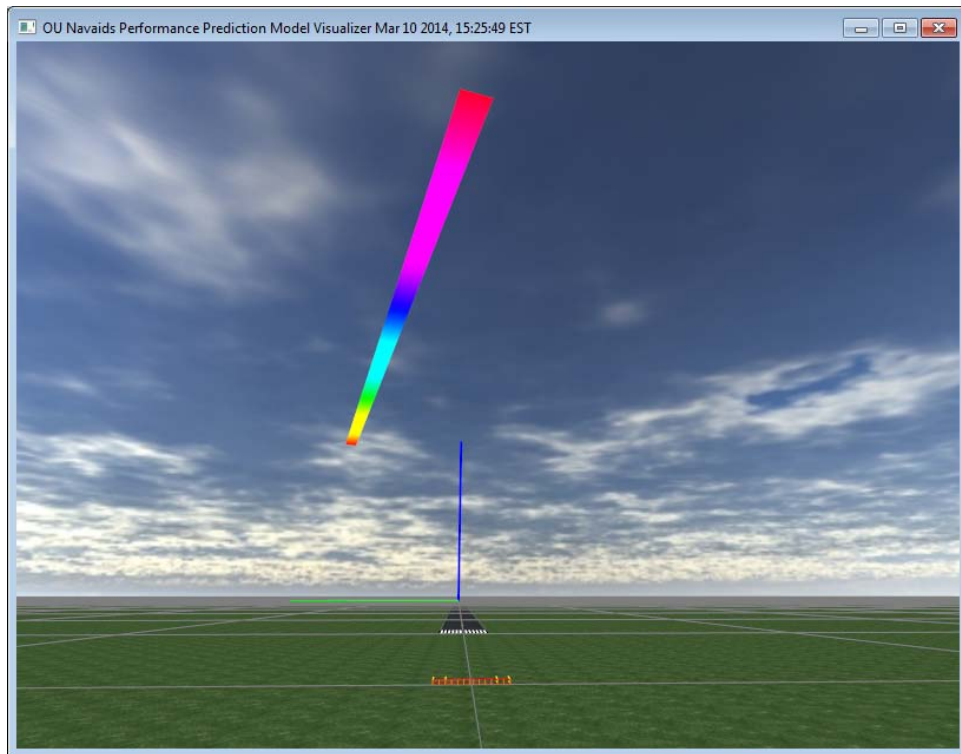


Figure 88: ILS 2 / Level Run Flight Path with a *Elevation at Start* of  $20^{\circ}$ , an *Elevation at Stop* of  $90^{\circ}$  at an *Altitude* of 1000ft with an *Azimuth Angle* of  $15^{\circ}$ .

The Localizer's ILS 2 / Level Run approach is a straight flight path specified by the following inputs: 1) *Elevation at Start* (defaulting to  $1.5^{\circ}$ ), 2) *Elevation at Stop* (defaulting to  $4^{\circ}$ ), 3) *Altitude* (defaulting to 1000ft), and 4) *Azimuth Angle*. As shown in Fig.86, the flight path begins at the point originating from the localizer, parallel to  $+X$ , with a slope of *Elevation at Start* extending until it reaches a height of *Altitude*. The *Linear Step* size denotes the distance between inspection points along the flight path. The corresponding 3D Virtual World is shown in Fig.87.

The *Azimuth Angle* will simply rotate the above described path about the localizer's position by *Azimuth Angle* in a counter-clockwise direction. The flight path is also aligned to the localizer when the localizer is offset along the  $\pm Y$  axis (green axis). Figure 88 shows a rotated ILS 2 Approach.

## Localizer ILS 1 / Orbit

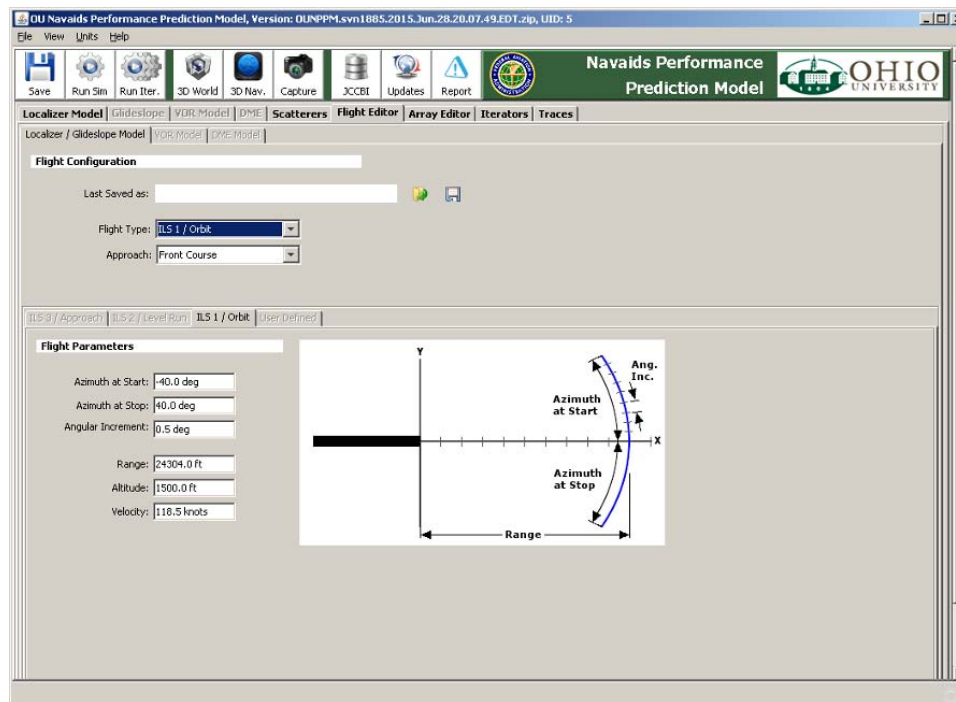


Figure 89: ILS 1 / Orbit Flight Path for a Localizer.

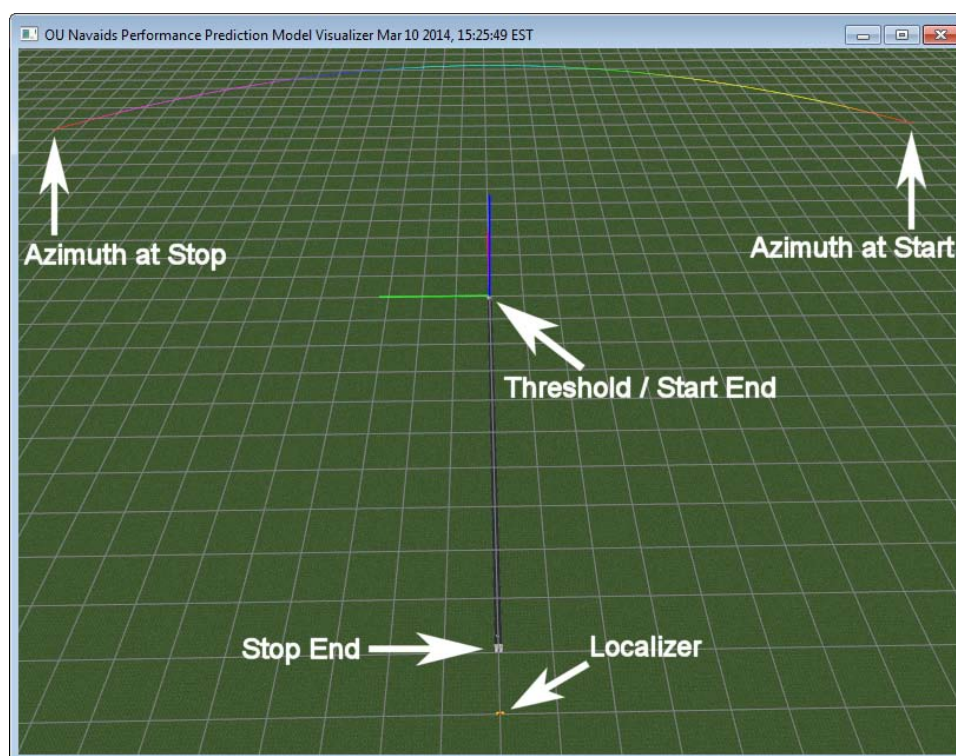


Figure 90: 3D Virtual World corresponding to the ILS 1 / Orbit Flight Path parameters from Fig.89.

Figure 89 shows the parameters for an ILS 1 / Orbital Flight Path. Figure 90 shows the corresponding visualization. The *Range* specifies the distance from the Localizer

to the flight path at each point along the curve. Typically values outside  $[-40^\circ, 40^\circ]$  cannot sense the Localizer signal (unless the Localizer is rotated off of center line).

Localizer/Glideslope. ILS1/2/3 maximum orbit width

VOR Orbital/Radial/RNAV/Fixed Cone of silence ; orbits can spiral, fixed are fixed distance orbits

DME Straight/Segmented/Distance/Radial/Orbit Cone of silence

## 14 Array Editor

The Array Editor Tab allows one to create, open, modify, and save any Localizer Array (.LDU), Glideslope Array (.GDU), Localizer Azimuthal Element Pattern (.LEL), or Glideslope Azimuthal Element Pattern .GEL file. This tab may be accessed at any time, and does not affect the current model. This tab simply enables a user to modify or create arrays and patterns that can be loaded in a Localizer or Glideslope model within the *Facility Info* Tab via *Array Type* and *Element Type* dropdown boxes.

### 14.1 Localizer Array Editor

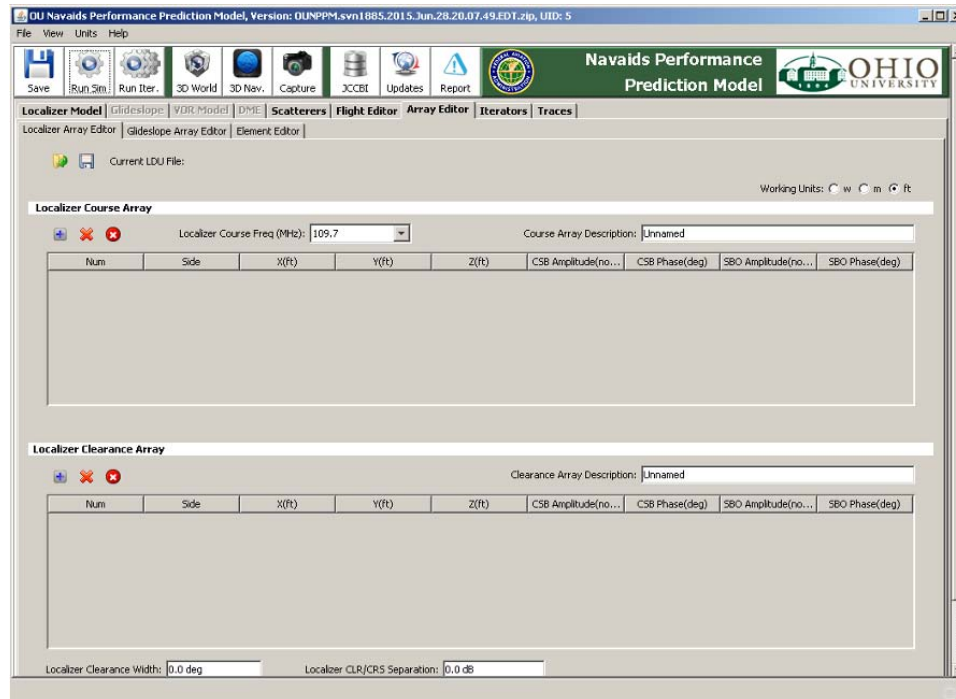



Figure 91: The Localizer Array Editor.

Figure 91 shows the Array Editor for all Localizer arrays. Clicking the  will open a File Chooser where any .LDU file may be selected. Figure 92 shows an opened "WI14-10.LDU" array. Both the Course and Clearance array are shown.



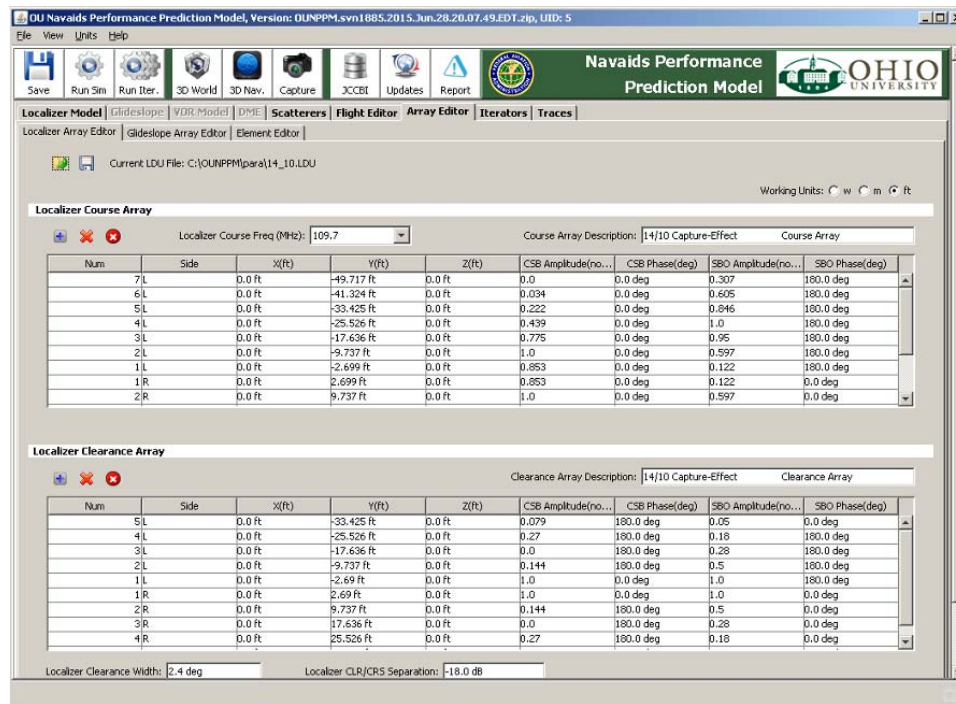



Figure 92: The Localizer Array Editor.

The course and clearance parameters may be modified directly via the table, new rows may be appended and existing rows may be removed or modified. Once modifications are complete, click the  will open a File Chooser where the modified LDU file may be saved. *Caution: Do not override existing LDU files. This will replace the existing LDU file with the modified version. Please save all LDU files using a unique name that does not over write the originals.*




## 14.2 Glideslope Array Editor

## 14.3 Azimuthal Element Pattern

To draw your own pattern, click the  icon.

### Drawing a pattern

A scatterer group can also be created based on positions relative to an image. This is a 4 step process.

1. Load image  (upper toolbar) - most image types are supported. When you click this button you will be prompted to select an image file which will then be opened and displayed on the panel. It will maintain its original size in pixels.
2. Set scale  (upper toolbar) - Optionally, enter a length into the field and then click and drag a length you intend to represent that length. The label next to the length field should now be populated with that number of pixels. When drawing an element pattern, correct results can still be achieved without knowing the correct distance, simply use the scale to set the radius of the pattern.
3. Orient x-axis  (upper toolbar) - in order to get a coherent reference frame, the user will define the positive x-axis. We use a right-handed coordinate system, and the y-axis will also fall in the plane of the image, so it is defined.

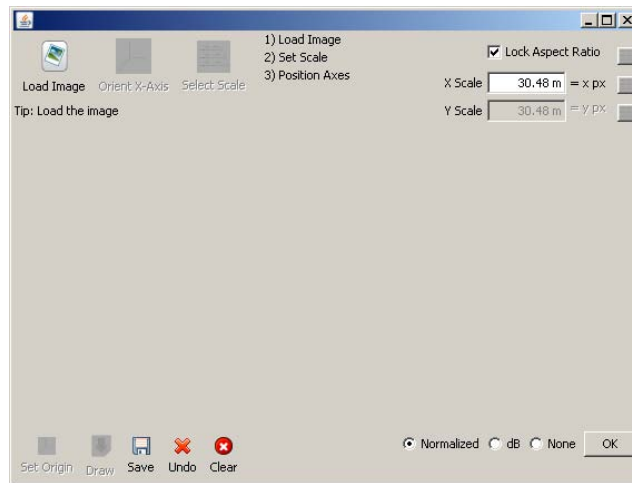


Figure 93: A freshly opened draw element pattern pane.

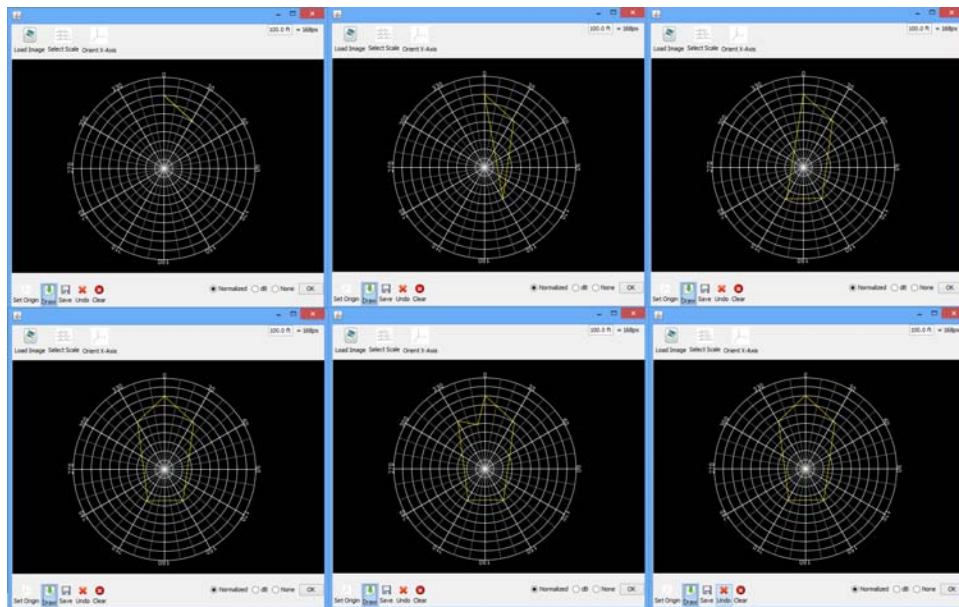





Figure 94: An example of a 5 point element pattern, and using the undo button to fix a mistake.



4. Click the “set origin” button  on the lower toolbar to select where the center of the pattern will be.
5. Now that we have a complete system in which to define the pattern, you can start drawing your pattern.



Click the draw button , and then click the points you wish to use starting at 0 degrees continuing in increasing azimuthal value. The pattern will form a closed



line loop until click the draw button  again.

If you make an error and wish to undo the last point, click the undo  button (lower toolbar). If you wish to start over, you can clear the entire pattern by clicking the clear button  (lower toolbar).

## 15 Iterators

Iterators are the system OUNPPM uses to run multiple related simulations at once. They allow the user to vary attributes of the simulation in a combinatorial manner.

### 15.1 Strategy

The paradigm for iterators in this software is as follows. Each iterator will have  $n$  different possible values. Typically, these will be numeric values starting with a *start* value, ending with a *stop* value, and incrementing by an *inc* value; although these could just as easily be  $n$  different types of localizer. When the iterative analysis is performed every permutation of all things being iterated are tested.

To determine how many iterations,  $X$  will be run, take the product of the number ( $n$ ) of options each of the  $x$  iterators have. See Equation 10.

$$X = \prod_{i=1}^x i_n \quad (10)$$

While running, the completion bar should increment in steps of  $100 / X$  percent. Once all  $X$  runs have completed there will be two different forms of output. The first is the table, which outlines every iteration and its outputs. The second is the plot, which is limited to graphing only the results of 1 or 2 of the iterators. If it is 1, then the x-axis will be the values of thing being iterated and the y axis will be the output of the analysis. If two iterators are selected, then both axes are iterator values, and analysis results are shown as points on the plots. More information these outputs can be found on in sections ?? and ??.



### 15.2 Iteration Tab

The iteration tab is a top level tab and provides the user a way to run, save, and load iterations, as well as an overview of all currently enabled iterators.



### 15.3 Iteration Table

This table contains a list of all the active iterators that will be used during the next run. Each specific iterator has a specific string that describes the conditions that that iterator will manipulate. Often this will be the minimum and maximum values and an increment.

### 15.4 CAS (Lower) Toolbar

This toolbar, located beneath the iterator table, contains functionality for loading and merging iteration plots. “Open”  (lower toolbar) – Opens a CAS file and shows the resulting plot. “Merge”  (lower toolbar) – Merges two CAS files.

### 15.5 ITL (Upper) Toolbar

This toolbar, located above the iterator table, has three buttons. “Iterate / Run Full”  (upper toolbar) – This button will run all of the existing iterations, but will not immediately plot results. “Get Iterative Results”  (upper toolbar) – This button will open the plots for an existing run of iterations. Whenever iterations are run, an



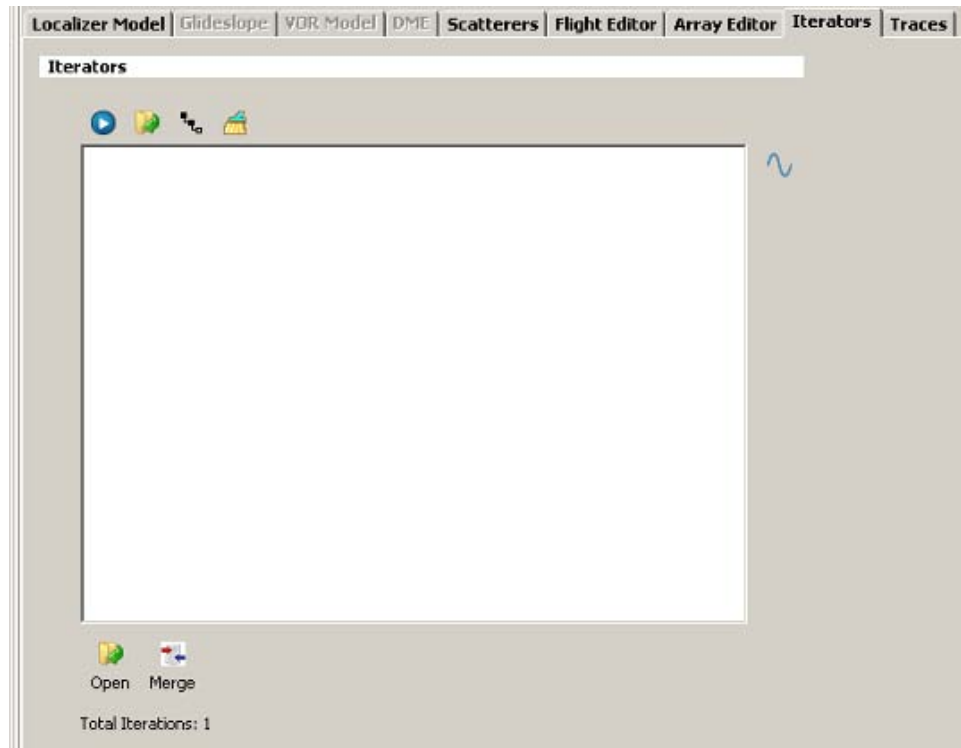




Figure 95: The iteration tab.

.itl file will be created. “Run and Get Results”  (upper toolbar) – This button is functionally equivalent to the icon on the main toolbar.

## 15.6 Sidebar

The sidebar contains access to iterators that do not fall under the scope of any other area.  - Iterate DU Parameters - This button spawns the Iterate DU Window that allows the user to manipulate the DU Phase, Amplitude, and X positions of the antenna elements. Iterate DU Windows: This window contains two tabs. The lefthand tab “Individual Antennae” allows the user to manipulate the phase, amplitude, and x position of each antenna element separately, or all of the selected elements as a group. The righthand tab allows pairs of both left and right elements be iterated in the same way. If the individual elements are chosen a single iterator is created for each element and attribute (phase, amplitude, x position). If the “Iterate As Group” box is checked, then of all the selected elements will be iterated individually as opposed to combinatorically. That is, if 5 elements are selected and asked to iterate over 2 phase values, then 10 iterations will be performed, not 32.

Iterators for individual antenna elements for the course array for phase are working at this time. This is sufficient to finish exercise 3.

Iterators for pair-to-pair, clearance array, position, and amplitude to be implemented soon.

## 15.7 Plots

Iterator plots are discussed later in section ??.

## 16 Traces

### 16.1 Localizer Traces

#### Output Parameter

##### Descriptions

1. CDI Digital - Course deviation indicator
2. CDI Analog - Course deviation indicator
3. Flag - Flag Current.
4. CSB Signal Strength - Carrier plus Side Band
5. SBO Signal Strength - Side Band Only

##### Units

1. CDI Digital - microamps or degrees.
2. CDI Analog - microamps or degrees.
3. Flag - microamps or degrees.
4. CSB Signal Strength - decibels.
5. SBO Signal Strength - decibels.

#### Switches

##### Filtering

##### Fields

For signal strength output parameters, you can isolate either the incident or scattered fields, or use the total. Total should equal incident plus scattered.

##### Use Course

**Clearance** This switch allows you to run the calculations using only the course array, only the clearance array, or both.

#### Course Parameters

##### Course Width

Recommended values fall between 3 and 6 degrees.

**Calc** The calc button near the course width will automatically calculate a value using the following equation:

**Mod. Balance**

**SBO Phase**

**Clearance Parameters**

**Course Width**

**Mod. Balance**

**SBO Phase**

**Clr/Crs Sep.**

**Capture Ang.**

## **16.2 Glideslope Traces**

## **16.3 VOR Traces**

**Flight Type**

**SS Units**

1. dB - deciBels
2. Relative - relative power

**Output**

1. Brg Error - Bearing Error, the difference between the actual bearing of the aircraft and where the receiving would interpret it to be.
2. Total SS -
3. Direct SS -
4. Reflected SS -

**Model Type**

There are two options for which VOR model to use. The Physical Alford Loop Model is more accurate, but takes longer to run than the Ideal Point Source model.

**Trace Name**

This is the name that will appear in the legend for this trace.

## 17 Software Updater

The OUNPPM program can be easily updated. Updates include new features, bug fixes, and other improvements over that are made to the software code base over time. These updates are released to the OUNPPM update web server at <http://ounppm.eecs.ohio.edu/ounppm/updates/>.

The current version of OUNPPM is always displayed at the top of the OUNPPM Window as shown below in Fig.96.

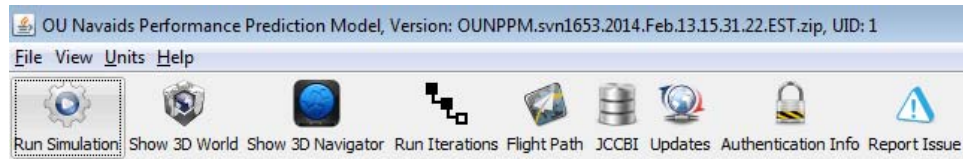


Figure 96: The Title Bar always displays the current version of OUNPPM. The version above is OUNPPM.svn1653.2014.Feb.13.15.31.22.EST.zip. This version number is 1653 and was built on February 13, at 3:31:22 PM EST.

When opening OUNPPM, the software checks for available updates. If an update is available, a notice informing the user occurs, as shown below:

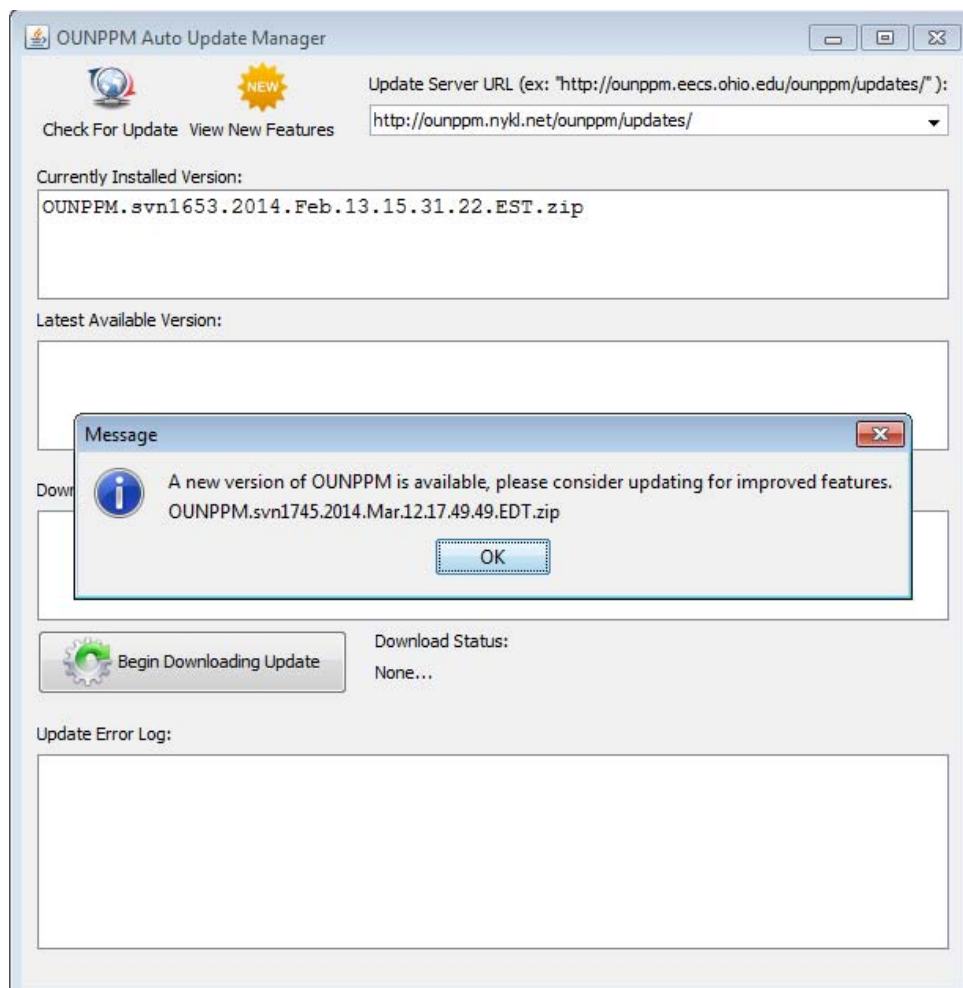


Figure 97: OUNPPM Checks for updates on startup. If a new version is available, the user is notified.

As long as the client machine has an internet connection (IPv4 or IPv6) *and* no firewall is blocking an outbound connection to TCP:80 (*http get* request) between the client and the server at [ounppm.eecs.ohio.edu](http://ounppm.eecs.ohio.edu), then updates can be achieved as follows:

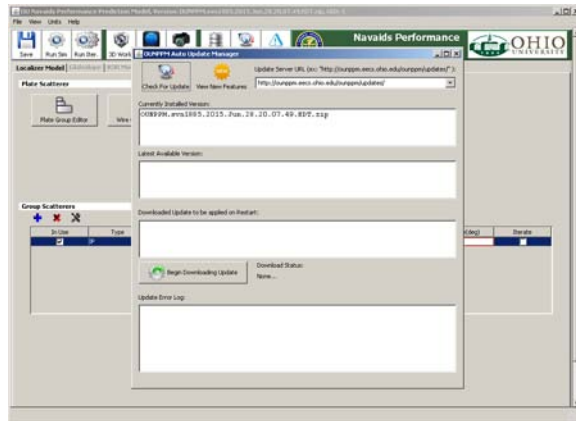


Figure 98: Clicking on the *Update* button from the main tool bar at the top of OUNPPM will open the Updater Window.

1. Click on the *Update* button from the main tool bar at the top of OUNPPM. This will open the Updater Window as shown in Fig.98.
2. Click on the *Check For Update* button in the upper left to query the OUNPPM Server for the latest version. The current version will appear in the *Latest Available Version* window.
3. If a newer version is available and the user would like to upgrade, click on the *Begin Downloading Update* button in mid/lower left part of the screen, as shown in Fig.99.
4. After the download completes successfully, the user must exit OUNPPM and restart it for the updates to take effect.
5. After restarting OUNPPM, notice the Version has changed in the Title Bar of the OUNPPM Window as shown in Fig.100.

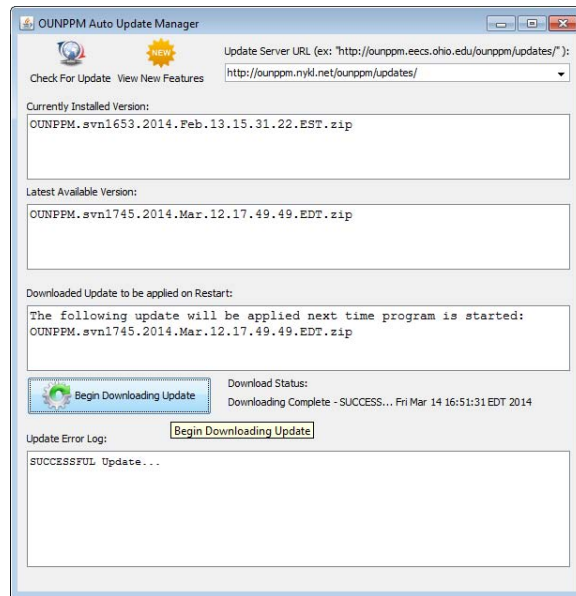


Figure 99: After a successfully downloaded update, OUNPPM must be exited and reopened for the updates to take effect.

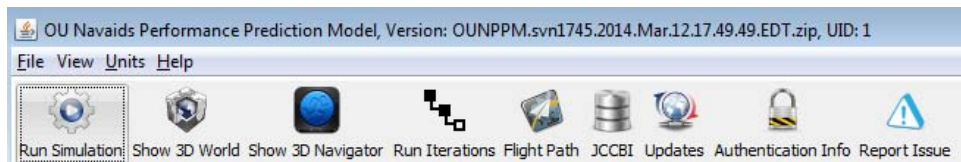


Figure 100: Upon restarting OUNPPM, the new Version is displayed.

## **18 JCCBI Database**

Stuff about JCCBI.



## 19 Authentication Information

OUNPPM requires the provided USB dongle is inserted into the client machine throughout the duration OUNPPM is used. If the USB dongle is removed, OUNPPM will ask the user to reinsert the dongle. OUNPPM will not run without the dongle attached. The dongle is provided during the OUNPPM training sessions.

If a dongle is lost or damaged, please contact Simbo Odunaiya at [odunaiya@ohio.edu](mailto:odunaiya@ohio.edu), or call 1-740-593-1534 8:00am - 5:00pm Monday Thru Friday.

OUNPPM must also authenticate with the update server [ounppm.eecs.ohio.edu](http://ounppm.eecs.ohio.edu) once every 30 days. By default, this happens each time OUNPPM starts. However, if no internet connection is available, a 30-day grace period exists where OUNPPM will continue to run (as long as the USB dongle is inserted).

If the 30-day grace period lapses, OUNPPM will not start until it can authenticate with the update server. Upon connection, the 30-grace period immediately resumes. In other words, if a user will be travelling and may not have internet connectivity, the user is strongly encouraged to run OUNPPM while connected to the internet before leaving.

Figure 101 shows the OUNPPM Authentication Window and provides the user with specific client information including the *Remaining Grace Period*.

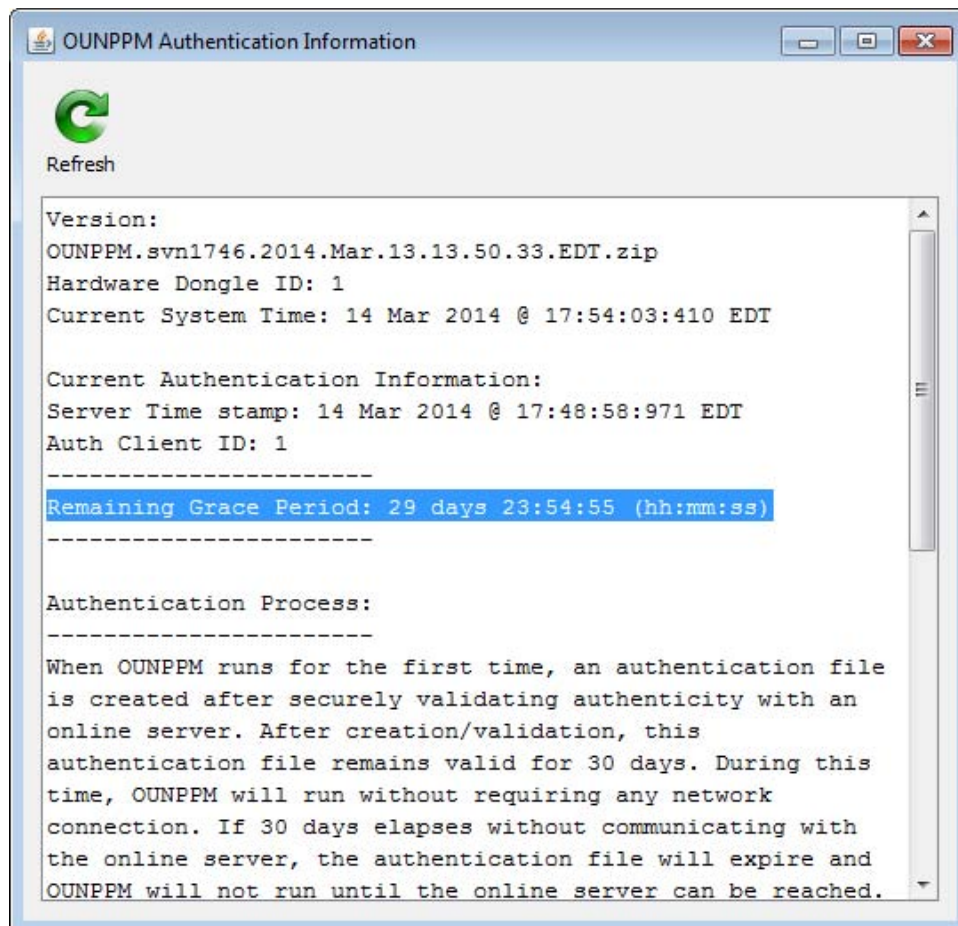


Figure 101: Clicking *Authentication Info* displays client-specific information including the *Remaining Grace Period* before contacting the update server. Clicking the *Refresh* button updates the *Grace Period Remaining* to the nearest Day Hour:Minute:Second.

The following text is taken from the *Authentication Information* Window and

describes, in detail, how the authentication system works.

-----  
Version:

OUNPPM.svn1755.2014.Mar.14.18.02.51.EDT.zip

Hardware Dongle ID: 1

Current System Time: 14 Mar 2014 @ 18:03:12:609 EDT

Current Authentication Information:

Server Time stamp: 14 Mar 2014 @ 18:02:56:864 EDT

Auth Client ID: 1

-----  
Remaining Grace Period: 29 days 23:59:44 (hh:mm:ss)  
-----

Authentication Process:

-----  
When OUNPPM runs for the first time, an authentication file is created after securely validating authenticity with an online server. After creation / validation, this authentication file remains valid for 30 days. During this time, OUNPPM will run without requiring any network connection. If 30 days elapses without communicating with the online server, the authentication file will expire and OUNPPM will not run until the online server can be reached. The 'Grace Period Remaining', shown above indicates the time remaining.

This grace period enables OUNPPM to run without an internet connection for 30 days. If a user will be unable to access the internet for a prolonged period, they may wish to verify OUNPPM immediately before disconnecting, thereby achieving up to 30 days of OUNPPM operation. This verification can be performed by simply running OUNPPM with a valid internet connection. Ensure the 'Grace Period Remaining' says ~29-30 days remaining. This indicates successful authentication.

OUNPPM attempts to validate with an online server each time it starts. If successful, the 30 day grace period restarts.


Hardware Dongle Information:



-----  
OUNPPM requires that the included USB Hardware Dongle be inserted in order for OUNPPM to operate. Once inserted and validated, the hardware dongle becomes 'keyed' with the particular installation. The same hardware dongle must be used throughout the remainder of the grace period.  
-----

**Part V**

**The Outputs (Plots)**

There are two kinds of output plots in the OUNPPM. Plots for a single run, and iterator plots encompassing multiple runs.

Single run plots are generally created by clicking on the “Run Simulation” button  or using the File -> Load Results dialogue.

Iteration plots are generally created by clicking on the “Run Iterations” button  or using the open button  in the iterator tab.

## 20 Localizer

### 20.1 The Plot

#### Axes

##### X-Axis

The localizer has three inspection types. The meaning of the x-axis is described below:

1. ILS3 - This is a fixed, descending approach along centerline. The x-axis of the plot will be distance from threshold in distance units, defaulting to nautical miles.
2. ILS2 - This is a level run at a fixed azimuth. The x-axis of the plot will be an elevation angle, defaulting to degrees.
3. ILS1 - This is an orbit. The x-axis of the plot will be a heading.

##### Y-Axis

For each trace a value can be plotted, refer to section [16.1](#) for more details on what each option means. You can find the units for each section below:

1. CDI Digital - Course angle: microamps or degrees
2. CDI Analog - Course angle: microamps or degrees
3. Flag - Course angle: microamps or degrees
4. CSB Signal Strength - Signal Strength: deciBels or normalized power
5. SBO Signal Strength - Signal Strength: deciBels or normalized power

Note: In the future we plan to add support for logarithmic axes for units like deciBels.

#### CAT III

Figure [116](#) shows an example of a CAT III plot.

#### CAT II

Figure [117](#) shows an example of a CAT II plot.

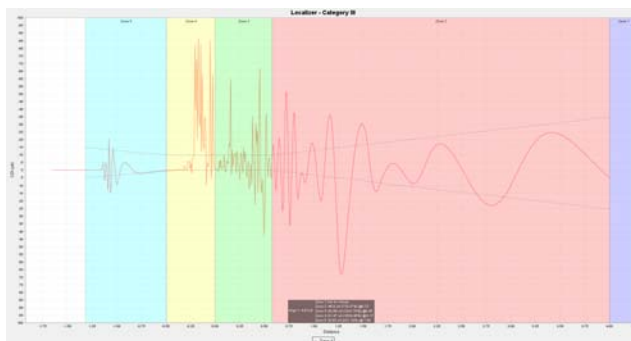


Figure 102: An example of a CATIII analysis.

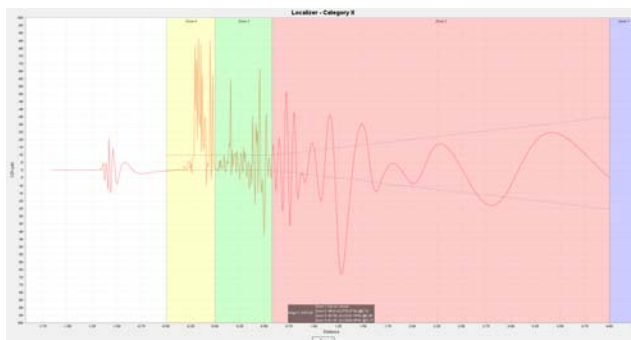


Figure 103: An example of a CATII analysis.

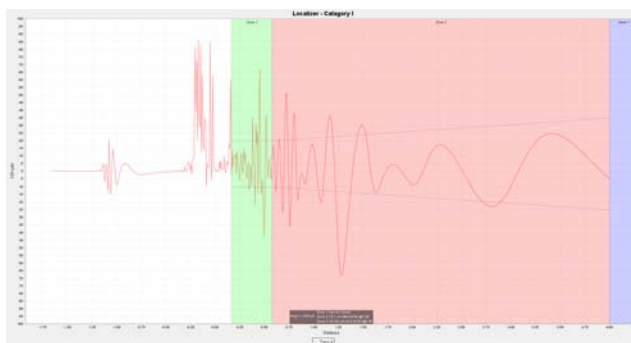


Figure 104: An example of a CATI analysis.

## CATI

Figure 118 shows an example of a CAT I plot.

## Context Menu

The context menu, as seen in figure 119, spawns when you right click on a plot. It has the following options:

## Properties

The chart properties window has three tabs that allow one to edit the title, plot, and miscellaneous features of the plot. Note: the axes adjustment features of the plot in this window only allow one to adjust the extents and tick markings for the axes. If one wishes to adjust the units, one will need to use the “Adjust Axes” feature described in section 22.5.

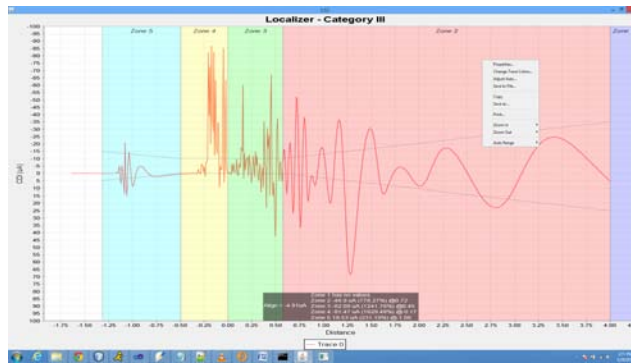


Figure 105: An example of the context menu displayed on a plot.

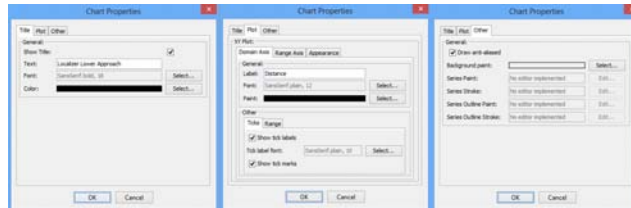


Figure 106: Features supported by the context menu.

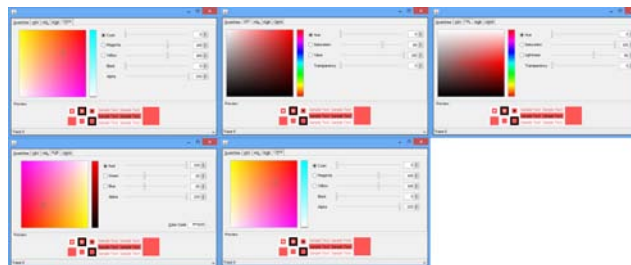


Figure 107: The different color types that are supported.

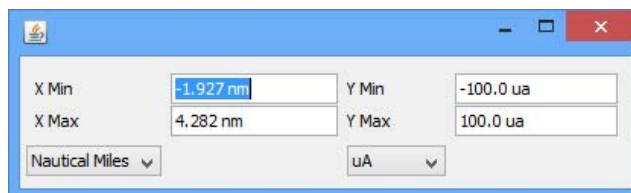


Figure 108: The different color types that are supported.

## Change Trace Colors

This allows the user to change the trace colors to whatever color they desire. It supports HSV, HSL, RGB, and CMYK color specifications.

## Adjust Axes

This window allows the user to adjust the extents and the units for the axes. When units are changed, the real value of the extents are preserved.

**Save to File**

This will save the file to a .gph file of the users choosing. This can be reopened at a later date, so one can view a plot without having to re-run an entire simulation.

**Copy**

Copies the contents of the graph to the clipboard.

**Save As**

Saves the plot as a .png image.

**Print**

Brings up the default print menu to print an image of the plot.

**Zoom In**

Zooms in one or both axes.

**Zoom Out**

Zooms out one or both axes.

**Auto Range**

Reverts one or both axes to their default values.

## **20.2 The Report**

Given the evaluation of all points inspected and those linearly interpolated between inspected points residing at the boundary of a zone, a report is generated. At the bottom of each plot is a report that shows the following:

1. The Alignment error in  $\mu A$
2. For each zone, the error in  $\mu A$  at the point with the highest percentage of tolerance error. Note: there may exist a point with a higher absolute error in that zone, but the report reports the evaluated point with the highest percentage relative to the tolerance at that point.
3. For each zone, the maximum percentage of tolerance at an evaluated point, in percent.
4. For each zone, the x-axis value value at which the maximum percentage of tolerance error occurs, in x-axis units.

## **20.3 Keyboard Interaction**

The following Key Presses affect localizer plots:

- 1 - If support for Category I inspection exists for this configuration, the report mode will switch to Category I.
- 2 - If support for Category II inspection exists for this configuration, the report mode will switch to Category II.
- 3 - If support for Category III inspection exists for this configuration, the report mode will switch to Category III.



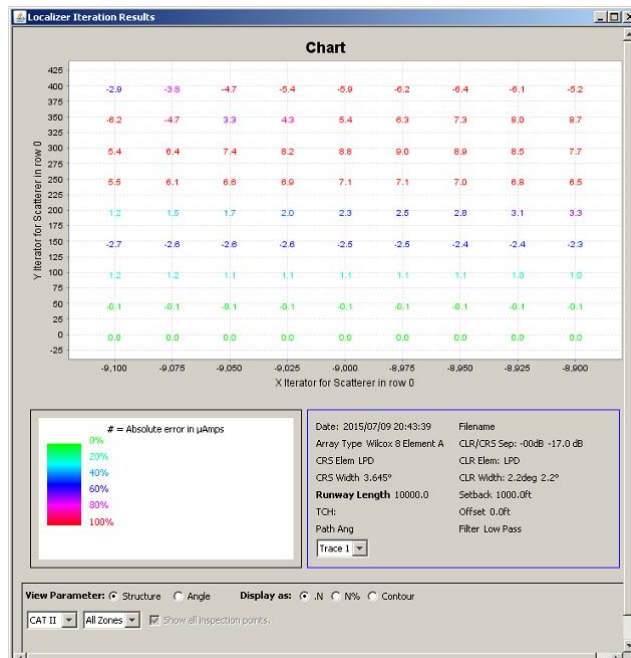


Figure 109: The default iteration plot, a structure plot showing decimal values.

## 20.4 Mouse Interaction

The right mouse button will spawn the context menu which is to be covered in section 22.5.

The left mouse button activates the zoom feature. Click and drag the mouse rightwards and downwards while holding down the left mouse button; this will replace the plot area with the region inside the highlighted area (aspect ratio is not necessarily preserved). Dragging the mouse in any other direction will reset the plot to its original bounds.

Hovering over a data point on a plot will display the  $x$  and  $y$  coordinates of that coordinate on the screen.

## 20.5 Localizer Iterator Plots

### Overview

There are two categories of iteration plots of the localizer: structure and angle. The default plot will be a structure - decimal plot as shown in figure 109. In addition to the plot itself, this frame contains contains several useful GUI components: the title, the legend, the trace panel, and the selection panel at the bottom. The title is customizable via the property menu; the legend will change based on current plot. The trace panel has a selector that chooses which trace information to put on the plot<sup>◇</sup> and to populate the labels of the trace panel. The selection panel at the bottom lets the user change people iteration plot types, as well as select which category and analysis dataset to use.

### Structure Plots

There are three variations of the structure iteration plot, described below: decimal, percentage, and contour.

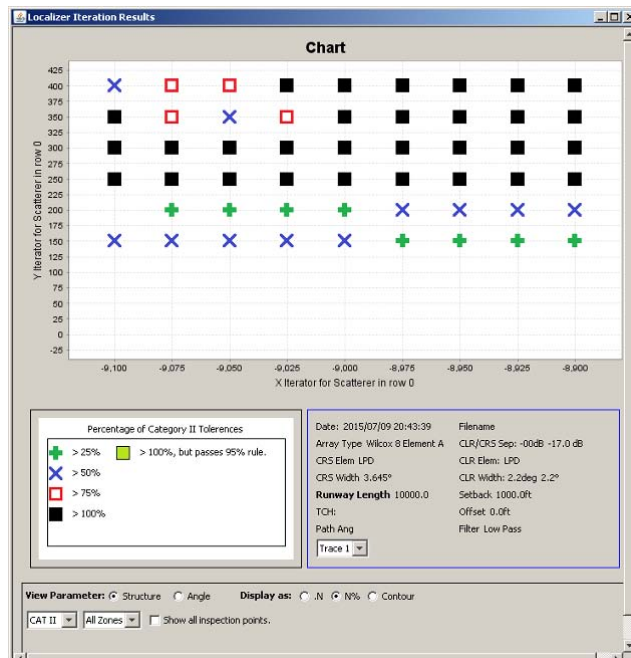


Figure 110: The default iteration plot, a structure plot showing decimal values.

## Decimal

The decimal structure plot is shown in figure 109. The plot and legend are described below.

**Plot** The plot contains one value at the X,Y location for each datapoint. How iteration coordinates are determined are explained in more detail in chapter 15. Each of these datapoints shows a decimal value representing

**Legend** The legend here shows the hue indicator coloring tolerance percentages from green at 0% to red at 100% or higher.

## Percentage

The decimal structure plot is shown in figure 114. The plot and legend are described below.

## Plot

## Legend

## Contour

The decimal structure plot is shown in figure 115. The plot and legend are described below.

## Plot

## Legend

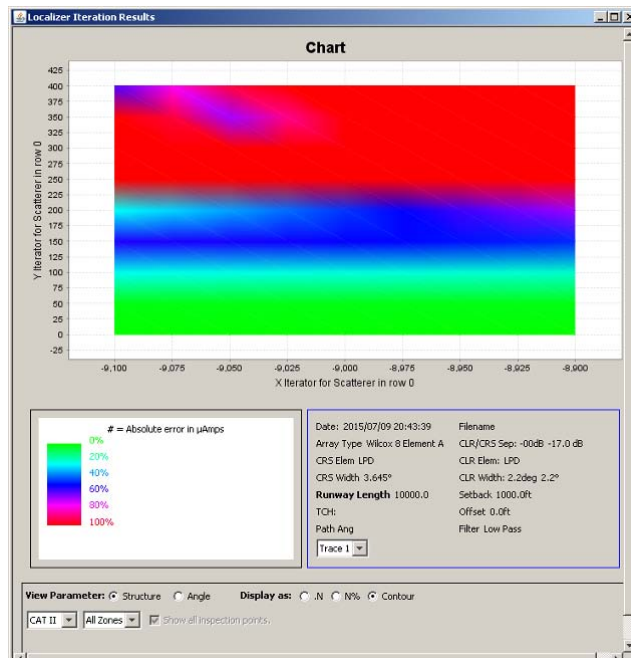


Figure 111: The default iteration plot, a structure plot showing decimal values.

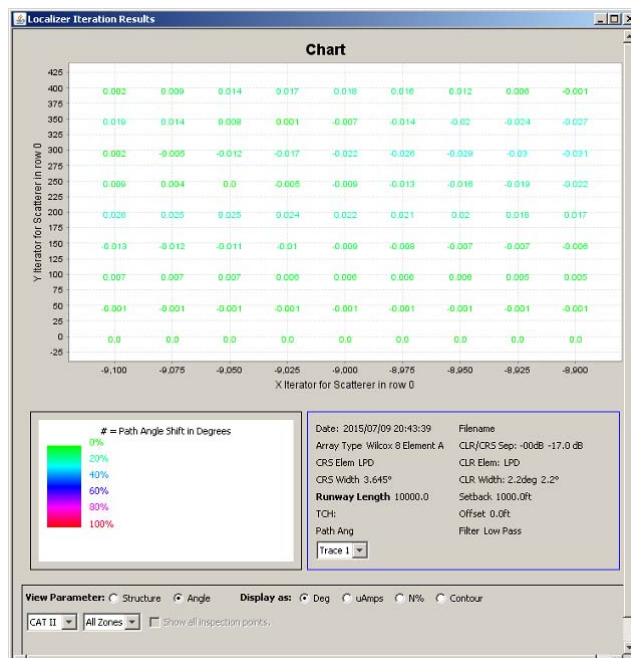


Figure 112: The default iteration plot, an angle plot showing decimal values.

## Angle Plots

Iterator plots use calculated course width for angles, since they can't rely on a specific trace.

## Degree

The decimal structure plot is shown in figure 109. The plot and legend are described below.

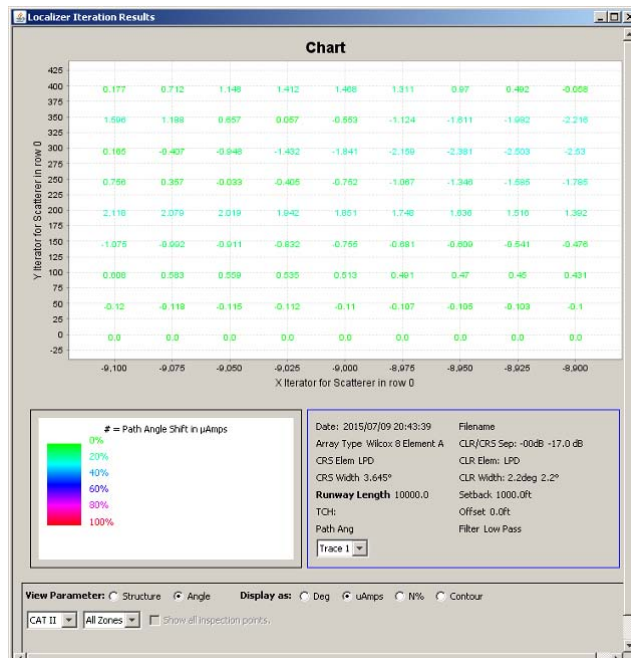


Figure 113: The default iteration plot, an angle plot showing decimal values.

**Plot** The plot contains one value at the X,Y location for each datapoint. How iteration coordinates are determined are explained in more detail in chapter 15. Each of these datapoints shows a decimal value representing

**Legend** The legend here shows the hue indicator coloring tolerance percentages from green at 0% to red at 100% or higher.

### **$\mu$ Amps**

The decimal structure plot is shown in figure 109. The plot and legend are described below.

**Plot** The plot contains one value at the X,Y location for each datapoint. How iteration coordinates are determined are explained in more detail in chapter 15. Each of these datapoints shows a decimal value representing

**Legend** The legend here shows the hue indicator coloring tolerance percentages from green at 0% to red at 100% or higher.

### **Percentage**

The decimal structure plot is shown in figure 114. The plot and legend are described below.

### **Plot**

### **Legend**

### **Contour**

The decimal structure plot is shown in figure 115. The plot and legend are described below.

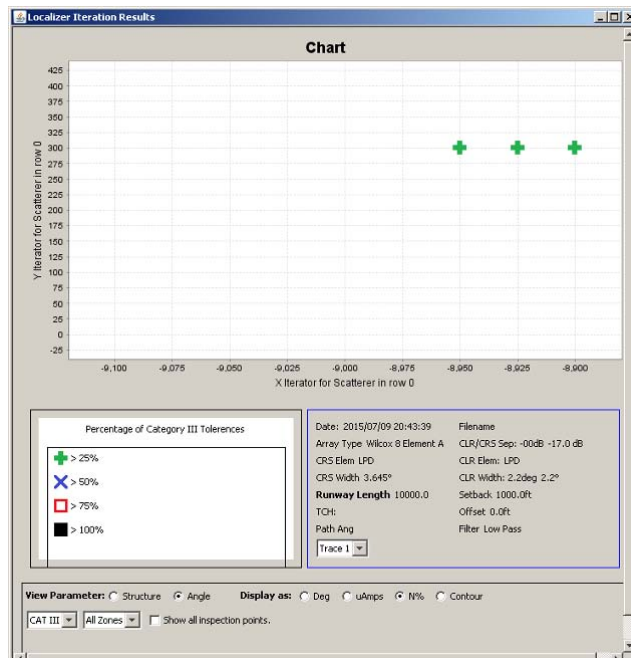


Figure 114: The default iteration plot, an angle plot showing decimal values.

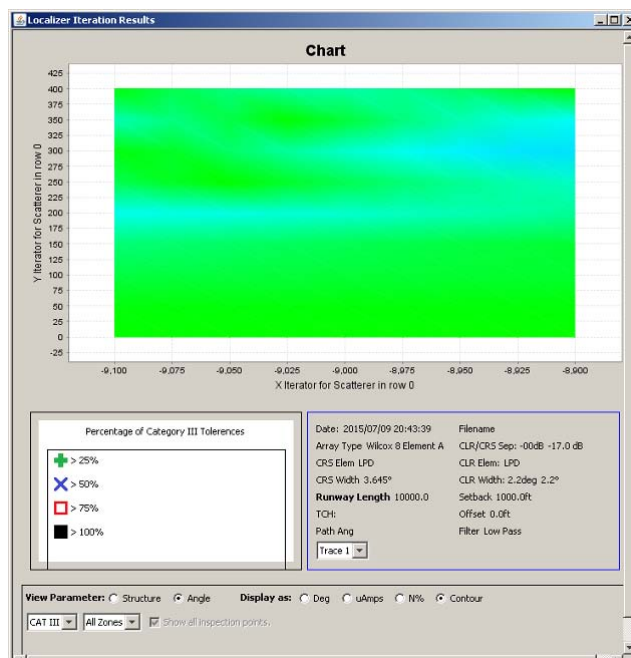


Figure 115: The default iteration plot, an angle plot showing decimal values.

## Plot

## Legend 21 Glideslope

The localizer has three inspection types. The parameters of these flight paths are described

1. ILS3 - This is a fixed approach along centerline. The x-axis of the plot will be distance from threshold and the y-axis will be error in degrees/ $\mu$ Amps.

2. ILS2 - This is an orbital approach. The x-axis of the plot will be an elevation angle and the y-axis will be an error in degrees/ $\mu$ Amps.
3. ILS1 - This is an orbital approach. The x-axis of the plot will be a heading and the y-axis will be an error in degrees/ $\mu$ Amps.

## 21.1 ILS3

### Axes

#### X-Axis

The glide slope has three inspection types. The meaning of the x-axis is described below:

1. ILS3 - This is a fixed, descending approach along centerline. The x-axis of the plot will be distance from threshold in distance units, defaulting to nautical miles.
2. ILS2 - This is a level run at a fixed azimuth. The x-axis of the plot will be an elevation angle, defaulting to degrees.
3. ILS1 - This is an orbit. The x-axis of the plot will be a heading.

#### Y-Axis

For each trace a value can be plotted, refer to section 16.1 for more details on what each option means. You can find the units for each section below:

1. CDI Digital - Course angle: microamps or degrees
2. CDI Analog - Course angle: microamps or degrees
3. Flag - Course angle: microamps or degrees
4. CSB Signal Strength - Signal Strength: deciBels or normalized power
5. SBO Signal Strength - Signal Strength: deciBels or normalized power

Note: In the future we plan to add support for logarithmic axes for units like deciBels.

### The Plot

Note: CATII and CATIII plots for glideslopes are very similar.

#### ILS3

**CAT III** Figure 116 shows an example of a CAT III plot.

#### CATII

Figure 117 shows an example of a CAT II plot.

#### CATI

Figure 118 shows an example of a CAT I plot.

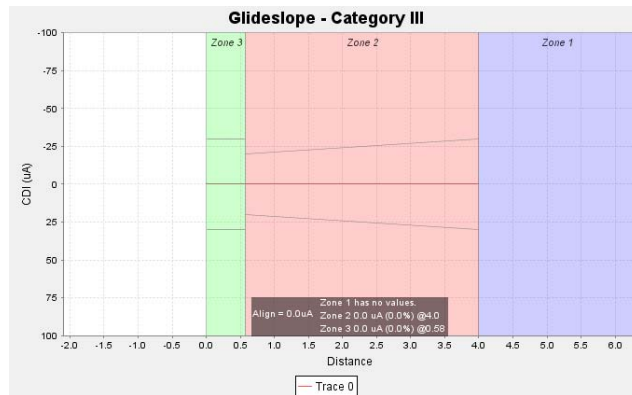


Figure 116: An example of a CATIII analysis.



Figure 117: An example of a CATII analysis.



Figure 118: An example of a CATI analysis.

## Context Menu

The context menu, as seen in figure 119, spawns when you right click on a plot. It has the following options:

**Properties** The chart properties window has three tabs that allow one to edit the title, plot, and miscellaneous features of the plot. Note: the axes adjustment features of the plot in this window only allow one to adjust the extents and tick markings for the axes. If one wishes to adjust the units, one will need to use the “Adjust Axes” feature described in section 22.5.



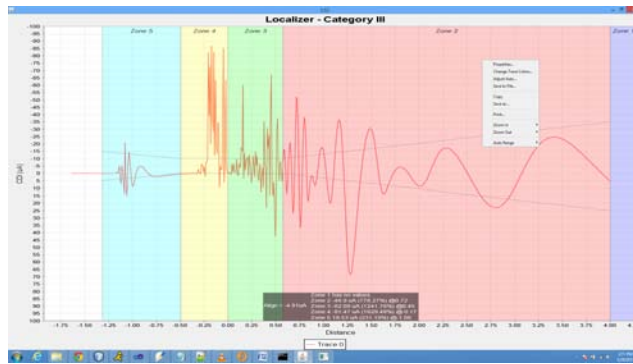


Figure 119: An example of the context menu displayed on a plot.

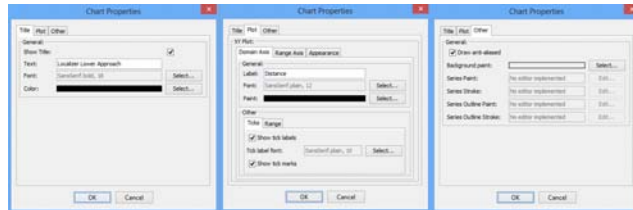


Figure 120: Features supported by the context menu.

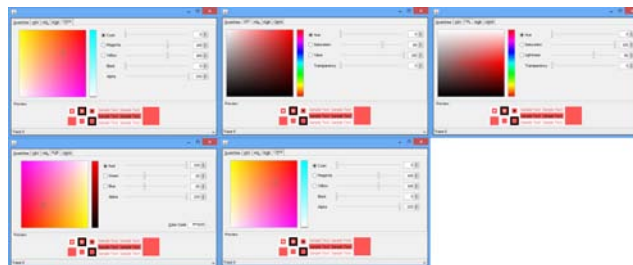


Figure 121: The different color types that are supported.

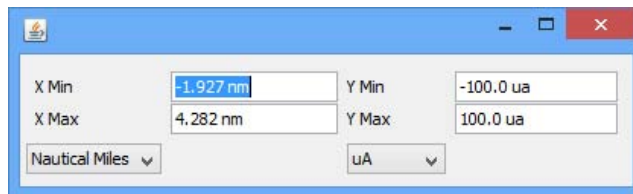


Figure 122: The different color types that are supported.

**Change Trace Colors** This allows the user to change the trace colors to whatever color they desire. It supports HSV, HSL, RGB, and CMYK color specifications.

**Adjust Axes** This window allows the user to adjust the extents and the units for the axes. When units are changed, the real value of the extents are preserved.

**Save to File** This will save the file to a .gph file of the users choosing. This can be reopened at a later date, so one can view a plot without having to re-run an entire simulation.

**Copy** Copies the contents of the graph to the clipboard.

**Save As** Saves the plot as a .png image.

**Print** Brings up the default print menu to print an image of the plot.

**Zoom In** Zooms in one or both axes.

**Zoom Out** Zooms out one or both axes.

**Auto Range** Reverts one or both axes to their default values.

## The Report

Given the evaluation of all points inspected and those linearly interpolated between inspected points residing at the boundary of a zone, a report is generated. At the bottom of each plot is a report that shows the following:

1. The Alignment error in  $\mu A$
2. For each zone, the error in  $\mu A$  at the point with the highest percentage of tolerance error. Note: there may exist a point with a higher absolute error in that zone, but the report reports the evaluated point with the highest percentage relative to the tolerance at that point.
3. For each zone, the maximum percentage of tolerance at an evaluated point, in percent.
4. For each zone, the x-axis value value at which the maximum percentage of tolerance error occurs, in x-axis units.

## Keyboard Interaction

The following Key Presses affect localizer plots:

- 1 - If support for Category I inspection exists for this configuration, the report mode will switch to Category I.
- 2 - If support for Category II inspection exists for this configuration, the report mode will switch to Category II.
- 3 - If support for Category III inspection exists for this configuration, the report mode will switch to Category III.

## Mouse Interaction

The right mouse button will spawn the context menu which is to be covered in section [22.5](#).

The left mouse button activates the zoom feature. Click and drag the mouse rightwards and downwards while holding down the left mouse button; this will replace the plot area with the region inside the highlighted area (aspect ratio is not necessarily preserved). Dragging the mouse in any other direction will reset the plot to its original bounds.

Hovering over a data point on a plot will display the  $x$  and  $y$  coordinates of that coordinate on the screen.

## 21.2 ILS2

### The Report

Given the evaluation of all points inspected and those linearly interpolated between inspected points residing at the boundary of a zone, a report is generated. At the bottom of each plot is a report that shows the following:

1. The Alignment error in  $\mu\text{A}$
2. For each zone, the error in  $\mu\text{A}$  at the point with the highest percentage of tolerance error. Note: there may exist a point with a higher absolute error in that zone, but the report reports the evaluated point with the highest percentage relative to the tolerance at that point.
3. For each zone, the maximum percentage of tolerance at an evaluated point, in percent.
4. For each zone, the x-axis value value at which the maximum percentage of tolerance error occurs, in x-axis units.
5. BP Stuct: The point at which the value will hit a CDI of 190 uA

## 21.3 ILS1

## 22 VOR

### 22.1 Axes

#### X-Axis

The VOR has four inspection types. The meaning of the x-axis is described below:

1. Orbital - This is a orbit about the VOR. The x-axis of the plot will be the current azimuth of the aircraft, defaulting to degrees.
2. Radial - This is a straight flight path heading towards the VOR. The x-axis of the plot will be distance from VOR, defaulting to nautical miles.
3. RNAV - This is a straight segment from two arbitrary end points. The x-axis of the plot will be the distance travelled from the start point towards the stop point, defaulting to nautical miles.
4. Fixed - This is a fixed radius, fixed altitude, fixed step size orbit. The x-axis of the plot will be the current azimuth of the aircraft, defaulting to degrees.

#### Y-Axis

If a VOR Trace is selected to show the bearing error, it will always be the primary (left-hand) range axis. If additional VOR traces are added for signal strengths they will appear on the secondary (right-hand) axis. If only signal strengths are plotted they will appear on the primary (left-hand) range axis.

For each trace a value can be plotted, refer to section [16.3](#) for more details on what each option means. You can find the units for each section below:

**Figure 11-2**  
**STRUCTURE**  
 (Example – not drawn to scale)

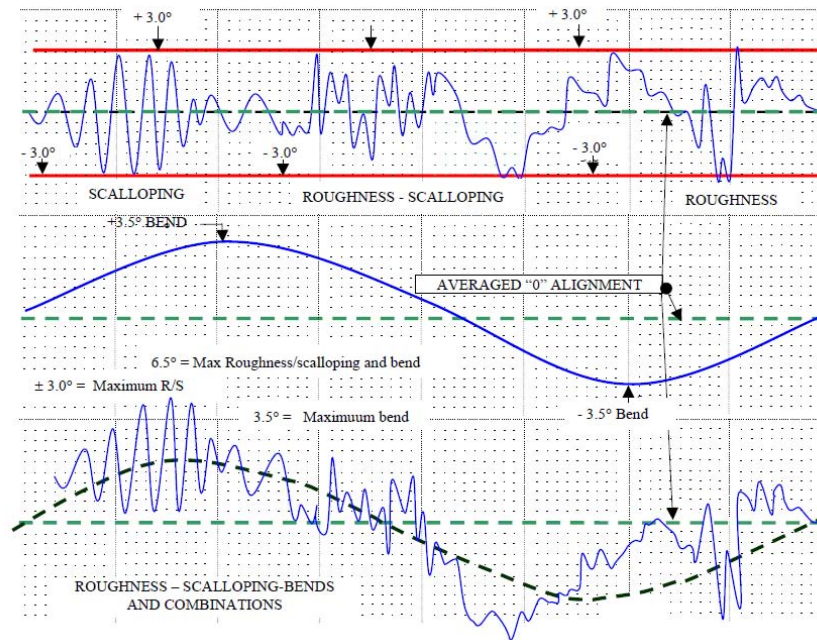


Figure 123: An example of roughness, scalloping, and bends. Taken from FAA 8200.1C page 11-18.

1. Brg Error - Angle: degrees
2. Direct SS - Signal Strength: deciBels or normalized power
3. Reflected SS - Signal Strength: deciBels or normalized power
4. Total SS - Signal Strength: deciBels or normalized power

Note: In the future we plan to add support for logarithmic axes for units like deciBels.

## 22.2 Source

The original source of all VOR plots is from a .prn file generated by the software, this can be found in the same directory as your .dat file.

## 22.3 The Plot

The bearing error generated by the .dll is a signal that can be thought of as being composed of three distinct parts. These parts (roughness, scalloping, bends) are outlined in figure 123, and can be isolated and displayed.

An example of a VOR plot is shown in figure 124. The red line is the original values. The green line is the scalloping (original passed through a high pass filter). The blue line are the bends (original passed through a low pass filter).

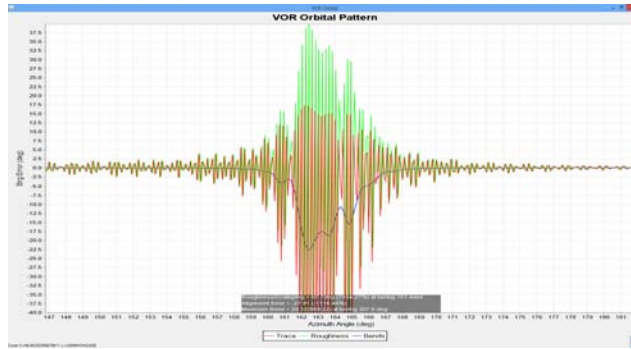


Figure 124: An example of a VOR plot.

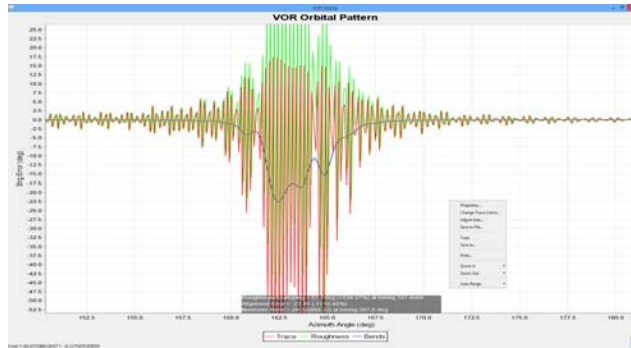


Figure 125: An example of the context menu displayed on a plot.

## 22.4 The Report

Given the evaluation of all points inspected and those linearly interpolated between inspected points residing at the boundary of a zone, a report is generated. At the bottom of each plot is a report that shows the following:

1. Roughness/Scalloping - maximum error value, percentage of tolerance, and location (bearing or distance)
2. Alignment Error - average value and percentage of tolerance
3. Maximum Bend - maximum value of the signal passed through a low pass filter, the maximum percentage of tolerance, and location (bearing or distance)

## 22.5 Context Menu

The context menu, as seen in figure 125, spawns when you right click on a plot. It has the following options:

### Properties

The chart properties window has three tabs that allow one to edit the title, plot, and miscellaneous features of the plot. Note: the axes adjustment features of the plot in this window only allow one to adjust the extents and tick markings for the axes. If one wishes to adjust the units, one will need to use the “Adjust Axes” feature described in section 22.5.

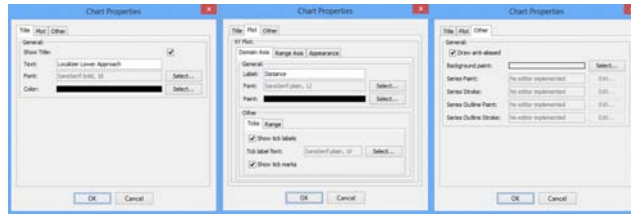


Figure 126: Features supported by the context menu.

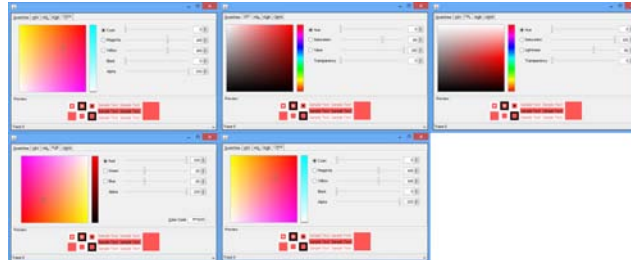


Figure 127: The different color types that are supported.

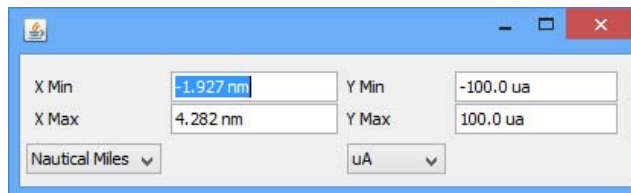


Figure 128: The different color types that are supported.

## Change Trace Colors

This allows the user to change the trace colors to whatever color they desire. It supports HSV, HSL, RGB, and CMYK color specifications.

## Adjust Axes

This window allows the user to adjust the extents and the units for the axes. When units are changed, the real value of the extents are preserved.

## Save to File

This will save the file to a .gph file of the users choosing. This can be reopened at a later date, so one can view a plot without having to re-run an entire simulation.

## Copy

Copies the contents of the graph to the clipboard.

## Save As

Saves the plot as a .png image.

## Print

Brings up the default print menu to print an image of the plot.

### **Zoom In**

Zooms in one or both axes.

### **Zoom Out**

Zooms out one or both axes.

### **Auto Range**

Reverts one or both axes to their default values, listed below:

1. Domain Axes
  - a) Orbital -  $0^\circ$  to  $360^\circ$
  - b) Radial - 0 to 20 nautical miles
  - c) RNAV - 0 to 20 nautical miles
  - d) Fixed -  $0^\circ$  to  $360^\circ$
2. Range Axes
  - a) Bearing Error -  $40^\circ$  to  $-40^\circ$
  - b) Signal Strength
    - i. Decibels - -140 dB to 0dB
    - ii. Normalized - 0 to 10

## **22.6 Keyboard Interaction**

The following Key Presses affect localizer plots:

- 1 - Toggles the trace for the bends (low frequency)
- 2 - Toggles the trace for the roughness (bandpass)

## **22.7 Mouse Interaction**

The right mouse button will spawn the context menu which is to be covered in section [22.5](#).

The left mouse button activates the zoom feature. Click and drag the mouse rightwards and downwards while holding down the left mouse button; this will replace the plot area with the region inside the highlighted area (aspect ratio is not necessarily preserved). Dragging the mouse in any other direction will reset the plot to its original bounds.

The plot constantly updates the X and Y values at the location of the mouse cursor.



**Part VI**

**The Virtual World**

OUNPPM is composed of two main windows: 1) The typical GUI window used for inputs and 2) The 3D Visualization window corresponding to the current model represented in the GUI. The 3D Visualization graphically depicts the current model described numerically by the GUI window. Figure 129 shows an example. The 3D world consists of 3D Objects, such as scatterers, a runway, flight paths, visual indicators, etc, see Fig. 26. Lastly, the 3D World also contains a virtual camera; this camera represents the virtual *eyeball* that views the world. The eyeball is always located at some position in the world and always looks in some direction, it uses the same reference frame as shown in 26. By moving this eyeball around the world, one may traverse through the visualization.

## 22.8 Navigating the Virtual World

The camera moves *forward* by clicking and holding the *right mouse button*. The *forward* direction is defined by the direction in which the camera is looking. Therefore, if the camera is looking at an object, such as a scatterer, right clicking and holding will move the camera towards the scatterer. This is not the same as zooming in, but reducing the geometric distance between the camera and viewed object.

One may change / rotate the direction in which the camera looks by clicking and holding the *left mouse button* while dragging the mouse up/down/left/right to look up/down/left/right, respectively.

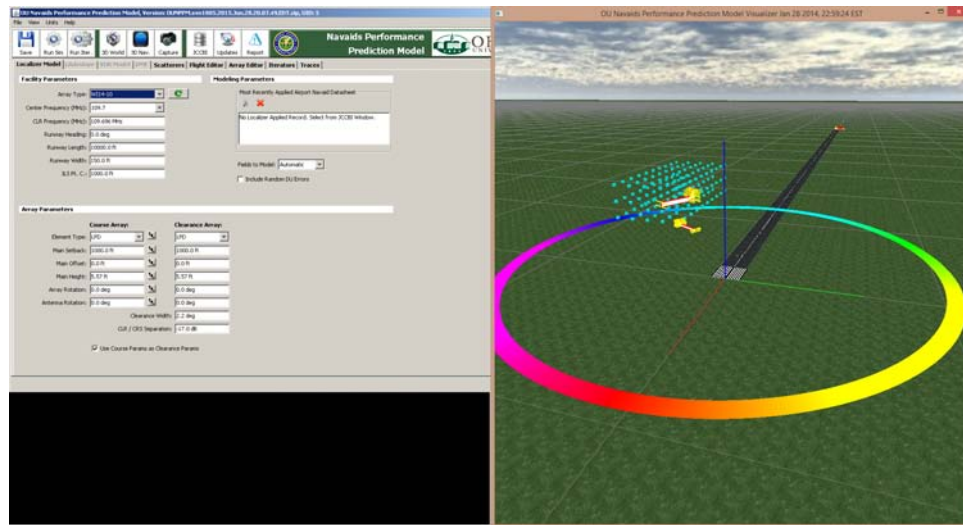


Figure 129: The GUI window used for inputting a navaid model (left). The 3D Visualization graphically depicting the navaid model (right).

## 22.9 Resetting the Virtual World

At any time, the user may close the 3D Visualization by clicking on the Red X in the upper right corner. The 3D Visualization may be restarted by clicking on the *Show 3D World* button in the top tool bar (top left), as shown in 129. This will reopen the world. One may want to do this if, one becomes lost within 3D world and cannot find a way to return to the area of interest.

## **22.10 Elements of the Virtual World**

### **Shared Elements**

#### **The Grid**

#### **The Runway**

Present in Localizer and Glideslope.

### **Localizer Elements**

#### **The Array**

### **Glideslope Elements**

#### **The Array**

### **VOR Elements**

#### **The Array**

### **DME Elements**

# **Part VII**

## **Examples**



# Exercise 1

## Vertical Pattern of CEGS

- Calculate the vertical radiation and DDM patterns for a CEGS
- Path Angle 2.6-degrees
- Glide Slope Frequency 331.4 MHz
- Glide Slope Offset 380', Setback 1010'
- Flight Profile
  - Range=20,000'; Elevation Angle - 0.1-10-degrees

## Exercise 2

# Transmitter Adjustments

- Determine the maximum CRS-CLR ratio on centerline to obtain acceptable clearance ( $> 200 \text{ uA}$ ) throughout the required coverage for the following:
- Localizer Array: RECA (Redlich Array)
- Runway Length: 10,500'
- Localizer Setback: 1,200'



## Exercise 3

# Antenna Distribution Modification

- System Configuration:
  - 8-element V-ring operating at 111.9 MHz
  - Localizer setback: 1,102'
  - Runway length: 6,001'

## Exercise 3 (cont'd)

- Determine the localizer shift for the following antenna feed line phase faults
  - 10-degrees 1 Left
  - 10-degrees 2 Right
  - 20-degrees 3 Left
  - 20-degrees 3 Right

## Exercise 4

### FLL Rwy 27L

- Runway 27L at FLL will be extended requiring the existing localizer to be relocated across a canal. The canal is a navigable channel and penetrates the localizer critical area. The crafts are limited in height based on bridges. The FAA had concerns that the crafts could degrade the localizer performance.

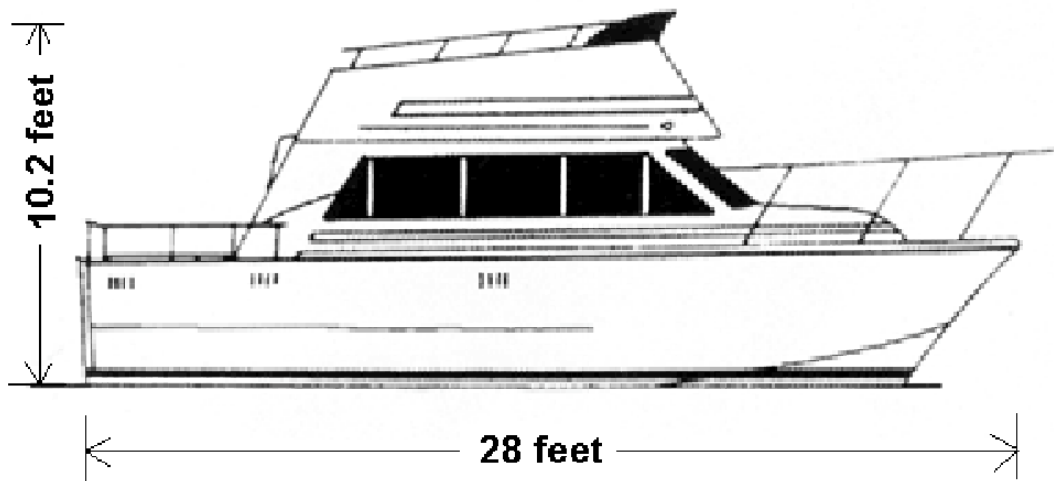
# Exercise 4 (cont'd)

## FLL Small Boat Club



## Exercise 4 (cont'd)

### 28-Foot Boat



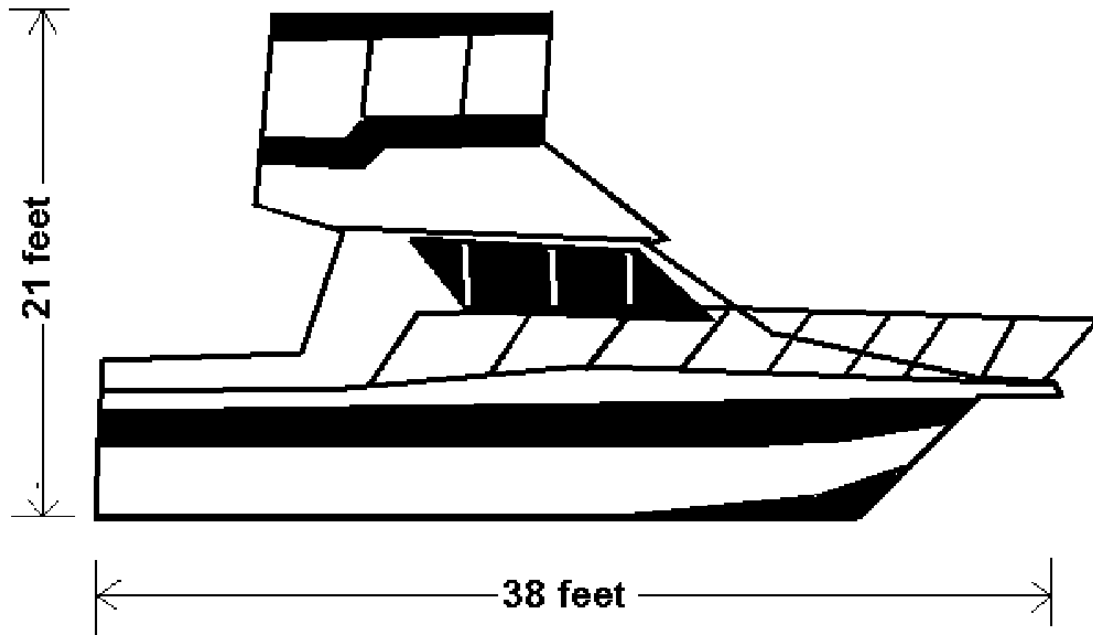
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## Exercise 4 (cont'd)

### 38-Foot Boat



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## Exercise 4 (cont'd)

### Parameters

- Array: 8 Element Array
- Element: LPD
- Frequency: 108.55 MHz
- Setback: 775'
- Runway Length: 7218



## Exercise 4 (cont'd)

### Canal

- Canal is located between localizer array and runway stop end, 150 feet in front of localizer and it is 225 feet wide.
- The canal transverses the entire width of the localizer
- Water level varies. Worst case: water level with the bank

## Exercise 4 (cont'd)

### Assignment

- Modeling the worst case scenario, will either boat cause degradation to the localizer signal??
- Note: Analyze the Boats at several different locations

## Exercise 5

# Max Building Height

Determine the acceptable locations near a runway which will not degrade the ILS service.

## Exercise 5 (cont'd)

### ILS Information

- Loc Arrays: 14\_10, 20\_10
- Runway Length: 9,000 ft
- Setback from SE: 1000 ft
- Frequency: 110.1MHz
- Service: Category II/III

## Exercise 5 (cont'd)

### Building Information

- Building length: 500 ft
- Building height: 120 ft

## Exercise 5 (cont'd)

- At what locations near the runway can this building be constructed?
  - Use iteration method
    - $[0, -8000, -1000], [200, 800, 50]$

## Exercise 6

### Limo Service Center

- City of Chicago plans to lease a parcel of land to a developer to construct a limo service center. This facility will consist of a main building, carwash facility, and security fence. The land is approximately 1,000' of ORD Runway 27R threshold. Will this proposed development cause any degradation to the existing glide slope?

# Exercise 6 (cont'd)

## Limo Center Information

### Distance from Rwy 27R Threshold

X1	Y1	X2	Y2	Height
28.06	866.81	177.1	666.7	18
2.61	962	119.34	963	26
-526.9	879.31	-340.64	879.31	11
-340.69	879.31	28.06	854.31	11
28.06	854.31	253.06	860.56	11



## Exercise 6 (cont'd)

### GS Information

Parameter	Data
GS Type	CEGS
Path Angle	3-degrees
Mast Setback	1,040
Mast Offset	463
TCH	55'
Category of Service	I and II/III

# Exercise 7

## Evaluating Airport Environments

### IND 23R

- *Background:* Indianapolis constructed a new runway and required ILS systems for both ends (Rwy 05L - Cat III, & 23R - Cat I). An 8-element LPD array was installed on Rwy 23R. This facility would not pass commissioning flight inspection because of excessive structure roughness

# Exercise 7

## Evaluating Airport Environments

### IND 23R

- Determine possible solutions to obtain satisfactory Category I course quality.
- Note: Please use the pull from image data acquisition approach for this example

# Exercise 7

## Evaluating Airport Environments

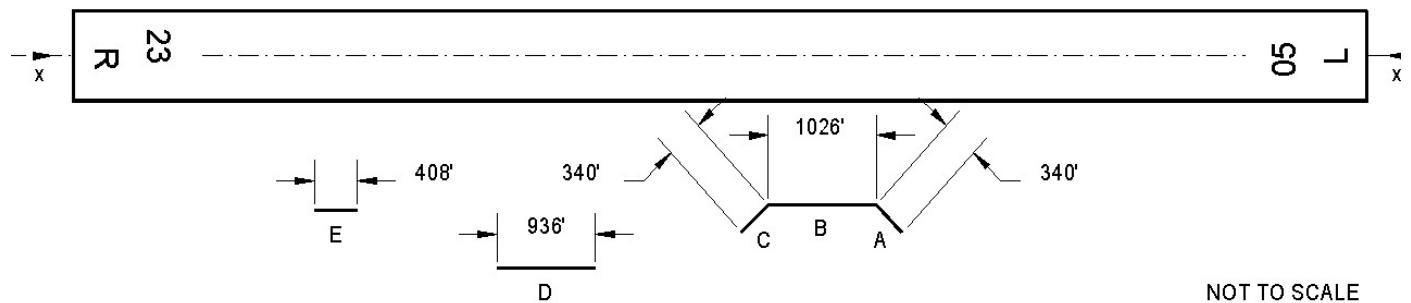
### IND 23R

- Localizer Configuration:
  - Array: 8-element LPD
  - Setback: 1,010'
  - Frequency: 109.7 MHz
  - Length: 11,200'
  - Threshold crossing height: 55'

# Exercise 7

## Evaluating Airport Environments

### IND 23R – Layout



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# Exercise 7

## Evaluating Airport Environments

### IND 23R – Structure Dimensions

Table 1. Scatterer Dimensions as Modeled.

Scatterer Reference	Position of Scatterer Relative to 23R Loc. (ft)			Dimensions of Scatterer (ft)	
	X	Y	Z	Length	Height
A	5528	1440	0	340	72
B	6160	1320	0	1026	72
C	6800	1440	0	340	72
D	8776	1880	0	936	80
E	10768	1368	0	408	75

Note: A,B,C United Airlines MOC II Facility  
 D U.S. Postal Service Eagle Facility  
 E USAir Maintenance Hangar



**OHIO**  
UNIVERSITY

# Exercise 8

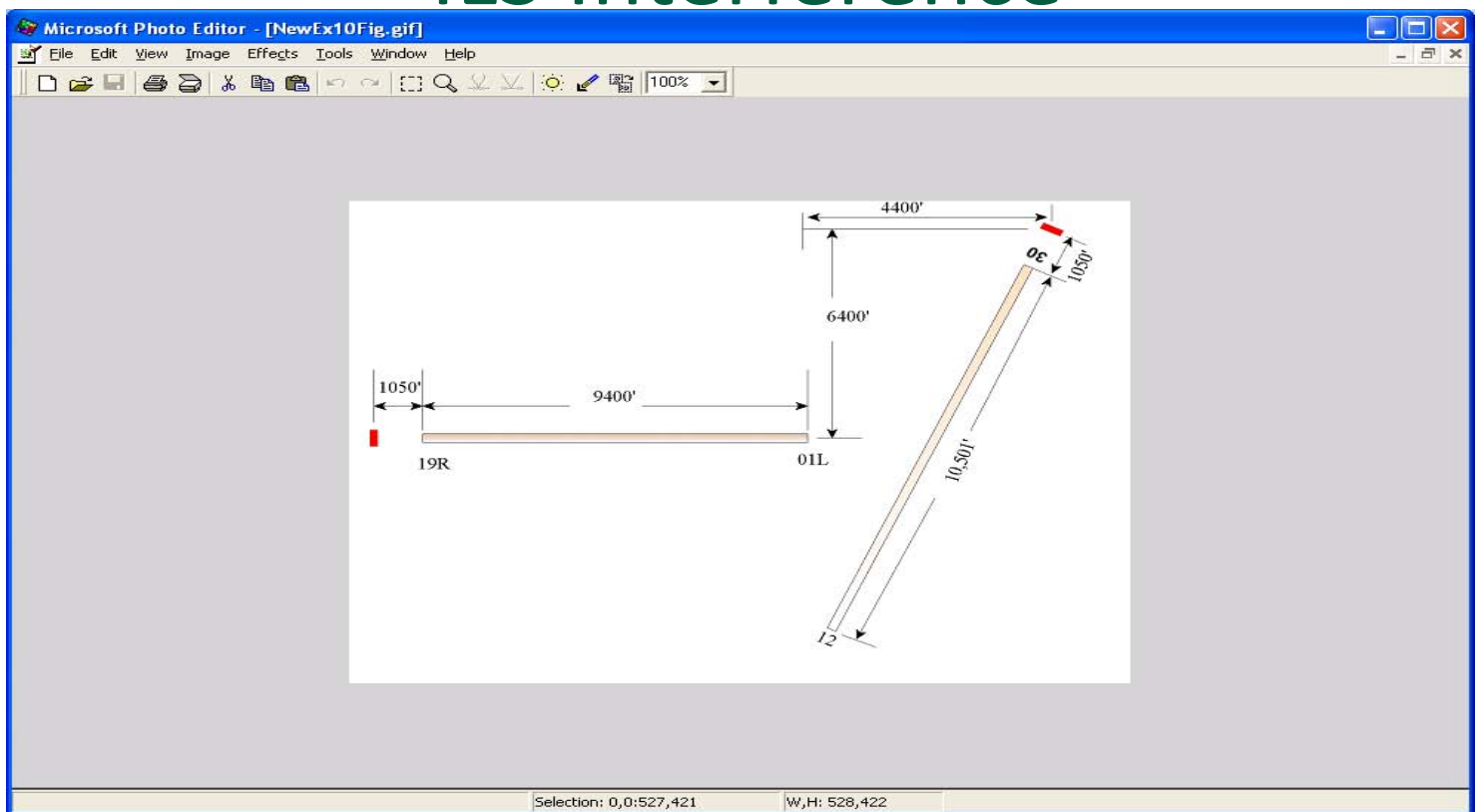
## ILS Interference

### IAD

- *Background:* The MWAA has proposed a fourth runway at IAD. The orientation of the new Runway 12 will cross in-front of existing Runway 01L. Will unacceptable guidance be given if both ILS localizers are radiating at the same time?

# Exercise 8

## ILS Interference





# Exercise 8

## ILS Interference

IAD

Desired Localizer 01L

Setback: 1050'

Offset: 0.0'

Runway Length:  
9,400'

Array: 14-10

• Interfering Localizer 12

– Setback: 13,800

– Offset: 6,400

– Width: 3.0 degrees

– Array: 14-10

# Exercise 9

## Fort Lauderdale VOR

- Planned future developments for the Fort Lauderdale International Airport (FLL) requires the construction of a consolidated rental car facility (CRCF) to be constructed near the terminal complex. This facility was initially approved by the Federal Aviation Administration (FAA) to 7-stories. Current planning is to have ten floors for this facility; which is three floors higher than the approved 7-story structure. Concern has arisen that this taller structure may cause unacceptable degradation to the VOR serving the Airport.
- ?Evaluate the Impact of the CRCF on the VOR

# Exercise 9 (cont'd)

## Fort Lauderdale VOR

- VOR Model Input Parameters -- Input File
- VOR Parameters
  - Conventional VOR
  - Frequency (MHz) = 114.40 CP Radius (Ft) = 26.0
  - Antenna Height (Ft) = 4.00 CP Height (Ft) = 12.0
  - Offset North (Ft) = 0.0 Offset East (Ft) = 0.0
  - Ground Elevation (Ft) = 0.0 Ground is Perfectly Conducting
- Flight Path
  - Segment 1: Orbital
    - Base Range (NMI) = 40.00 Radial Start (Deg) = 0.0
    - Altitude (Ft MSL) = 1000.0 Radial End (Deg) = 360.0
    - Radial Step (Deg) = 1.000

## Exercise 9 (cont'd)

- Scatterers
- Scatterer 1: Rectangle
  - Range (Ft) = 4381.0      Azimuth (Deg) = 106.70
  - Ground Elevation (Ft) = 0.0      Base Height (Ft) = 0.0
  - Length (Ft) = 449.6      Height (Ft) = 104.8
  - Rotation (Deg) = 0.40      Tilt (Deg) = 0.00
  - Material is Steel      Ground Plane Present
- Scatterer 2: Rectangle
  - Range (Ft) = 4820.3      Azimuth (Deg) = 102.50
  - Ground Elevation (Ft) = 0.0      Base Height (Ft) = 0.0
  - Length (Ft) = 1020.0      Height (Ft) = 104.8
  - Rotation (Deg) = 90.40      Tilt (Deg) = 0.00
  - Material is Steel      Ground Plane Present

## Exercise 10:

### Norfolk VOR

- *Background:* A new runway is planned for Norfolk airport. As a result, the VOR serving this airport, which is currently on airport grounds, needs to be relocated to a new area. A location has been selected; the new environment has trees, power lines, and some building structures which may degrade the performance. Determine the effects of the tree lines and how this can be mitigated to allow satisfactory performance.

## Exercise 10 (cont'd)

### Norfolk VOR



## Exercise 10 (cont'd)

- ORF Model Input Parameters -- Input File
- VOR Parameters
  - Conventional VOR
  - Frequency (MHz) = 113.00      CP Radius (Ft) = 26.0
  - Antenna Height (Ft) = 4.00      CP Height (Ft) = 12.0
  - Offset North (Ft) = 0.0      Offset East (Ft) = 0.0
  - Ground Elevation (Ft) = 0.0      Ground is Perfectly Conducting
- Flight Path
- Segment 1: Orbital
  - Base Range (NMi) = 25.00      Radial Start (Deg) = 0.0
  - Altitude (Ft MSL) = 3000.0      Radial End (Deg) = 360.0
  - Radial Step (Deg) = 0.500
-

## Exercise 10 (cont'd)

- Scatterers
- Scatterer 1: Rectangle
  - Range (Ft) = 251.2                      Azimuth (Deg) = 240.20
  - Ground Elevation (Ft) = 0.0            Base Height (Ft) = 0.0
  - Length (Ft) = 252.9                      Height (Ft) = 60.0
  - Rotation (Deg) = 113.90                Tilt (Deg) = 0.00
  - Material is Trees                          Ground Plane Present
- Scatterer 2: Rectangle
  - Range (Ft) = 233.8                      Azimuth (Deg) = 201.20
  - Ground Elevation (Ft) = 0.0            Base Height (Ft) = 0.0
  - Length (Ft) = 91.4                        Height (Ft) = 60.0
  - Rotation (Deg) = 157.10                Tilt (Deg) = 0.00
  - Material is Trees                          Ground Plane Present
- Scatterer 3: Rectangle
  - Range (Ft) = 572.0                      Azimuth (Deg) = 176.40
  - Ground Elevation (Ft) = 0.0            Base Height (Ft) = 0.0
  - Length (Ft) = 39.3                        Height (Ft) = 64.0
  - Rotation (Deg) = 36.30                Tilt (Deg) = 0.00
  - Material is Trees                          Ground Plane Present



## Exercise 10 (cont'd)

- Scatterer 4: Rectangle
  - Range (Ft) = 589.7                      Azimuth (Deg) = 166.50
  - Ground Elevation (Ft) = 0.0          Base Height (Ft) = 0.0
  - Length (Ft) = 184.7                      Height (Ft) = 64.0
  - Rotation (Deg) = 101.40              Tilt (Deg) = 0.00
  - Material is Trees                      Ground Plane Present
- Scatterer 5: Rectangle
  - Range (Ft) = 719.0                      Azimuth (Deg) = 151.80
  - Ground Elevation (Ft) = 0.0          Base Height (Ft) = 0.0
  - Length (Ft) = 238.1                      Height (Ft) = 95.0
  - Rotation (Deg) = 110.60              Tilt (Deg) = 0.00
  - Material is Trees                      Ground Plane Present
- Scatterer 6: Rectangle
  - Range (Ft) = 734.7                      Azimuth (Deg) = 131.80
  - Ground Elevation (Ft) = 0.0          Base Height (Ft) = 0.0
  - Length (Ft) = 418.1                      Height (Ft) = 95.0
  - Rotation (Deg) = 27.40              Tilt (Deg) = 0.00
  - Material is Trees                      Ground Plane Present

## Exercise 10 (cont'd)

- Scatterer 7: Rectangle
  - Range (Ft) = 508.2                      Azimuth (Deg) = 113.60
  - Ground Elevation (Ft) = 0.0          Base Height (Ft) = 0.0
  - Length (Ft) = 409.3                      Height (Ft) = 64.0
  - Rotation (Deg) = -60.40              Tilt (Deg) = 0.00
  - Material is Trees                      Ground Plane Present
- Scatterer 8: Rectangle
  - Range (Ft) = 367.5                      Azimuth (Deg) = 108.80
  - Ground Elevation (Ft) = 0.0          Base Height (Ft) = 0.0
  - Length (Ft) = 124.4                      Height (Ft) = 64.0
  - Rotation (Deg) = 105.20              Tilt (Deg) = 0.00
  - Material is Trees                      Ground Plane Present
- Scatterer 9: Rectangle
  - Range (Ft) = 701.8                      Azimuth (Deg) = 102.00
  - Ground Elevation (Ft) = 0.0          Base Height (Ft) = 0.0
  - Length (Ft) = 186.1                      Height (Ft) = 64.0
  - Rotation (Deg) = 17.20              Tilt (Deg) = 0.00
  - Material is Trees                      Ground Plane Present

## Exercise 10 (cont'd)

- Scatterer 10: Rectangle
  - Range (Ft) = 653.4                      Azimuth (Deg) = 85.50
  - Ground Elevation (Ft) = 0.0      Base Height (Ft) = 0.0
  - Length (Ft) = 122.7                      Height (Ft) = 64.0
  - Rotation (Deg) = 18.00      Tilt (Deg) = 0.00
  - Material is Trees                      Ground Plane Present
- Scatterer 11: Rectangle
  - Range (Ft) = 646.2                      Azimuth (Deg) = 80.50
  - Ground Elevation (Ft) = 0.0      Base Height (Ft) = 0.0
  - Length (Ft) = 66.4                      Height (Ft) = 64.0
  - Rotation (Deg) = -95.60              Tilt (Deg) = 0.00
  - Material is Trees                      Ground Plane Present
- Scatterer 12: Rectangle
  - Range (Ft) = 594.6                      Azimuth (Deg) = 78.90
  - Ground Elevation (Ft) = 0.0      Base Height (Ft) = 0.0
  - Length (Ft) = 46.5                      Height (Ft) = 64.0
  - Rotation (Deg) = -62.80              Tilt (Deg) = 0.00
  - Material is Trees                      Ground Plane Present

## Exercise 10 (cont'd)

- Scatterer 13: Rectangle
  - Range (Ft) = 587.6                      Azimuth (Deg) = 74.40
  - Ground Elevation (Ft) = 0.0        Base Height (Ft) = 0.0
  - Length (Ft) = 126.0                  Height (Ft) = 64.0
  - Rotation (Deg) = -5.40        Tilt (Deg) = 0.00
  - Material is Trees                      Ground Plane Present
- Scatterer 14: Rectangle
  - Range (Ft) = 415.4                      Azimuth (Deg) = 339.60
  - Ground Elevation (Ft) = 0.0        Base Height (Ft) = 0.0
  - Length (Ft) = 997.4                  Height (Ft) = 65.0
  - Rotation (Deg) = -156.30        Tilt (Deg) = 0.00
  - Material is Trees                      Ground Plane Present
- Scatterer 15: Rectangle
  - Range (Ft) = 811.1                      Azimuth (Deg) = 32.50
  - Ground Elevation (Ft) = 0.0        Base Height (Ft) = 0.0
  - Length (Ft) = 608.7                  Height (Ft) = 64.0
  - Rotation (Deg) = -60.70        Tilt (Deg) = 0.00
  - Material is Trees                      Ground Plane Present

## Exercise 10 (cont'd)

- Scatterer 16: Rectangle
- Range (Ft) = 846.3      Azimuth (Deg) = 62.10
- Ground Elevation (Ft) = 0.0      Base Height (Ft) = 0.0
- Length (Ft) = 292.0      Height (Ft) = 64.0
- Rotation (Deg) = -18.60      Tilt (Deg) = 0.00
- Material is Trees      Ground Plane Present
-

# **Part VIII**

## **Solutions**

## 23 Exercises

### 23.1 Exercise 1

#### Setup Exercise 1

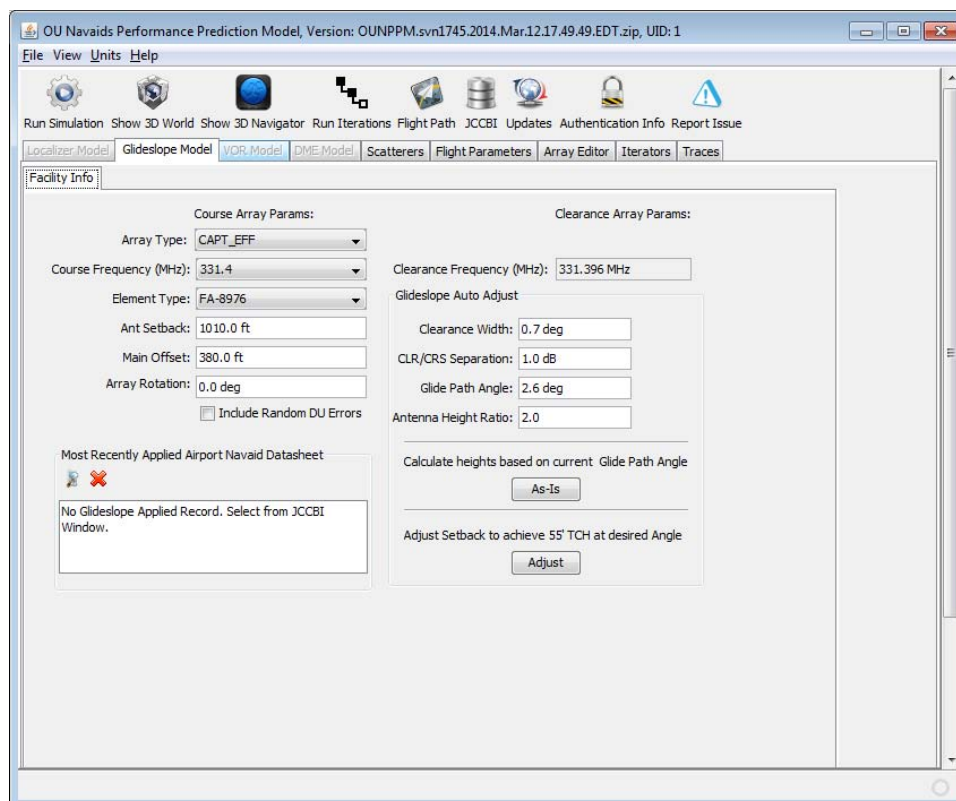


Figure 130: Exercise 1 Facility Info.

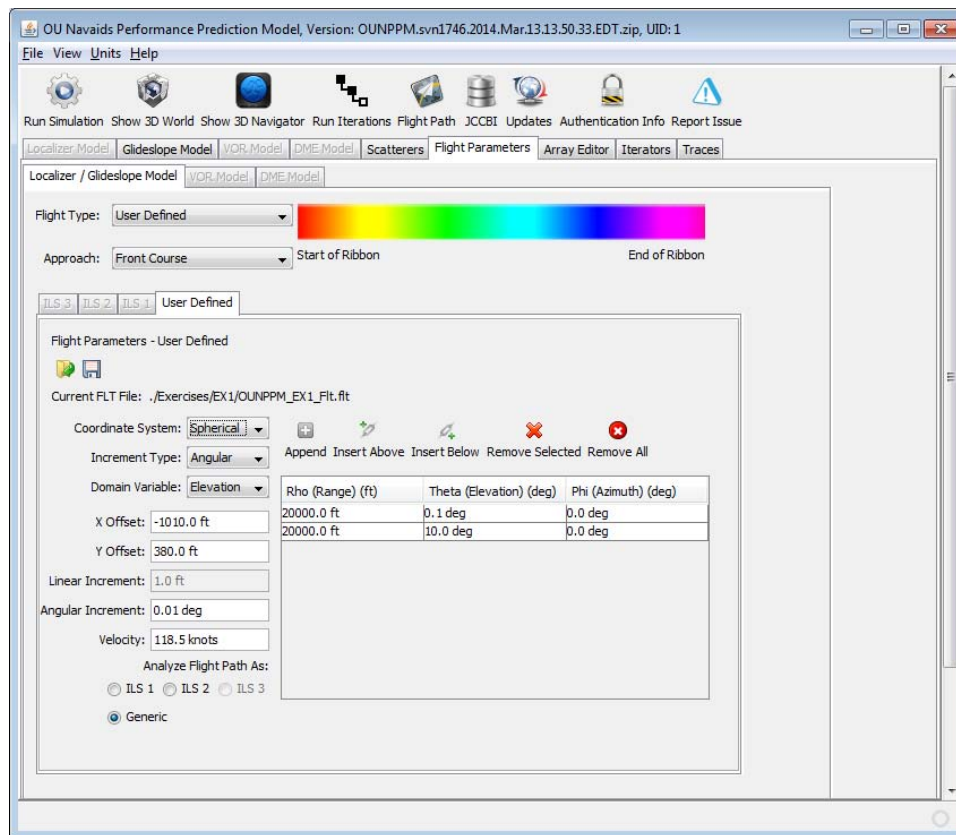


Figure 131: Exercise 1 Flight Path.

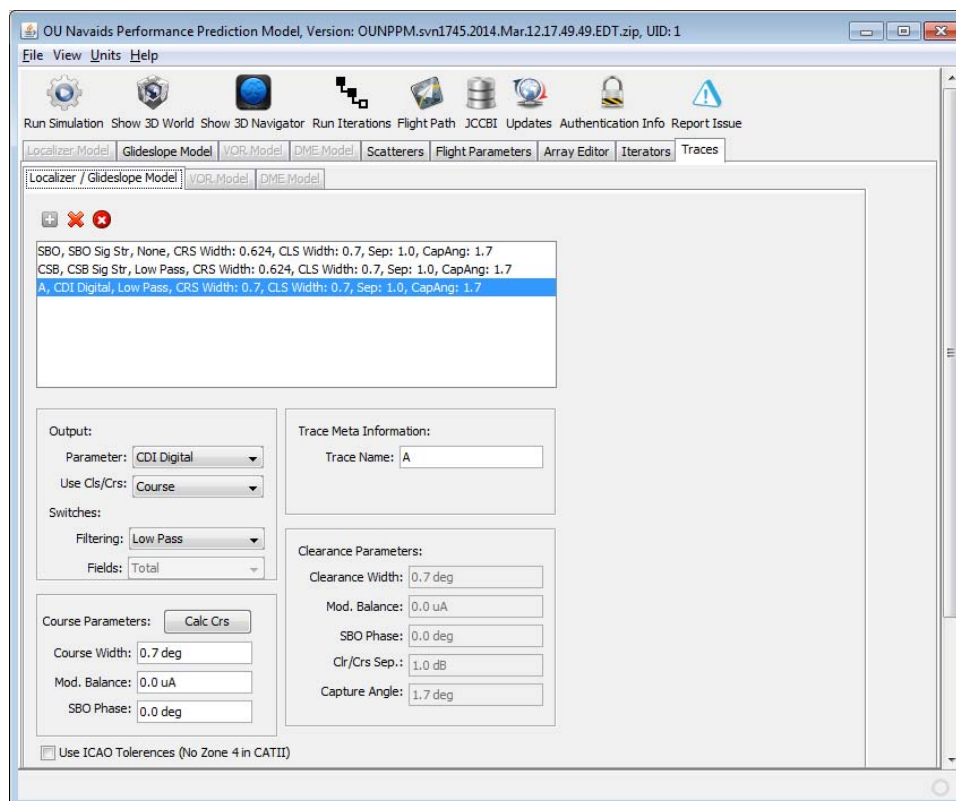


Figure 132: Exercise 1 Traces.



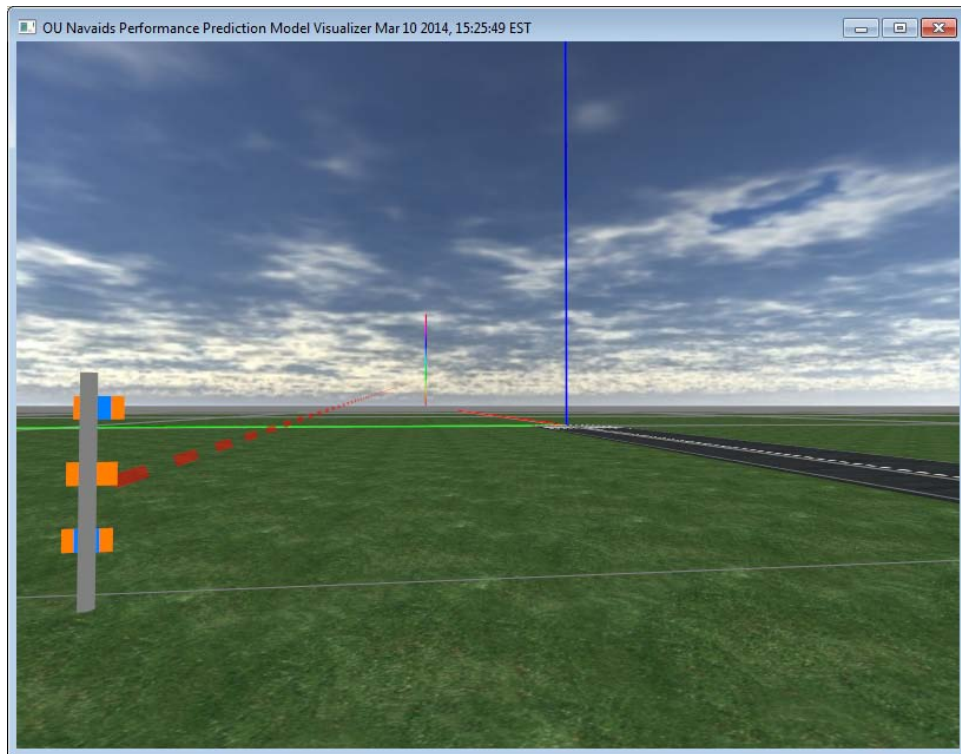


Figure 133: Exercise 1 Virtual World A.

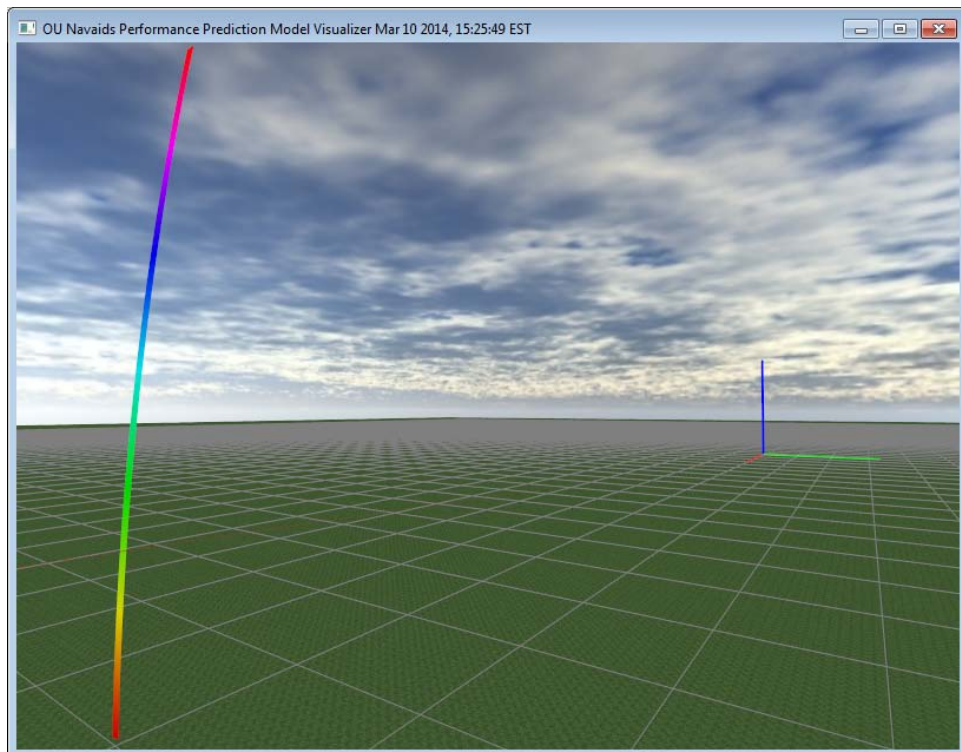


Figure 134: Exercise 1 Virtual World B.

## Results Exercise 1

Figure 135 shows the results for this exercise. If your chart does not look the same, try adjusting the axes. If you have one hump instead of two in your CDI, make sure it is using *both* for the “Use Crs/Clr”.

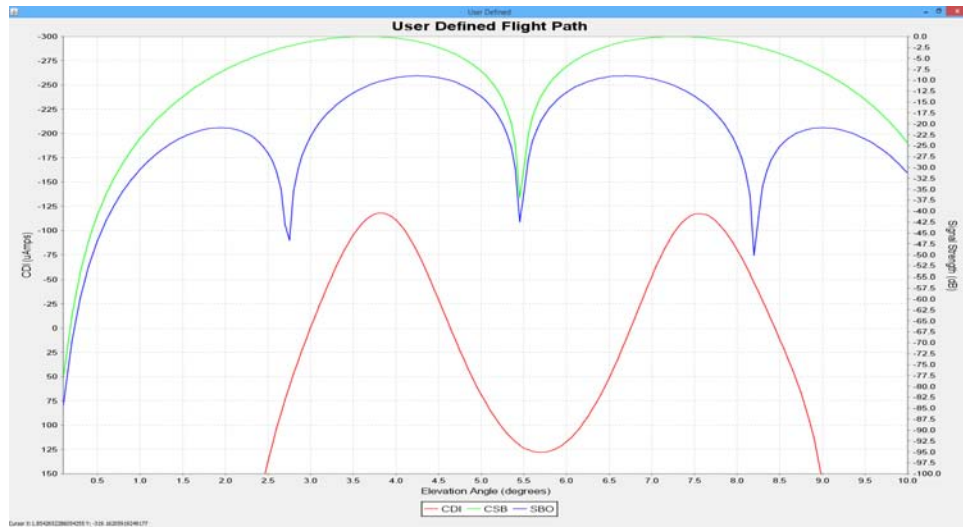


Figure 135: Exercise 1, Expected Results.

## 23.2 Exercise 2

### Setup Exercise 2

The "Facility Info" window in the OUNPPM software shows the following configuration:

- Array Type:** RECA
- Runway Length:** 10500.0 ft
- Runway Width:** 150.0 ft
- Runway Heading:** 0.0 deg
- ILS Pt. C.:** 1000.0 ft
- Center Frequency (MHz):** 109.7
- Clearance Frequency (MHz):** 109.696 MHz
- Include Random DU Errors:** ☐
- Most Recently Applied Airport Navaid Datasheet:** No Localizer Applied Record. Select from JCCBI Window.
- Use Course Params as Clearance Params:** ☒
- Course Array Params:**
  - Element Type: LPD
  - Ant Setback: 1200.0 ft
  - Main Offset: 0.0 ft
  - Main Height: 5.57 ft
  - Array Rotation: 0.0 deg
  - Antenna Rotation: 0.0 deg
- Clearance Array Params:**
  - Element Type: LPD
  - Ant Setback: 1200.0 ft
  - Main Offset: 0.0 ft
  - Main Height: 5.57 ft
  - Array Rotation: 0.0 deg
  - Antenna Rotation: 0.0 deg
  - Clearance Width: 1.3 deg
  - CLR/CRS Separation: -20.0 dB

Figure 136: Exercise 2 Facility Info.

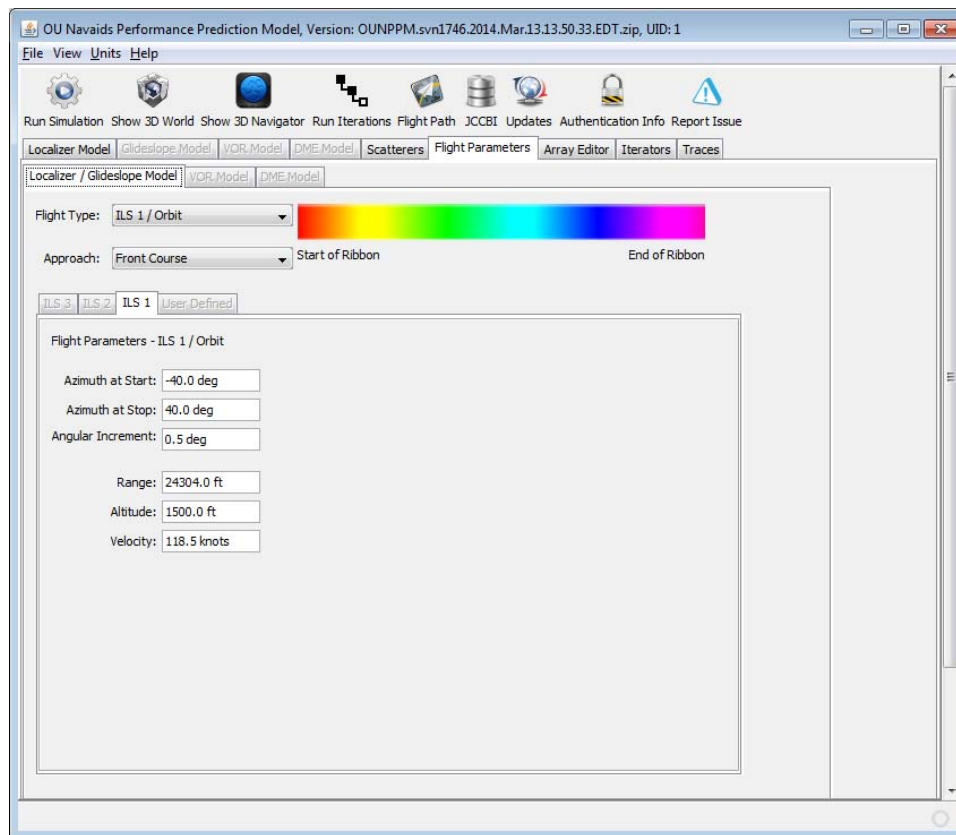


Figure 137: Exercise 2 Flight Path.

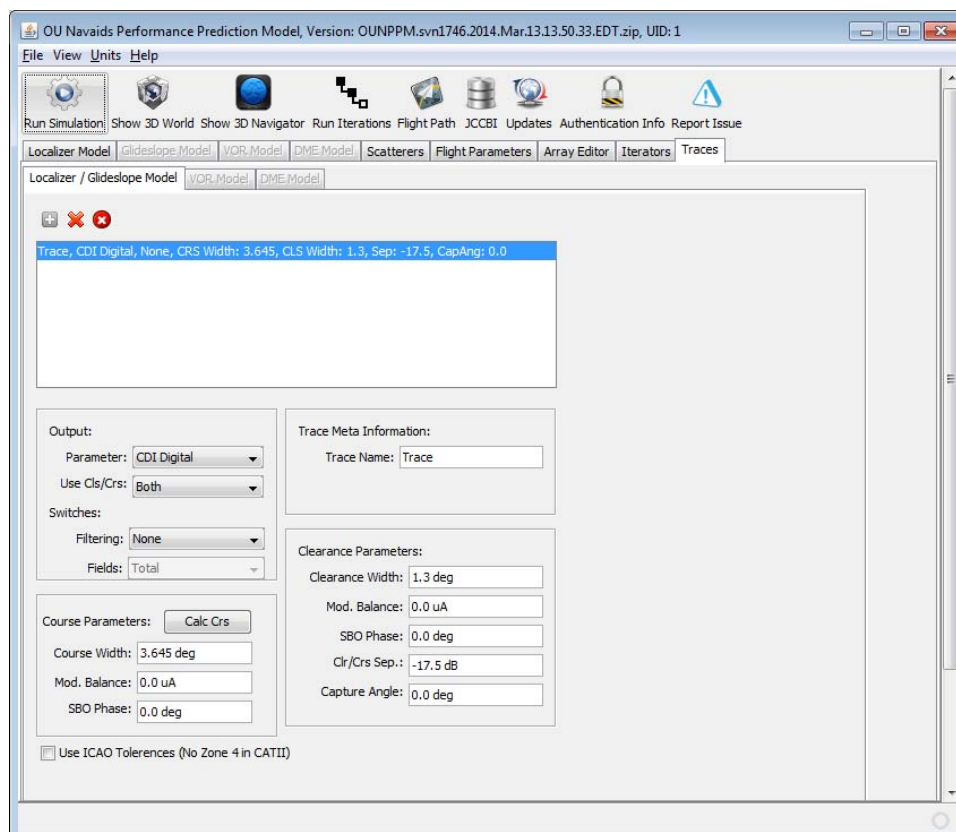


Figure 138: Exercise 2 Traces.

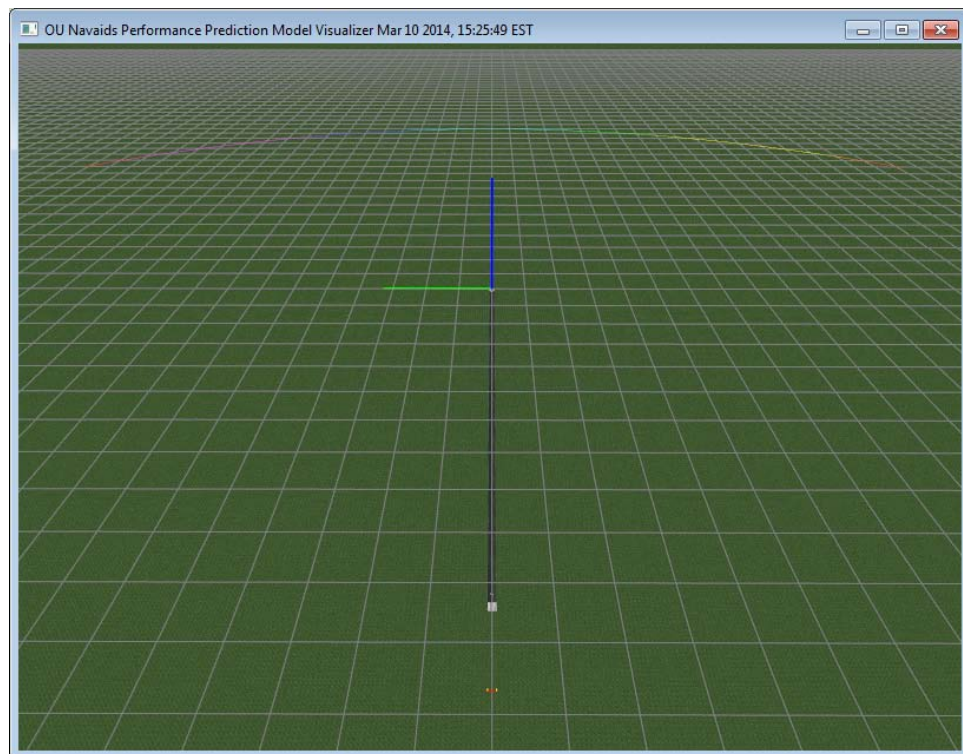


Figure 139: Exercise 2 Virtual World.

## Results Exercise 2

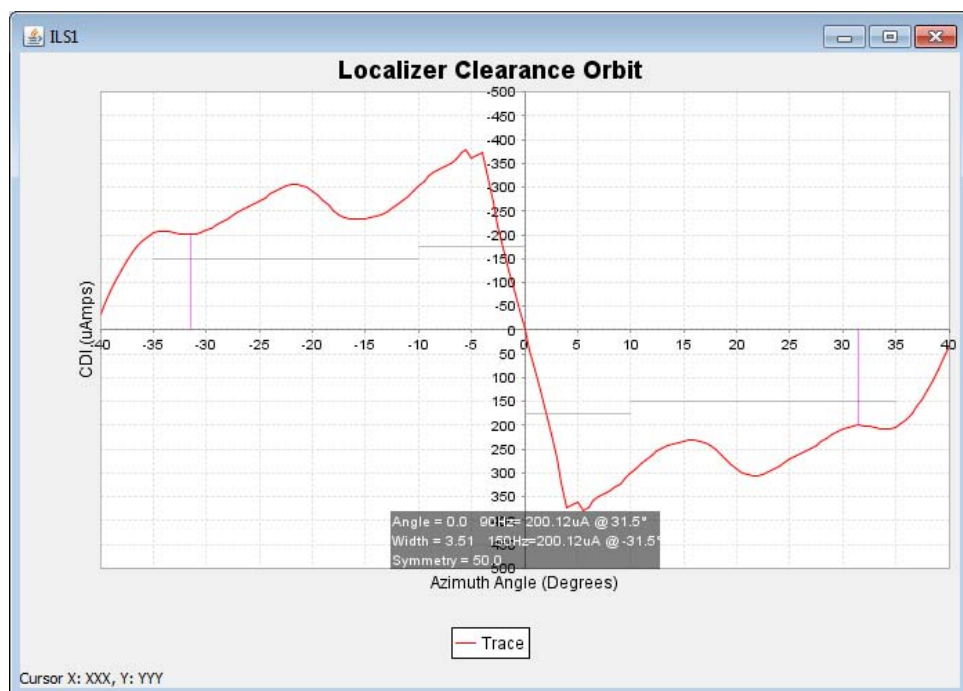


Figure 140: Exercise 2 Plot.



## 23.3 Exercise 3

### Setup Exercise 3

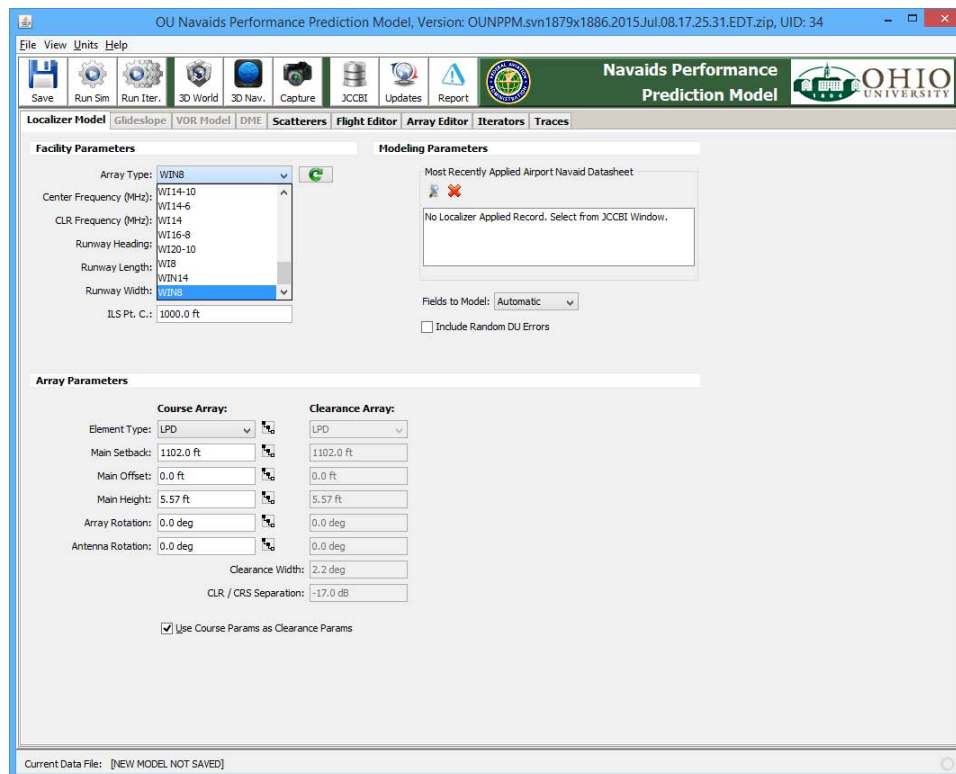


Figure 141: Exercise 3 Facility Info.

On the iterators tab, click the Iterate DU Parameters button (↺), as seen in Figure 142. This will open a new frame.

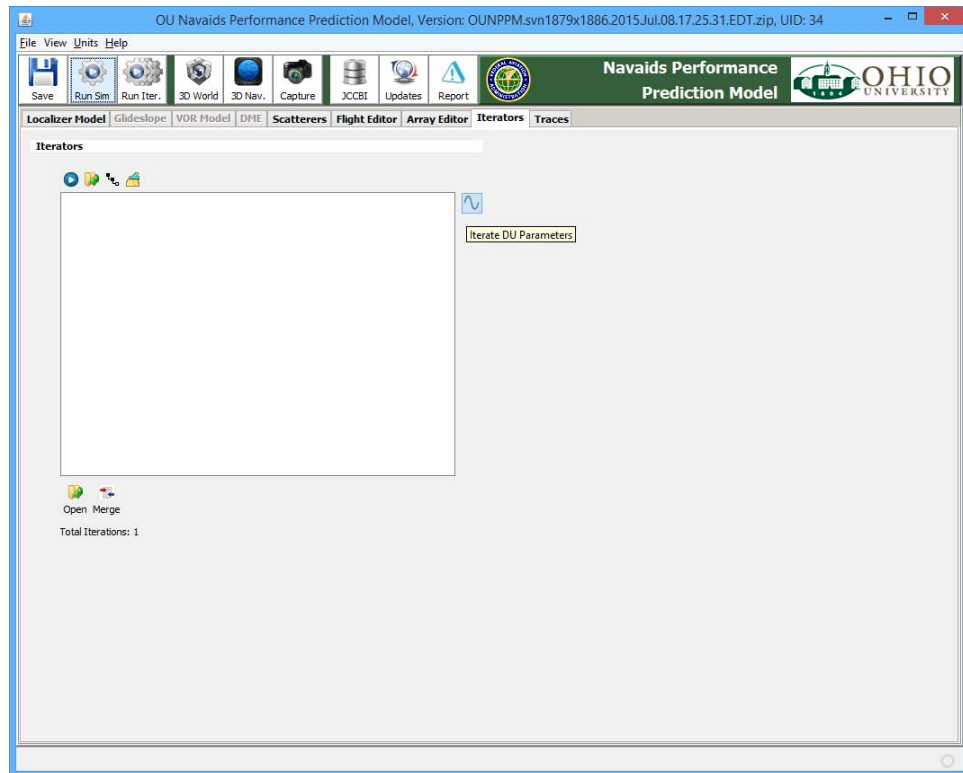


Figure 142: On the iterators tab, click the Iterate DU Parameters button.

In this window, shown in Figure 143, click the “Iterate As Group” checkbox. If you select each element individually, it will attempt to iterate over all combinations of each value of each element. Instead we treat them as a single group that does not combine with each other.

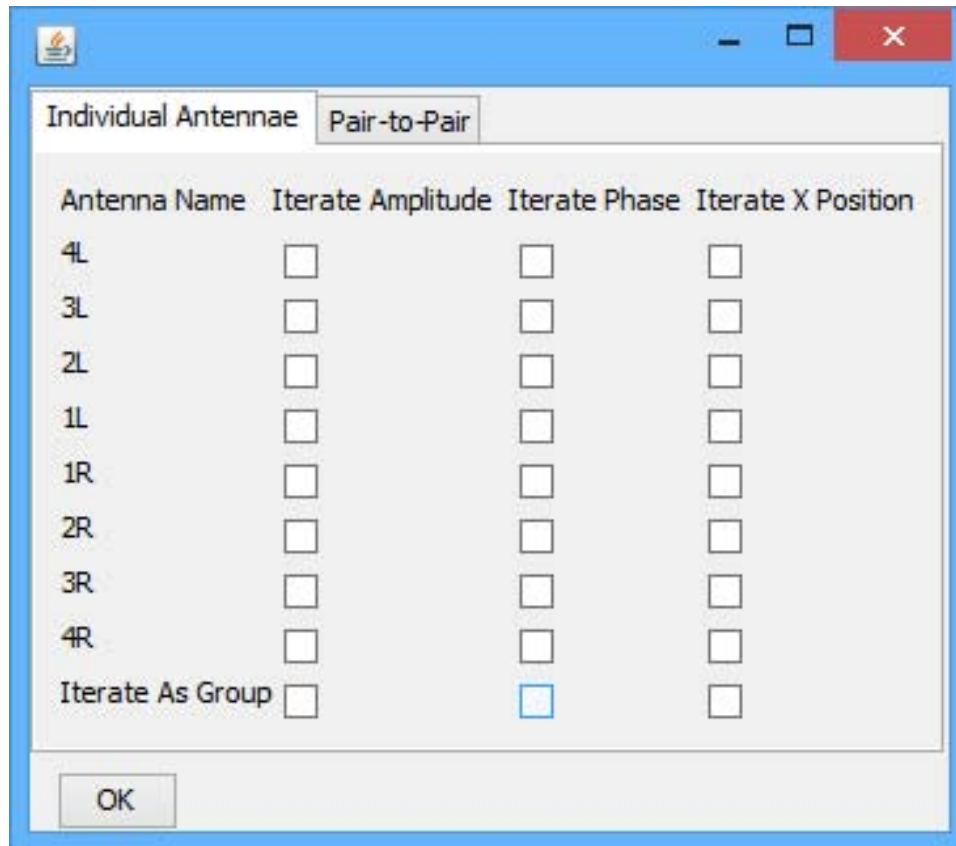


Figure 143: The DU iteration selection window.

If you set your iteration values to be like those shown in Figure 144 then you can test the selected elements at 0, 10, and 20 degrees. This covers all options in this example.

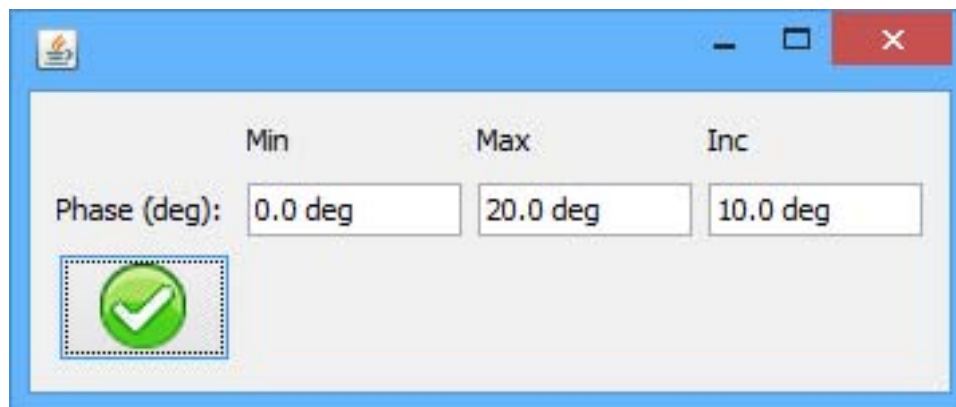


Figure 144: Values for the DU group iteration.

Select at least the elements needed for this example, as shown in Figure 145.

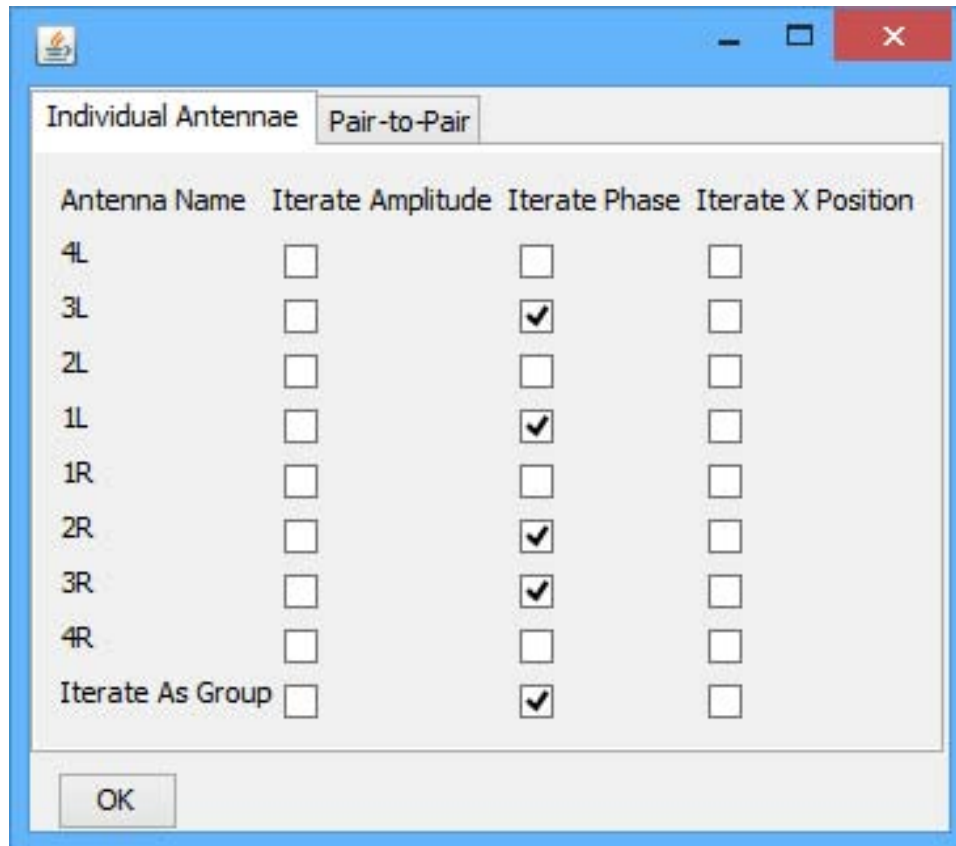


Figure 145: Exercise 3 elements.

Figure 146 shows the iterators tab after adding the DU iterators. Notice this will create 12 iterators total.

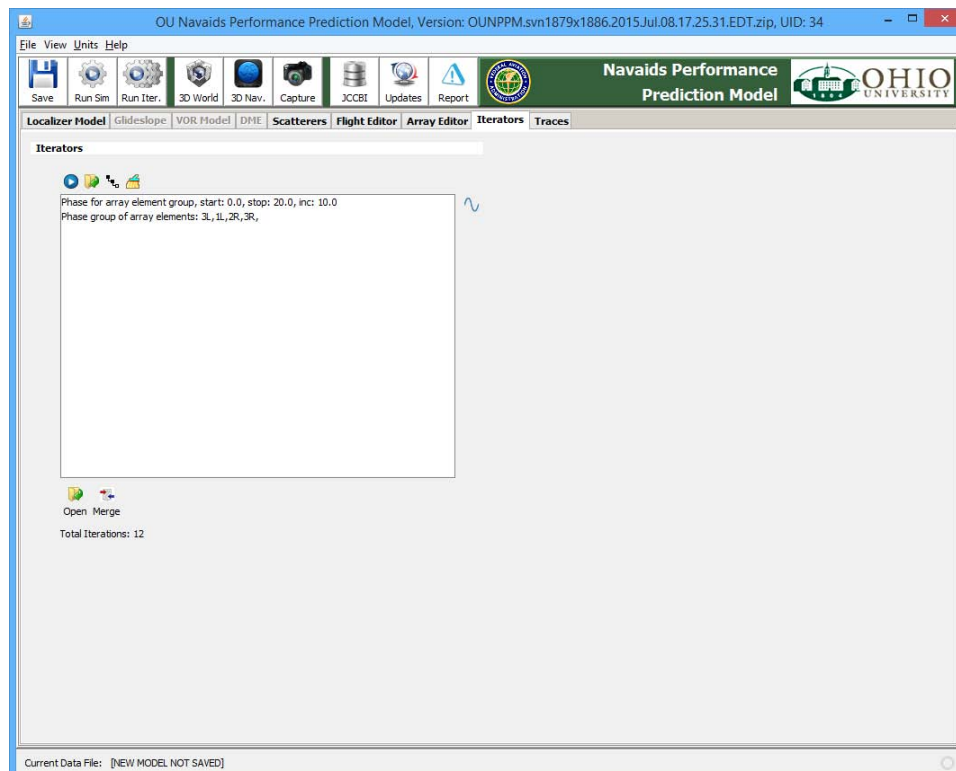
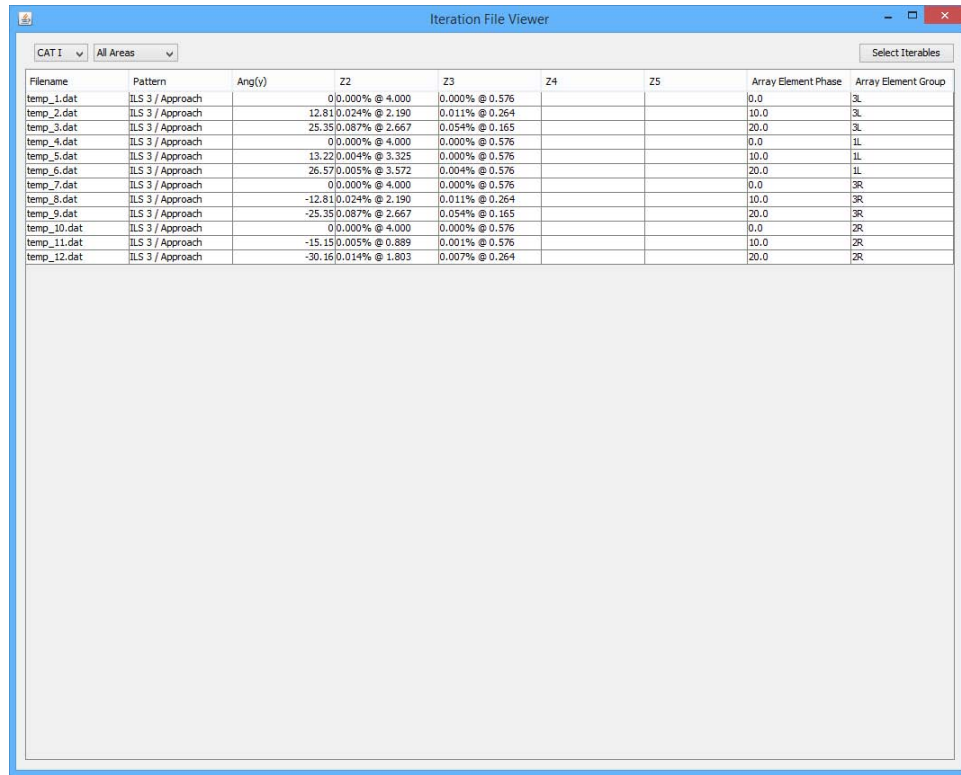


Figure 146: 12 total iterations.



After running iterations a table of iterations will appear, as seen in Figure 147.



The screenshot shows a window titled "Iteration File Viewer" with a menu bar containing "CAT I" and "All Areas". Below the menu bar is a table with the following columns: Filename, Pattern, Ang(y), Z2, Z3, Z4, Z5, Array Element Phase, and Array Element Group. The table contains 12 rows of data, each representing an iteration from temp\_1.dat to temp\_12.dat. The data is as follows:

Filename	Pattern	Ang(y)	Z2	Z3	Z4	Z5	Array Element Phase	Array Element Group
temp_1.dat	ILS 3 / Approach		0.0.000% @ 4.000	0.000% @ 0.576			0.0	3L
temp_2.dat	ILS 3 / Approach		12.810.024% @ 2.190	0.011% @ 0.264			10.0	3L
temp_3.dat	ILS 3 / Approach		25.350.087% @ 2.667	0.054% @ 0.165			20.0	3L
temp_4.dat	ILS 3 / Approach		0.0.000% @ 4.000	0.000% @ 0.576			0.0	1L
temp_5.dat	ILS 3 / Approach		13.220.004% @ 3.325	0.000% @ 0.576			10.0	1L
temp_6.dat	ILS 3 / Approach		26.570.005% @ 3.572	0.004% @ 0.576			20.0	1L
temp_7.dat	ILS 3 / Approach		0.0.000% @ 4.000	0.000% @ 0.576			0.0	3R
temp_8.dat	ILS 3 / Approach		-12.810.024% @ 2.190	0.011% @ 0.264			10.0	3R
temp_9.dat	ILS 3 / Approach		-25.350.087% @ 2.667	0.054% @ 0.165			20.0	3R
temp_10.dat	ILS 3 / Approach		0.0.000% @ 4.000	0.000% @ 0.576			0.0	2R
temp_11.dat	ILS 3 / Approach		-15.150.005% @ 0.889	0.001% @ 0.576			10.0	2R
temp_12.dat	ILS 3 / Approach		-30.160.014% @ 1.803	0.007% @ 0.264			20.0	2R

Figure 147: Table of iteration values.

### Results Exercise 3

See results in Figure 148. Phases on X-Axis, Element on Y-Axis.

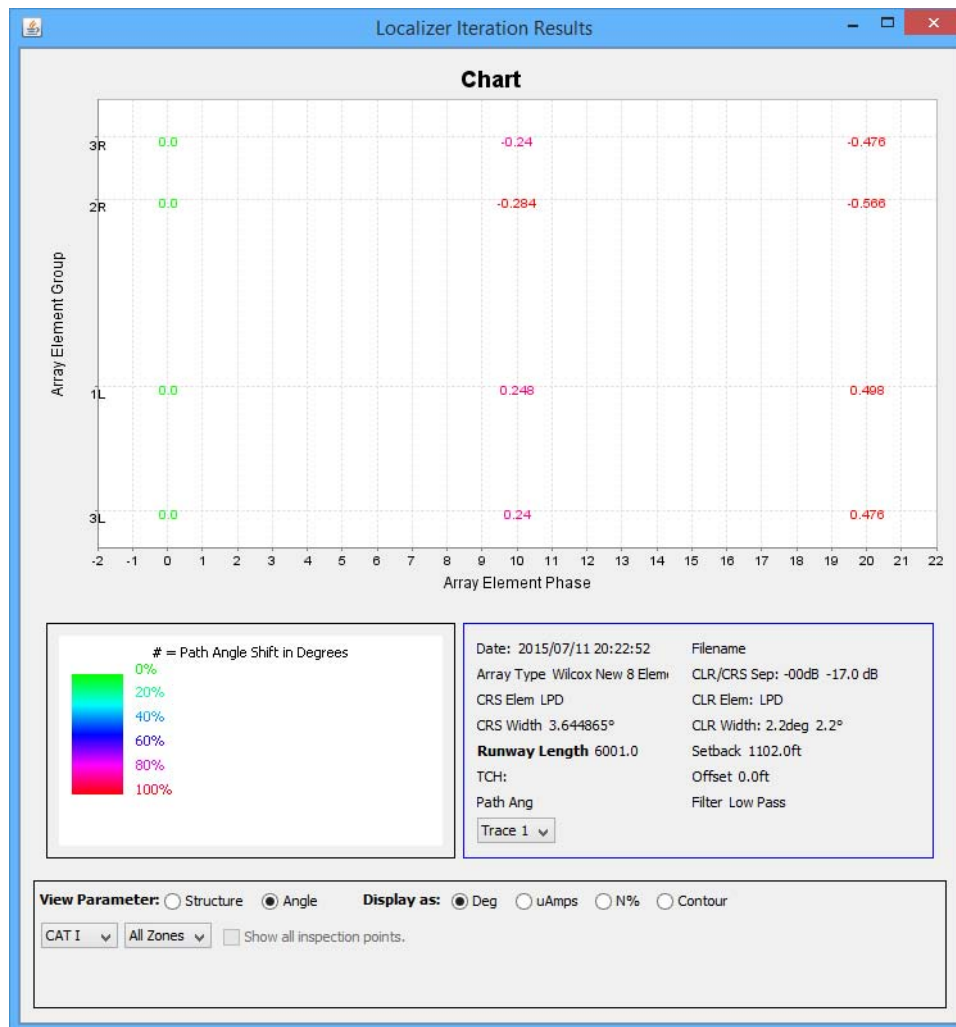


Figure 148: Exercise 3 Results.

## 23.4 Exercise 4

### Setup Exercise 4

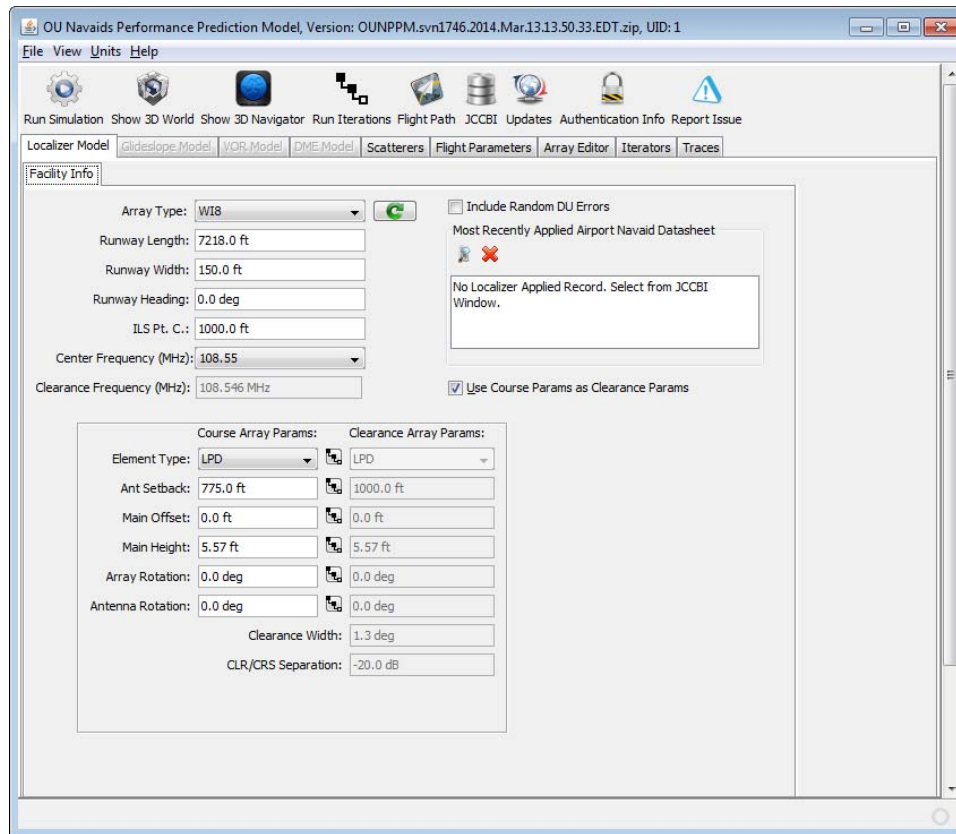


Figure 149: Exercise 4 Facility Info.

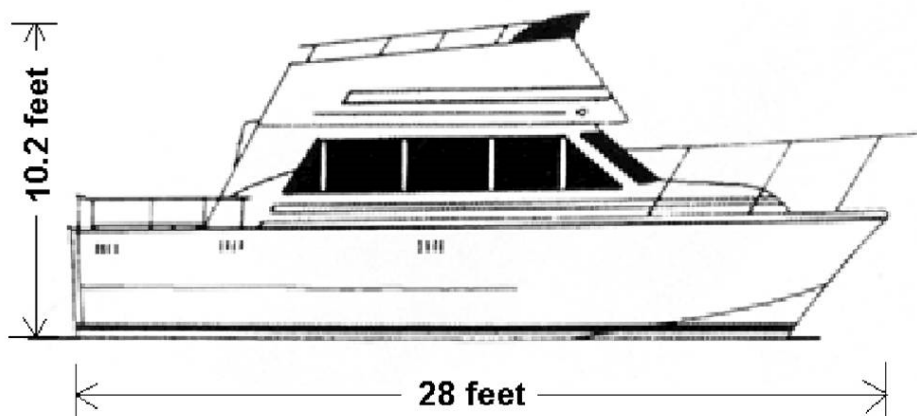


Figure 150: Exercise 4 Small Boat.

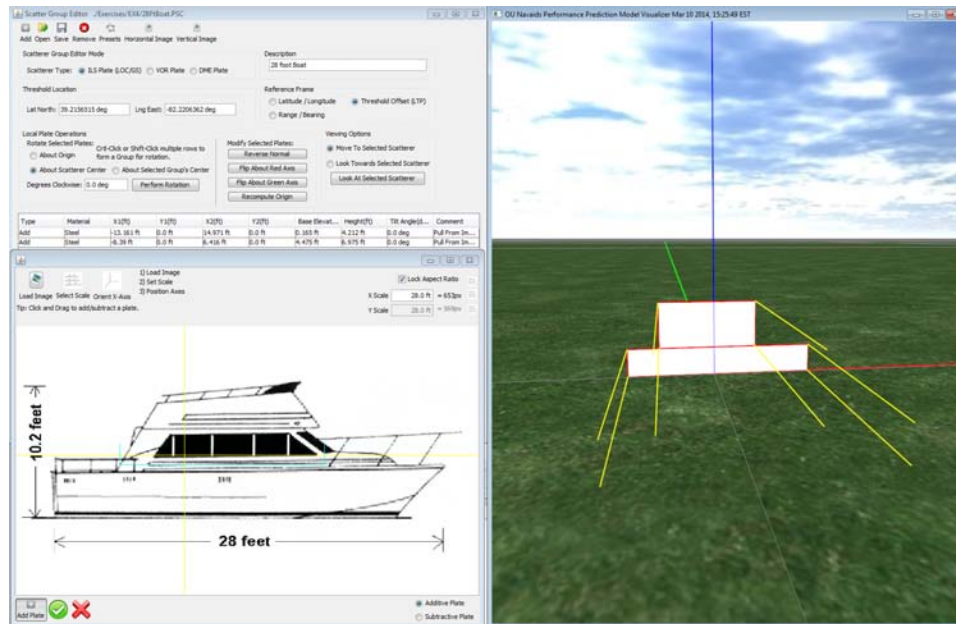


Figure 151: In the Scatterer Group Editor, click “XZ Image” to Pull from Image. 2) Load the 28 ft boat image. 3) Set the Scale. 4) Position the origin at the BOTTOM CENTER of the boat. The origin denotes the point about which the scatterer is locally rotated when manipulated in the editor. 5) Click the “Add Plate” button in the lower left to enter into *Add Plate* mode. 6) Drag box around lower hull of the boat. Notice the newly formed scatterer plate appears in the virtual world and in the Scatterer Group Editor. Repeat step 6 for the upper cabin of the boat. Notice a second plate appears in the virtual world and in the Scatterer Group Editor. Type a description of the boat in the Description window and click “Save” to save this small Boat to a *.psc* file.

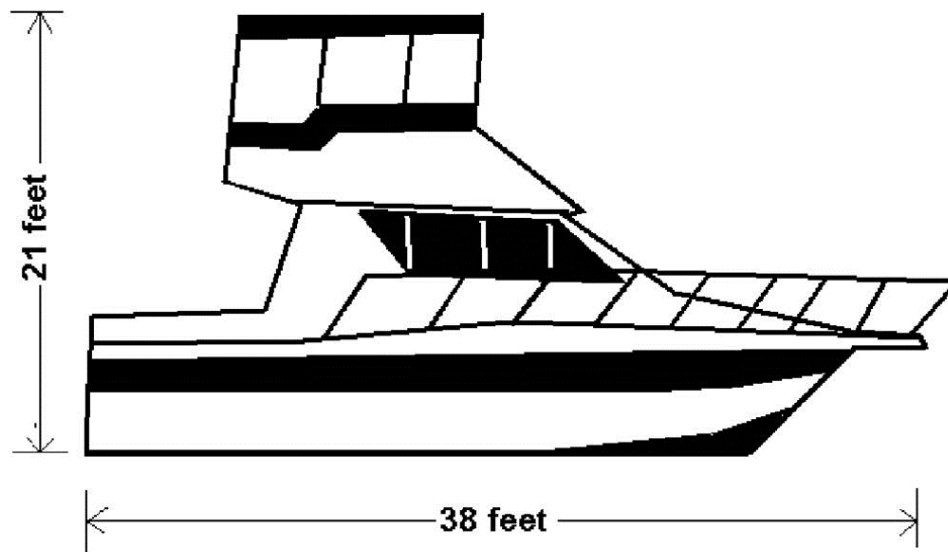


Figure 152: Exercise 4 Large Boat.

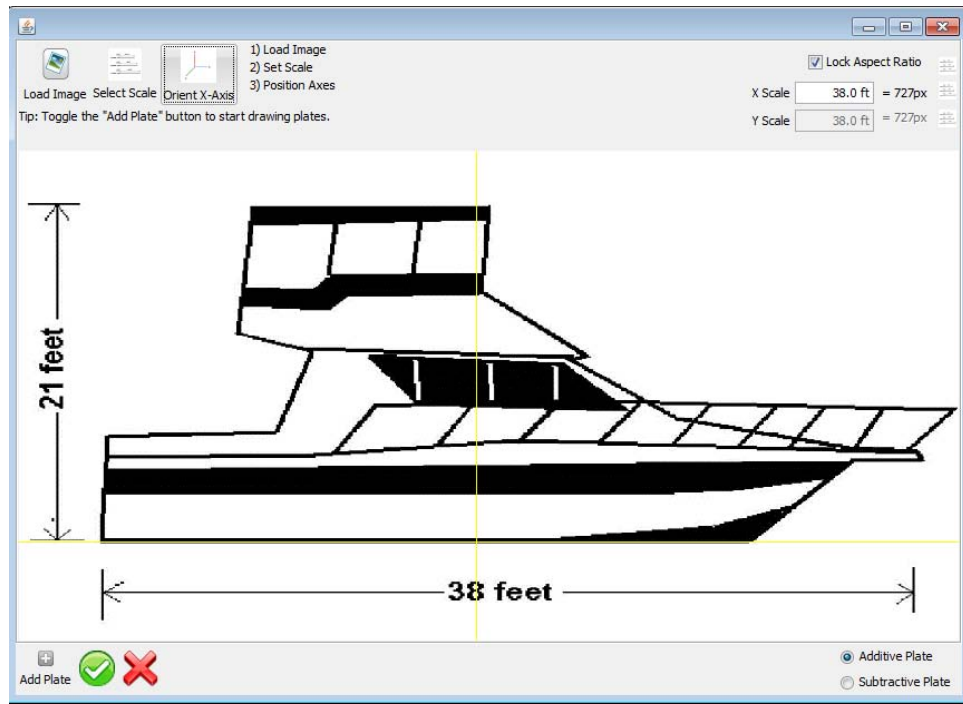


Figure 153: Setting origin of Large Boat to the boat's Bottom Center. This is the point of rotation for manipulations within the editor.

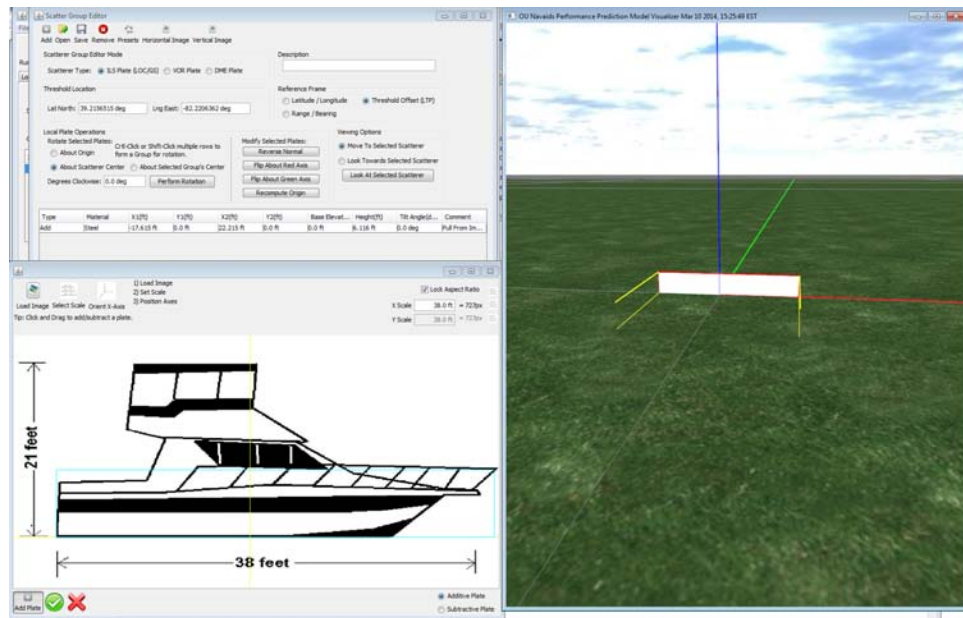


Figure 154: Creating Bottom Plate of Large Boat.

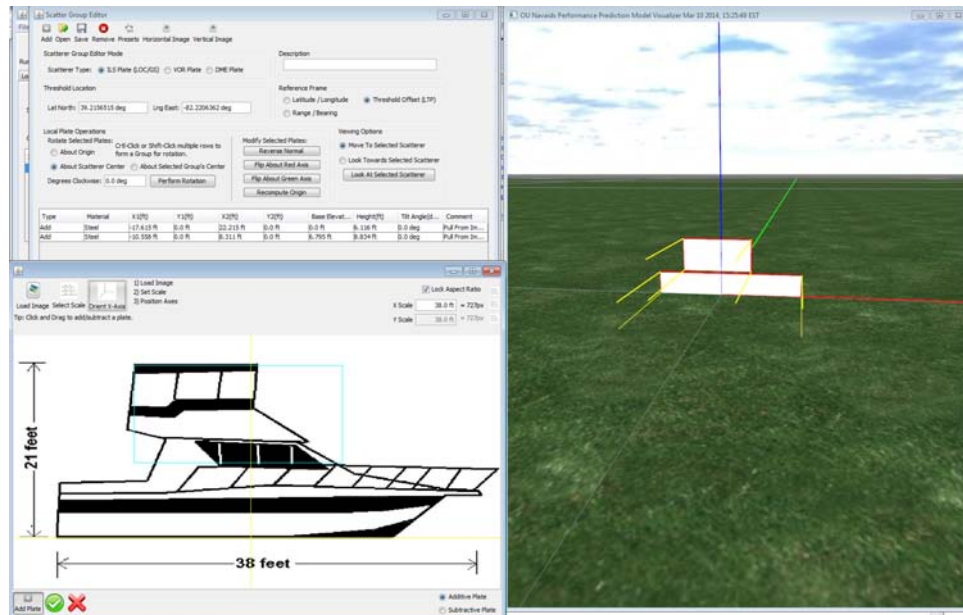


Figure 155: Creating Top Plate of Large Boat.

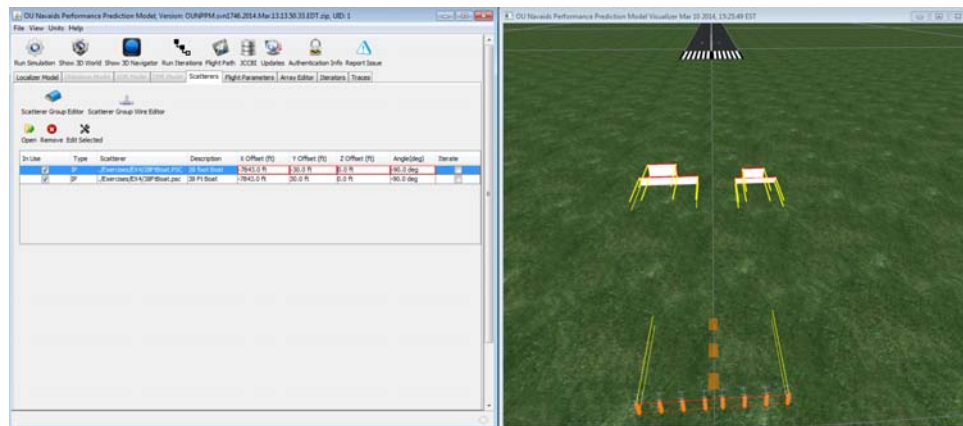


Figure 156: From the localizer's viewpoint, the large boat is on the left and the small boat is on the right. Notice the X Offset, Y Offset, and Angle specified within the *Scatterers* Tab.

OUNPPM  
Solution EX 4

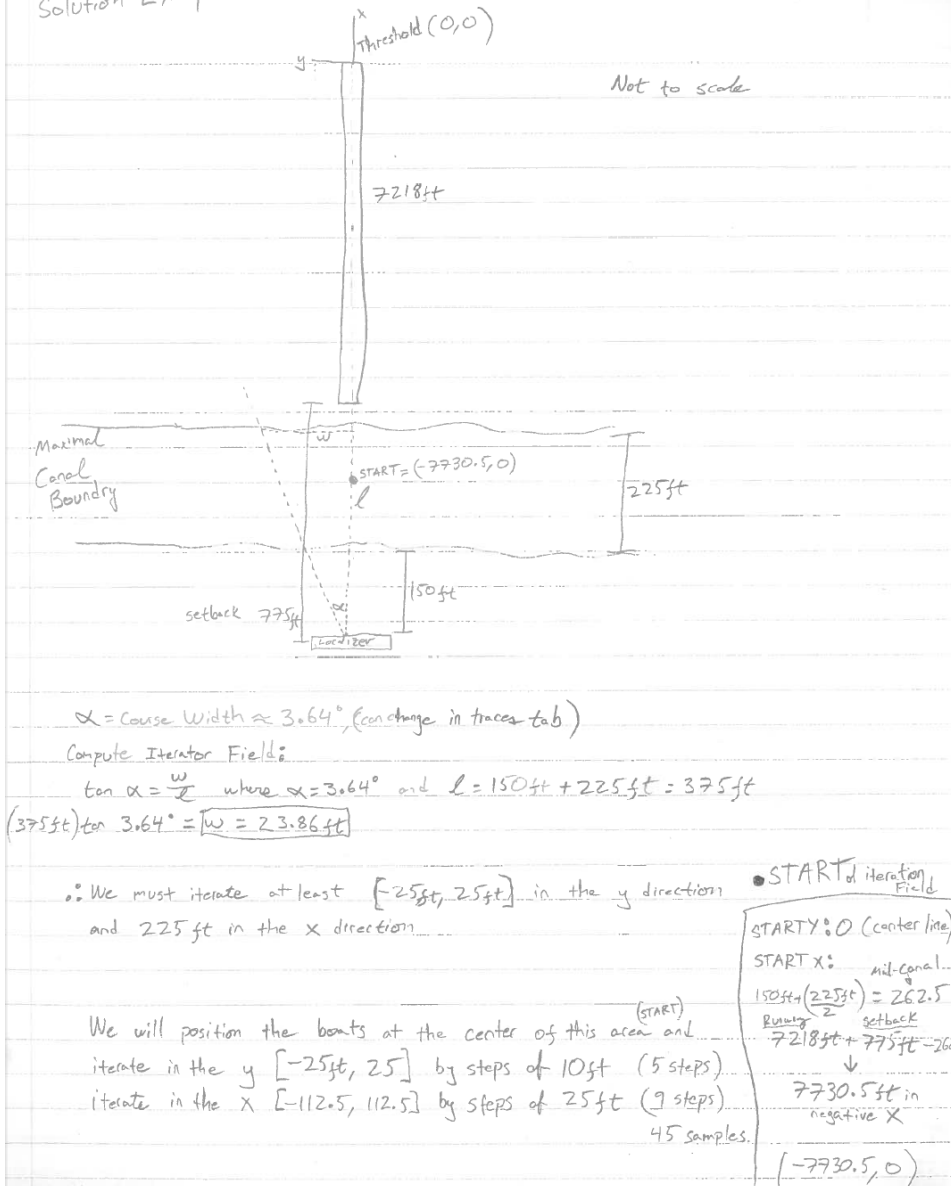


Figure 157: A pictorial representation of the model. The derivation of the requisite iterator field is shown given a course width of  $3.64^\circ$  and the aforementioned environmental dimensions.



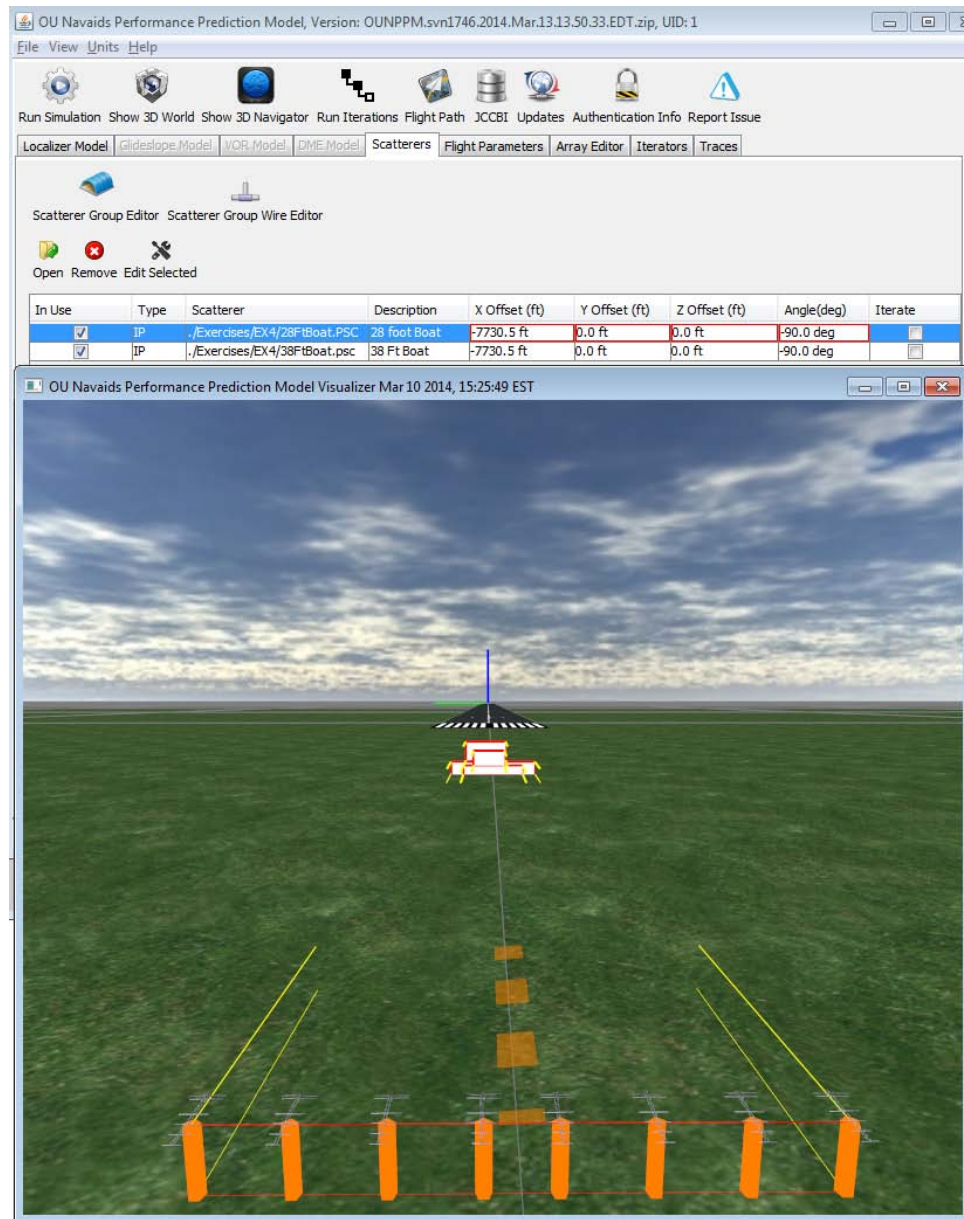


Figure 158: The boats have been positioned at the center of the iterator field derived in Fig.157.



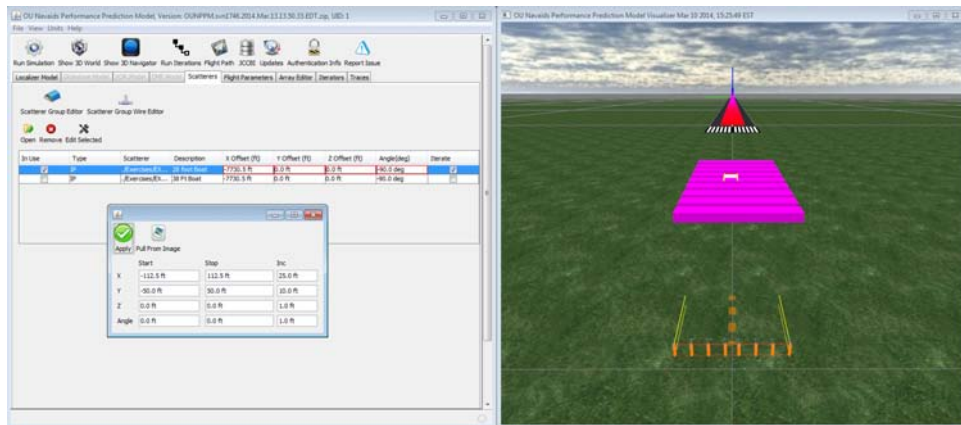


Figure 159: Small Boat: The iteration parameters have been set for the small boat. Using the diagram above, the Y iterator values were selected to be double the range computed in the diagram above (Fig. 157. Click *Run Iterations* to simulate the model.

## Results Exercise 4 Small Boat

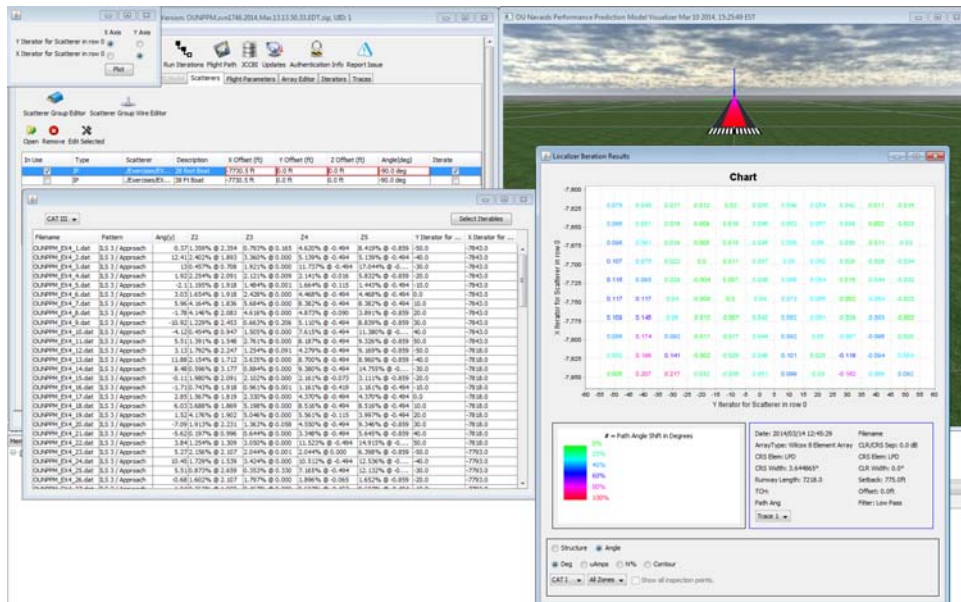


Figure 160: Small Boat: Plot results Table appears. Click *Select Iterables* to view the corresponding plot.

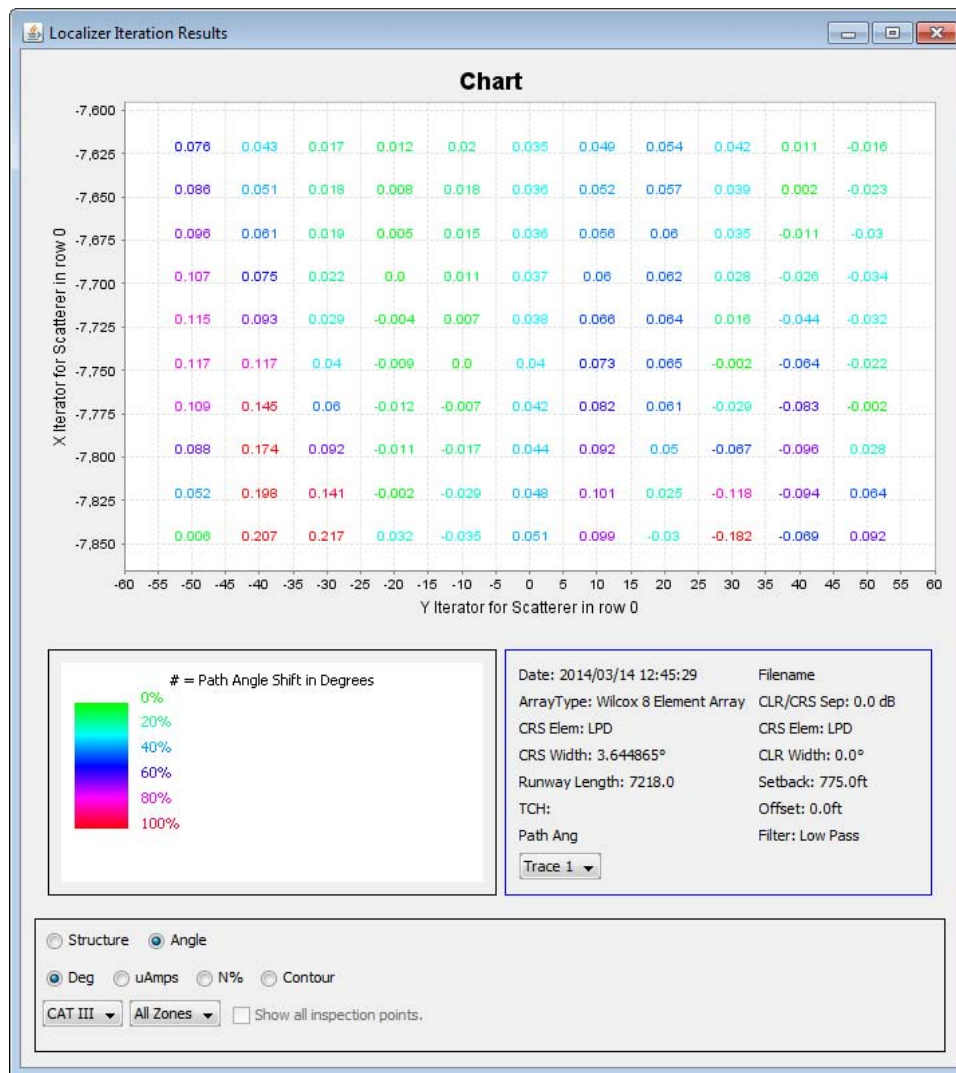


Figure 161: Small Boat: Cat III Angle plot results shown in Degrees. Very little is out of tolerance; if the size of the plates approximating the small boat were made a little smaller, then these areas may be within tolerance. Cat I is within tolerance.

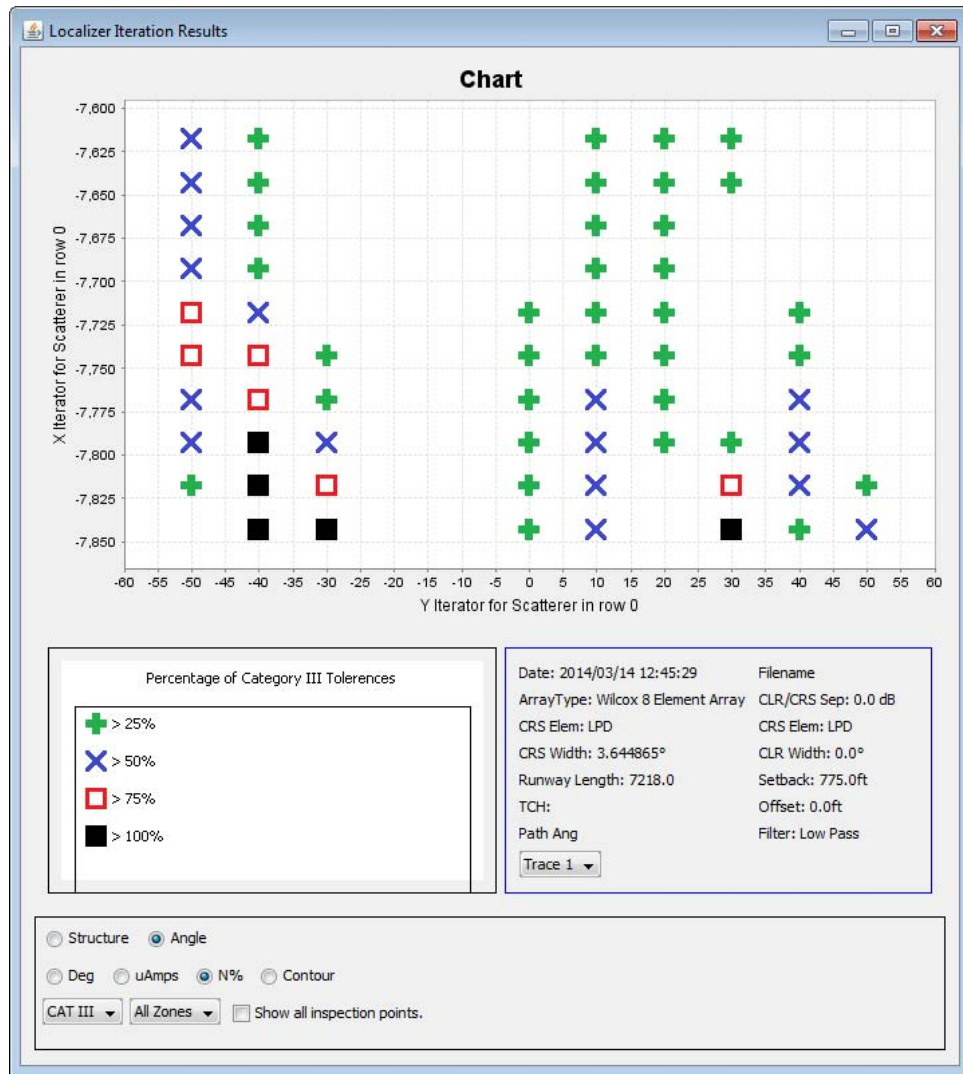


Figure 162: Small Boat: Cat III Angle plot results shown as a percent of tolerance. Very little is out of tolerance; if the size of the plates approximating the small boat were made a little smaller, then these areas may be within tolerance.

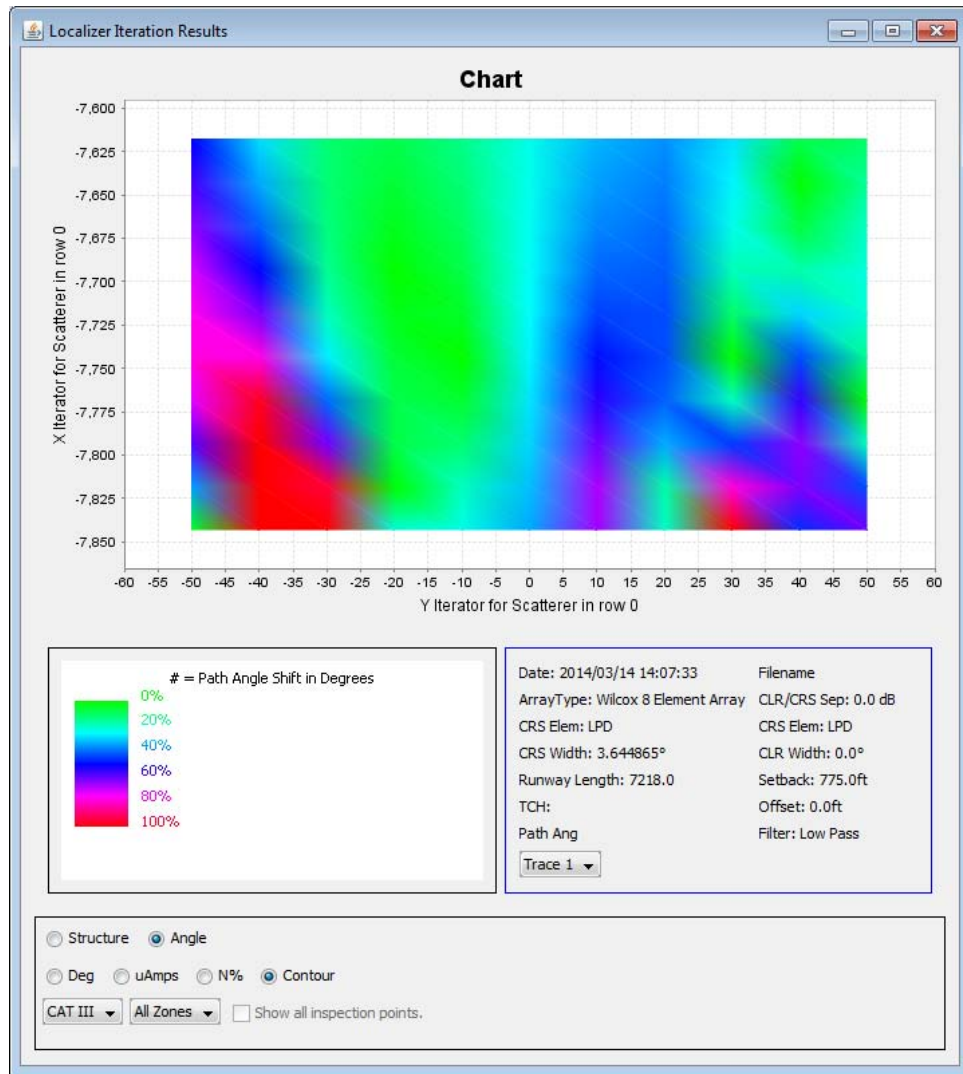


Figure 163: Small Boat: Cat III Angle plot results shown as a contour map of percent of tolerance. Very little is out of tolerance; if the size of the plates approximating the small boat were made a little smaller, then these areas may be within tolerance.

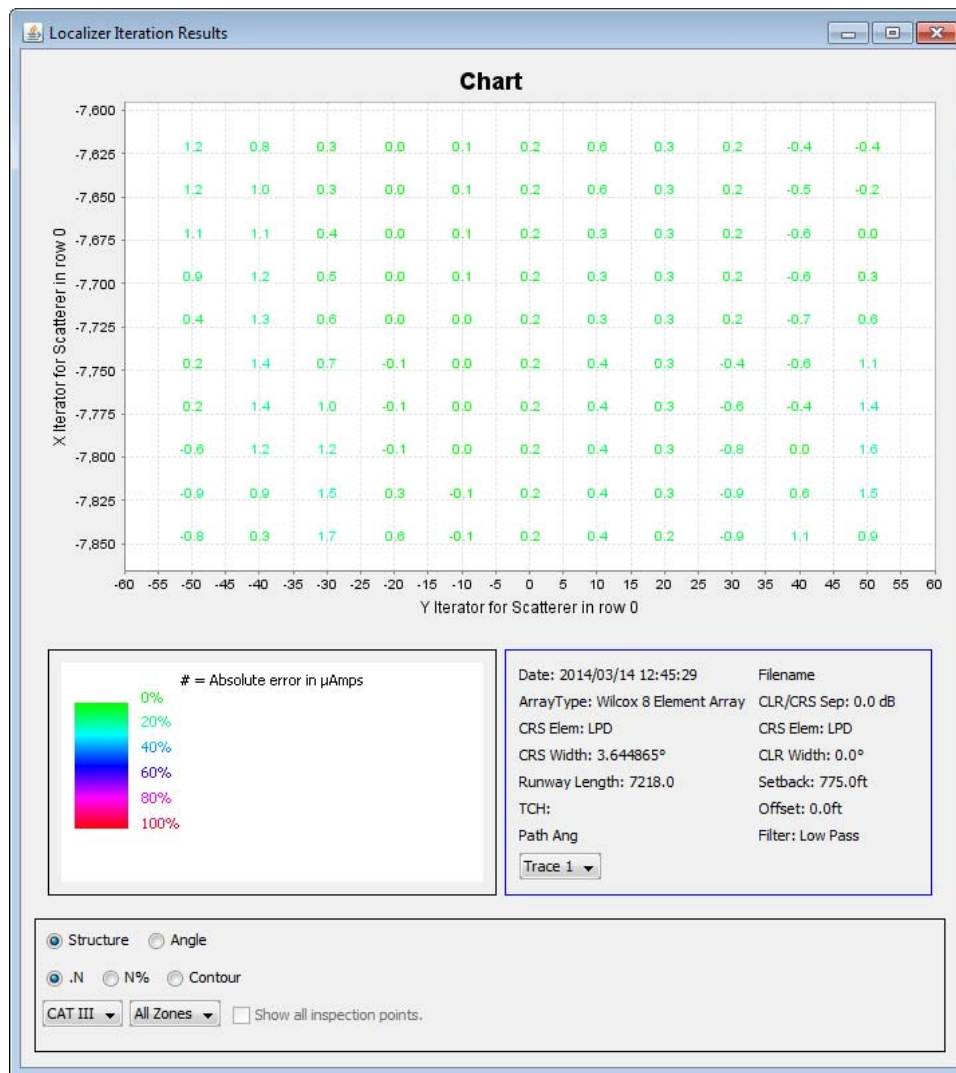


Figure 164: Cat III Structure plot shows very little error with nothing out of tolerance; the angle plot shows more error.

## Results Exercise 4 Large Boat

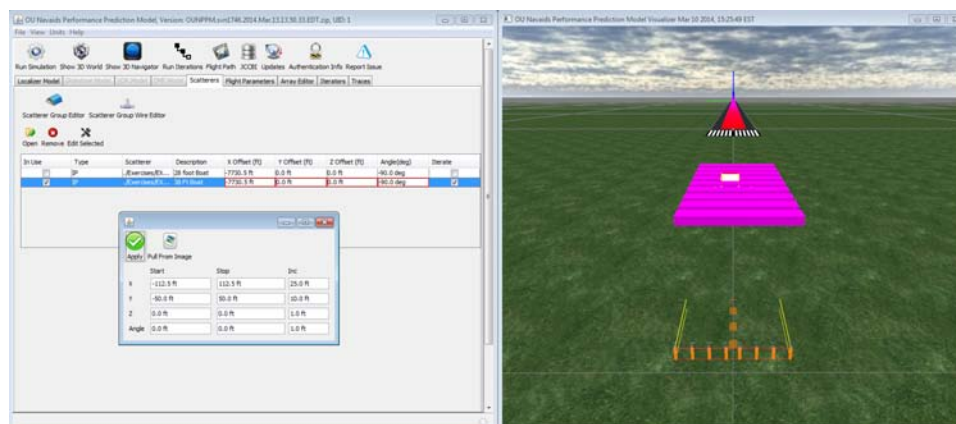


Figure 165: Large Boat: Iterator settings to model the large boat's effect on the localizer. Using the diagram show in Fig.157, the Y iterator values were selected to be double the range computed. Click *Run Iterations* to simulate the model.



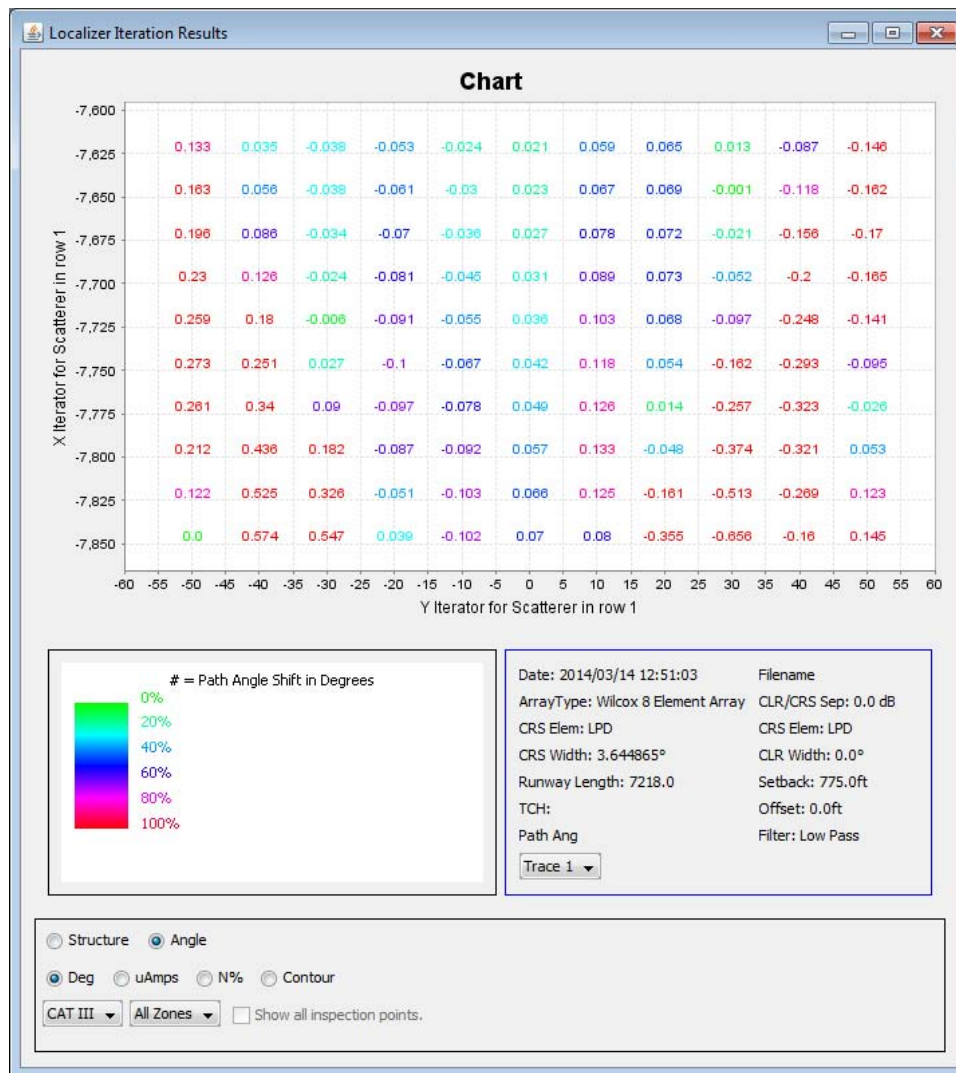


Figure 166: Large Boat: Cat III Angle plot results shown in Degrees. Areas shown in red are out of tolerance. The Angle tolerances of Categories I, II, and III are all out of tolerance, in contrast to the results shown with the small boat.

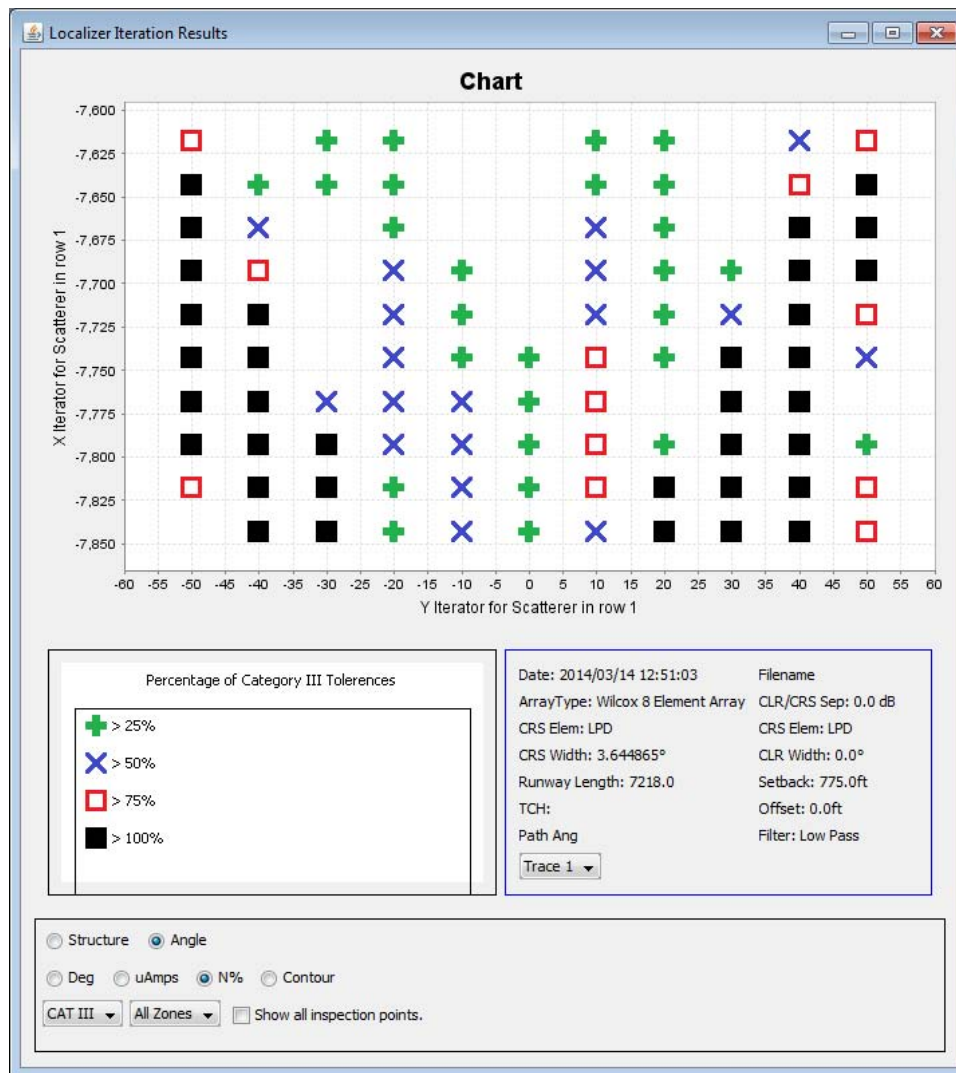


Figure 167: Large Boat: Cat III Angle plot results shown as a percentage of tolerance. Areas shown in black are out of tolerance.

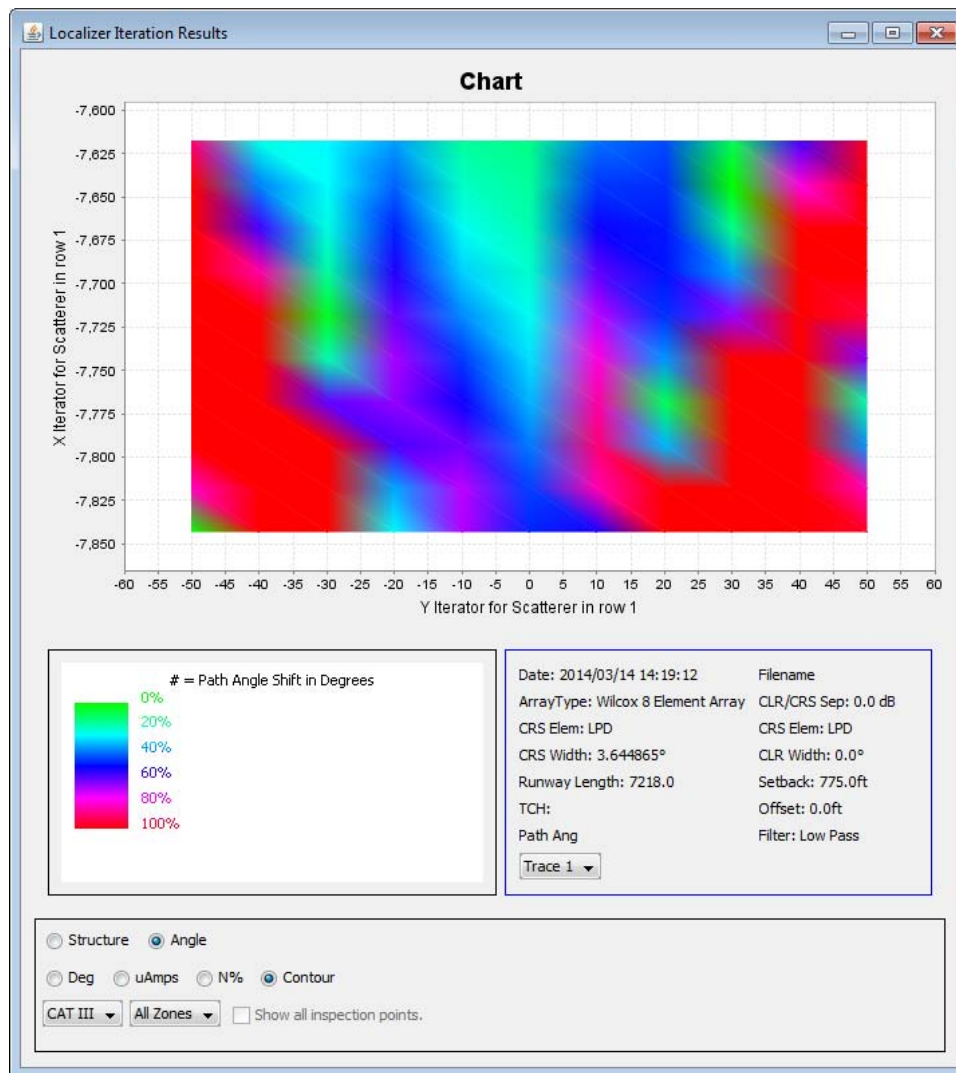


Figure 168: Large Boat: Cat III Angle plot results shown as a contour map of percent of tolerance.. Areas shown in red are out of tolerance.



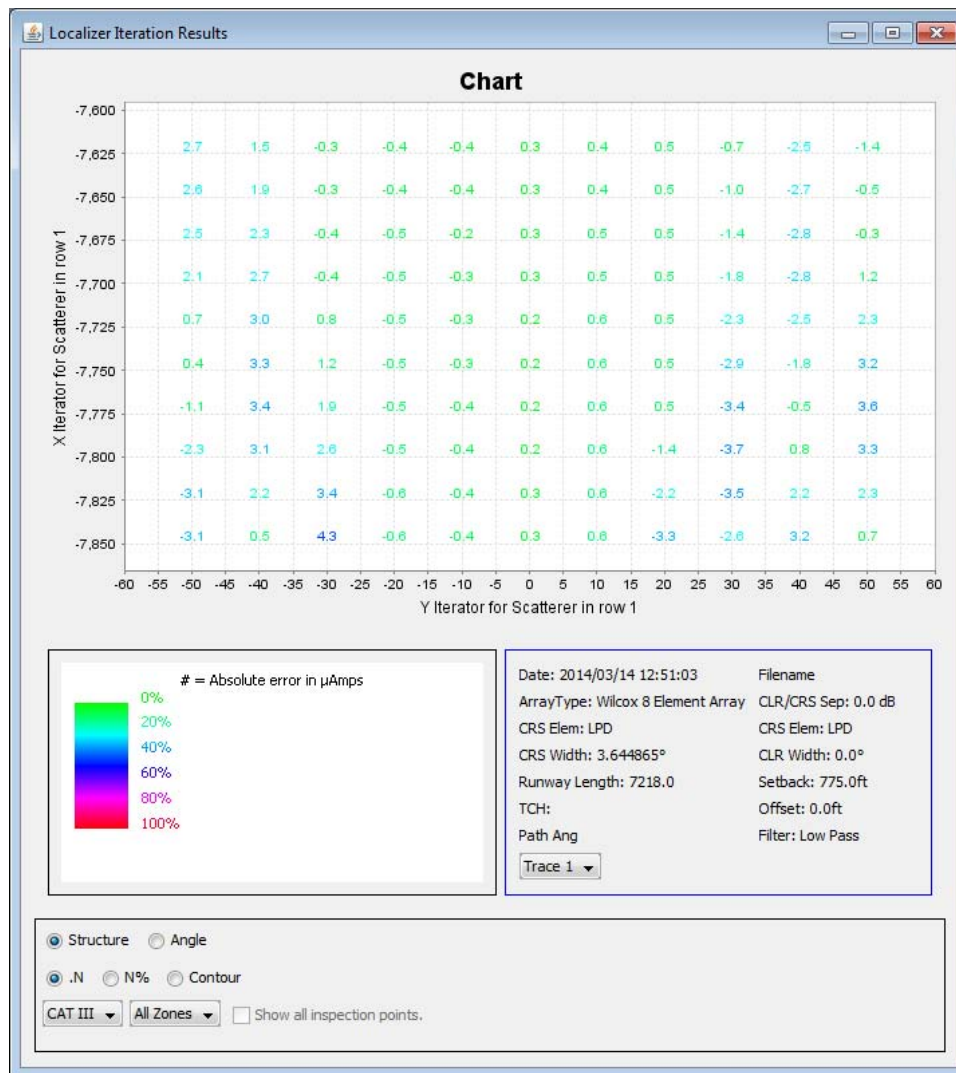


Figure 169: Large Boat: Cat III Structure plot shown in degrees. Notice the structure is well within tolerance whereas the angle is not.

## 23.5 Exercise 5

### Exercise 5 Setup

The screenshot displays the 'OU NavAids Performance Prediction Model' software interface. The title bar indicates the version is 'OUNPPM.svn1892x1893.2015Jul.12.15.22.04.EDT.zip, UID: 50'. The menu bar includes 'File', 'View', 'Units', and 'Help'. The toolbar contains icons for 'Save', 'Run Sim', 'Run Iter...', '3D World', '3D Nav...', 'Capture', 'JCCBI', 'Updates', 'Report', and the 'Ohio University' logo. The main window is divided into three sections: 'Facility Parameters', 'Modeling Parameters', and 'Array Parameters'.

**Facility Parameters:**

- Array Type: WI14-10
- Center Frequency (MHz): 110.1
- CLR Frequency (MHz): 110.096 MHz
- Runway Heading: 0.0 deg
- Runway Length: 9000.0 ft
- Runway Width: 150.0 ft
- ILS Pt. C.: 1000.0 ft

**Modeling Parameters:**

- Most Recently Applied Airport Navaid Datasheet: No Localizer Applied Record. Select from JCCBI Window.
- Fields to Model: Automatic
- ☐ Include Random DU Errors

**Array Parameters:**

Course Array:		Clearance Array:	
Element Type: LPD		LPD	
Main Setback: 1000.0 ft		1000.0 ft	
Main Offset: 0.0 ft		0.0 ft	
Main Height: 5.57 ft		5.57 ft	
Array Rotation: 0.0 deg		0.0 deg	
Antenna Rotation: 0.0 deg		0.0 deg	
Clearance Width: 2.2 deg			
CLR / CRS Separation: -17.0 dB			

☒ Use Course Params as Clearance Params

Figure 170: Exercise 5 Facility Info.

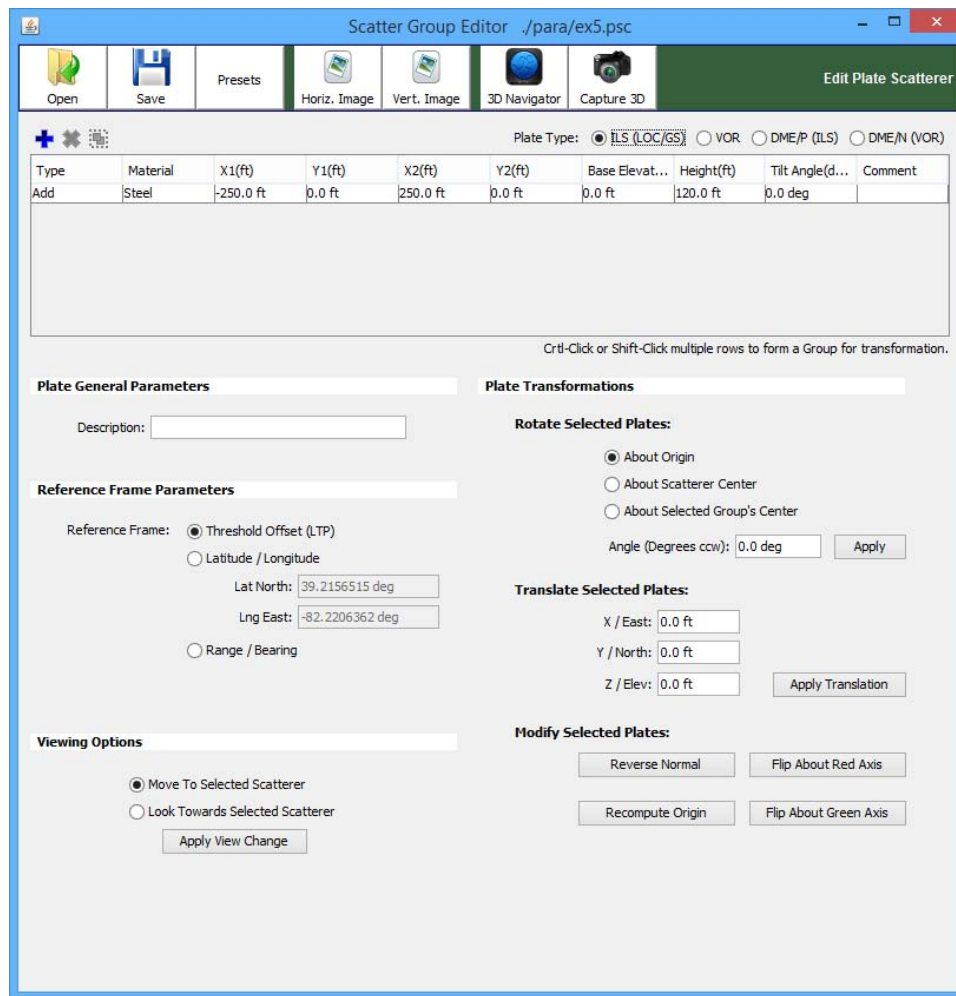


Figure 171: Exercise 5 Scatterer.

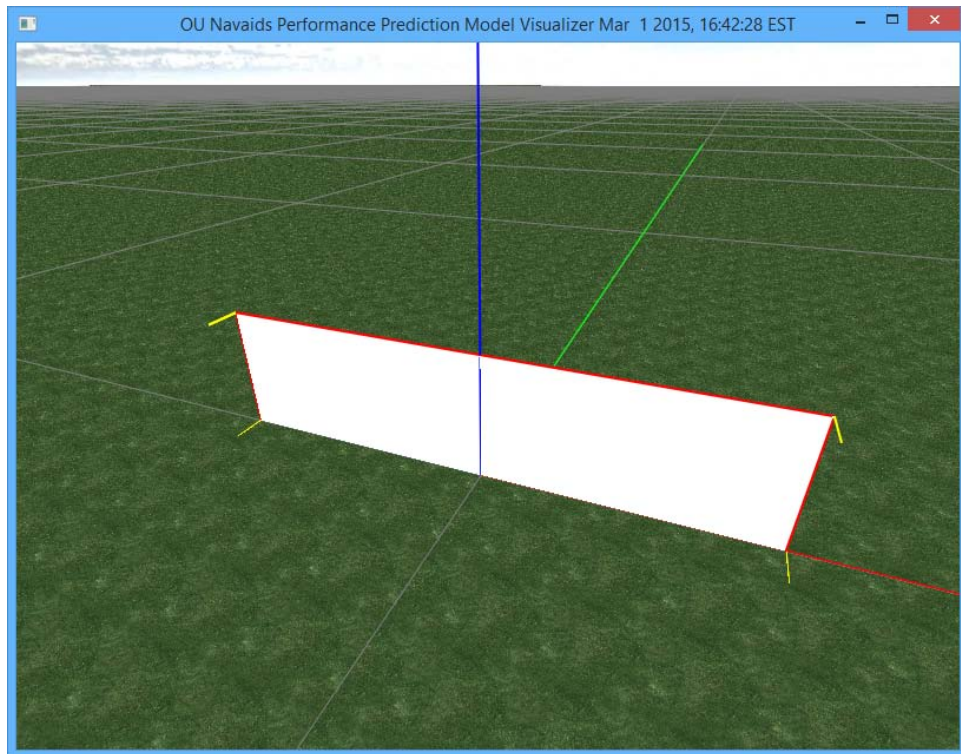


Figure 172: Exercise 5 scatterer in the virtual world.

	Start	Stop	Inc
X	0.0 ft	-8000.0 ft	-1000
Y	200.0 ft	800.0 ft	50.0 ft
Z	0.0 ft	0.0 ft	1.0 ft
Angle	0.0 deg	0.0 deg	1.0 deg

Figure 173: Exercise 5 iteration values.

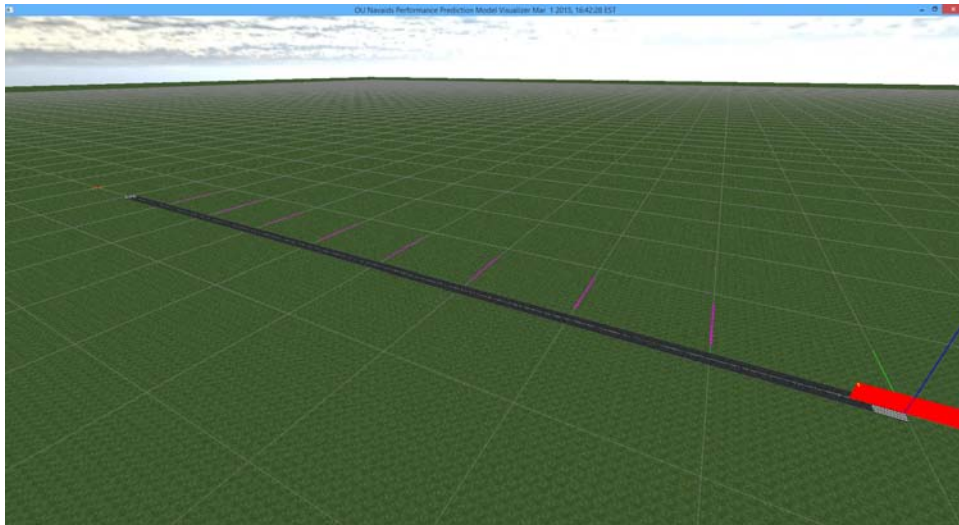


Figure 174: Exercise 5 iteration locations in the virtual world.

OU NavAids Performance Prediction Model, Version: OUNPPM.svn1892x1893.2015.Jul.12.15.22.04.EDT.zip, UID: 50

File View Units Help

Save Run Sim Run Iter. 3D World 3D Nav. Capture JCCBI Updates Report

NavAids Performance Prediction Model OHIO UNIVERSITY

Localizer Model Glideslope VOR Model DME Scatterers Flight Editor Array Editor Iterators Traces

**Facility Parameters**

Array Type: W120-10  
Center Frequency (MHz): 110.1  
CLR Frequency (MHz): 110.096 MHz  
Runway Heading: 0.0 deg  
Runway Length: 9000.0 ft  
Runway Width: 150.0 ft  
ILS Pt. C.: 1000.0 ft

**Modeling Parameters**

Most Recently Applied Airport Navaid Datasheet:  
No Localizer Applied Record. Select from JCCBI Window.

Fields to Model: Automatic  
☐ Include Random DU Errors

**Array Parameters**

**Course Array:**  
Element Type: LPD  
Main Setback: 1000.0 ft  
Main Offset: 0.0 ft  
Main Height: 5.57 ft  
Array Rotation: 0.0 deg  
Antenna Rotation: 0.0 deg

**Clearance Array:**  
LPD  
1000.0 ft  
0.0 ft  
5.57 ft  
0.0 deg  
0.0 deg  
Clearance Width: 2.2 deg  
CLR / CRS Separation: -20.0 dB

☒ Use Course Params as Clearance Params

Figure 175: Exercise 5 Facility Info with better array.

## Exercise 5 Results

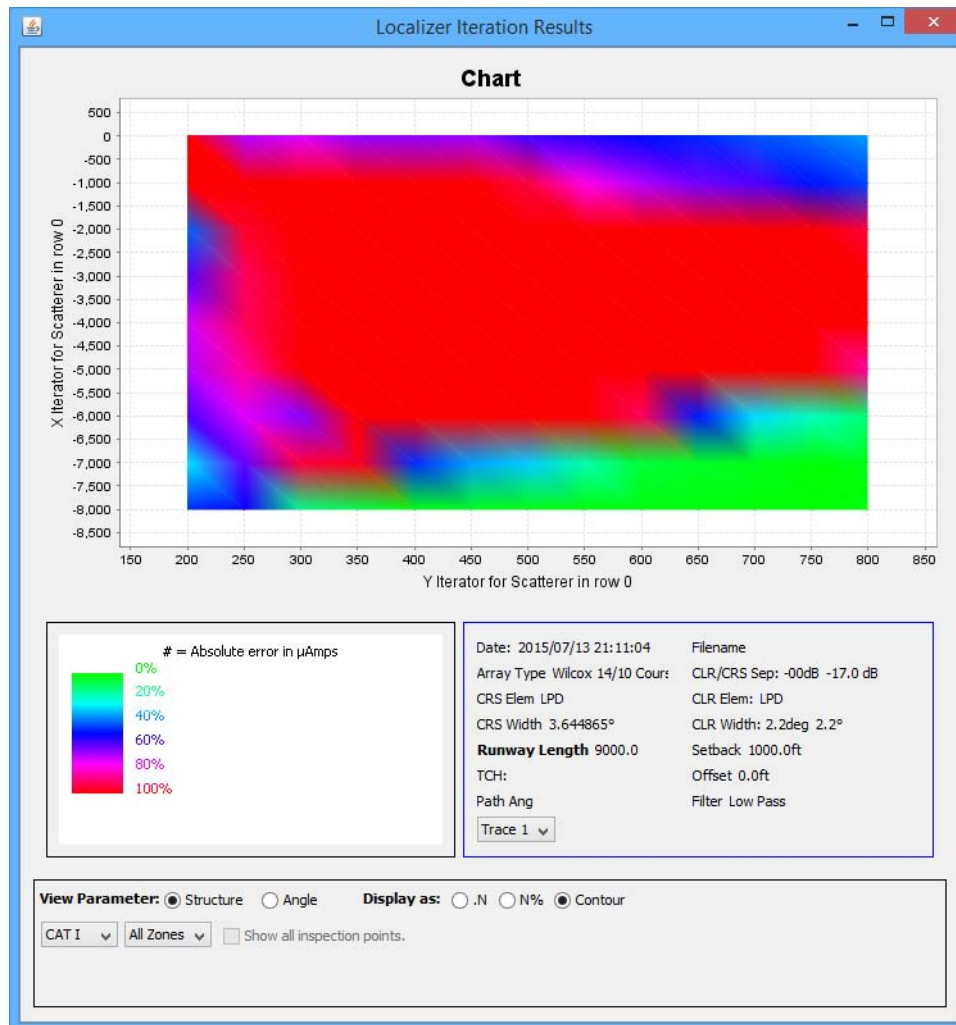


Figure 176: Exercise 5 Solution with WI 14-10.



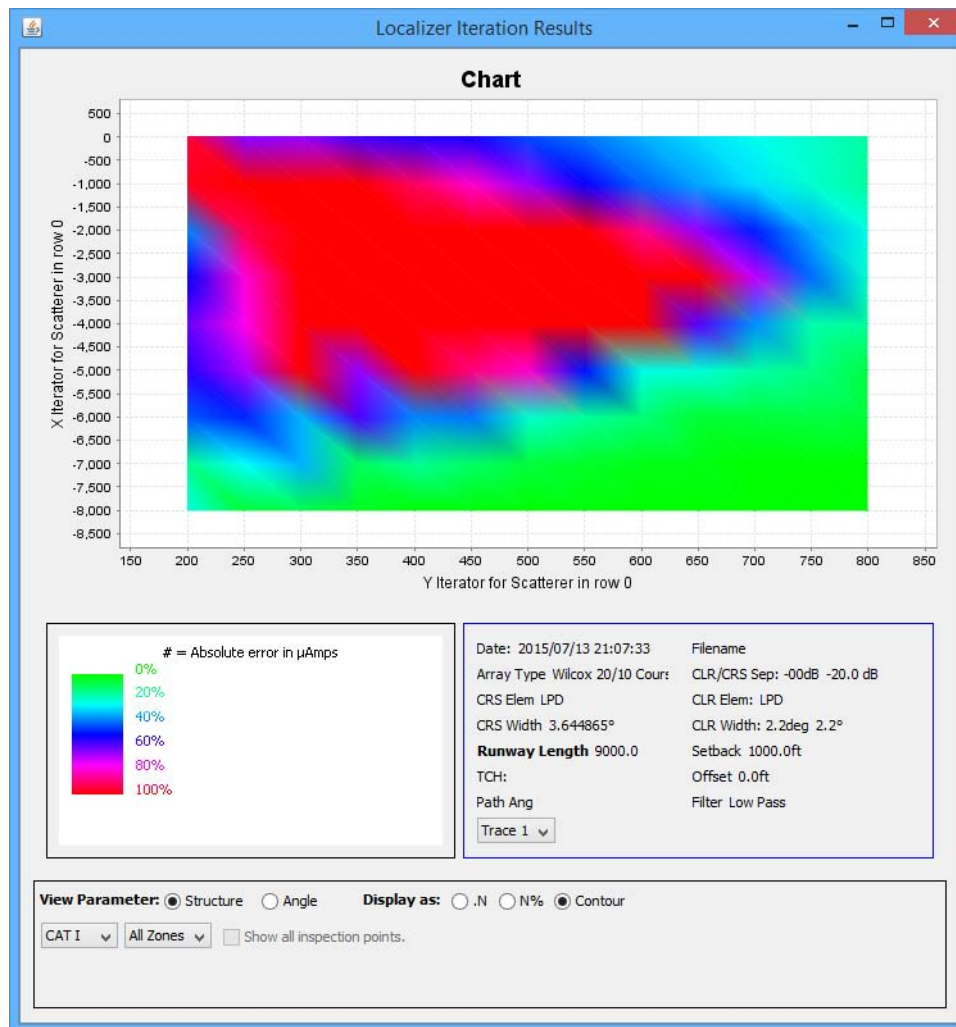


Figure 177: Exercise 5 Solution with WI 20-10.

## 23.6 Exercise 6

## 23.7 Exercise 7

## 23.8 Exercise 8

## 23.9 Exercise 9

### Setup Exercise 9

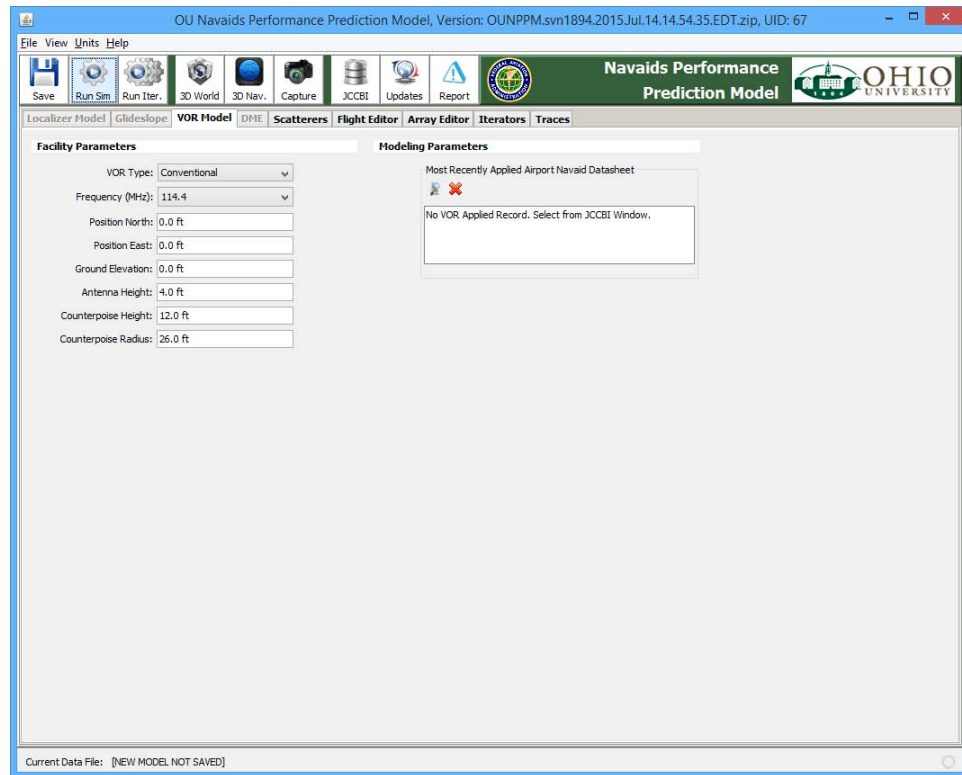


Figure 178: Facility Info for Exercise 9.



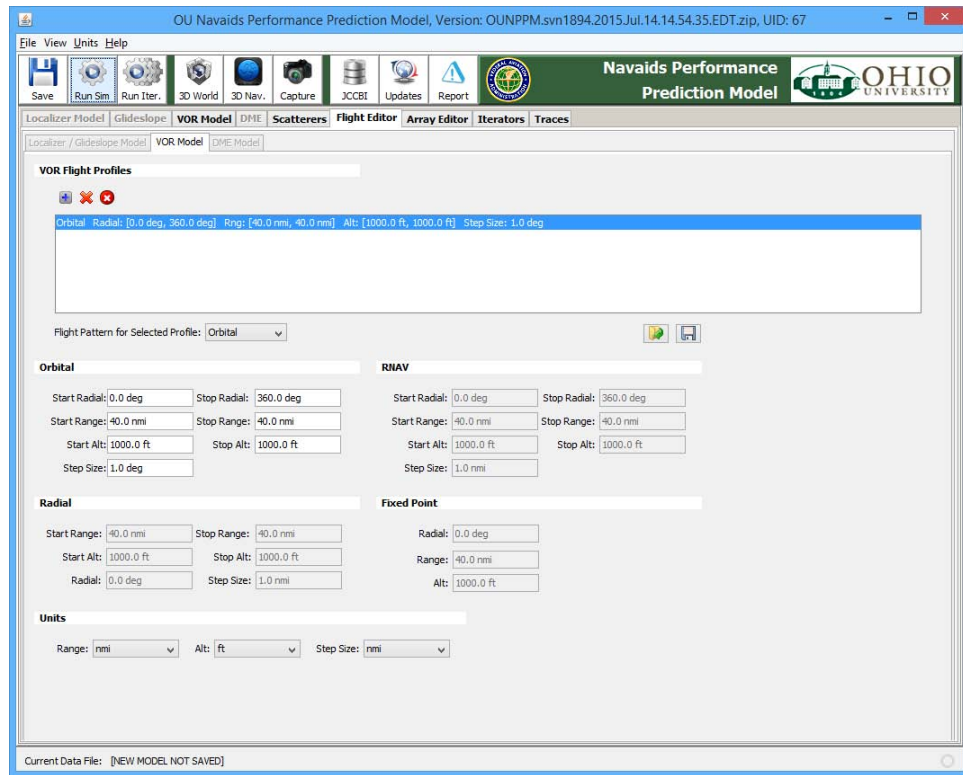


Figure 179: The flight for Exercise 9.

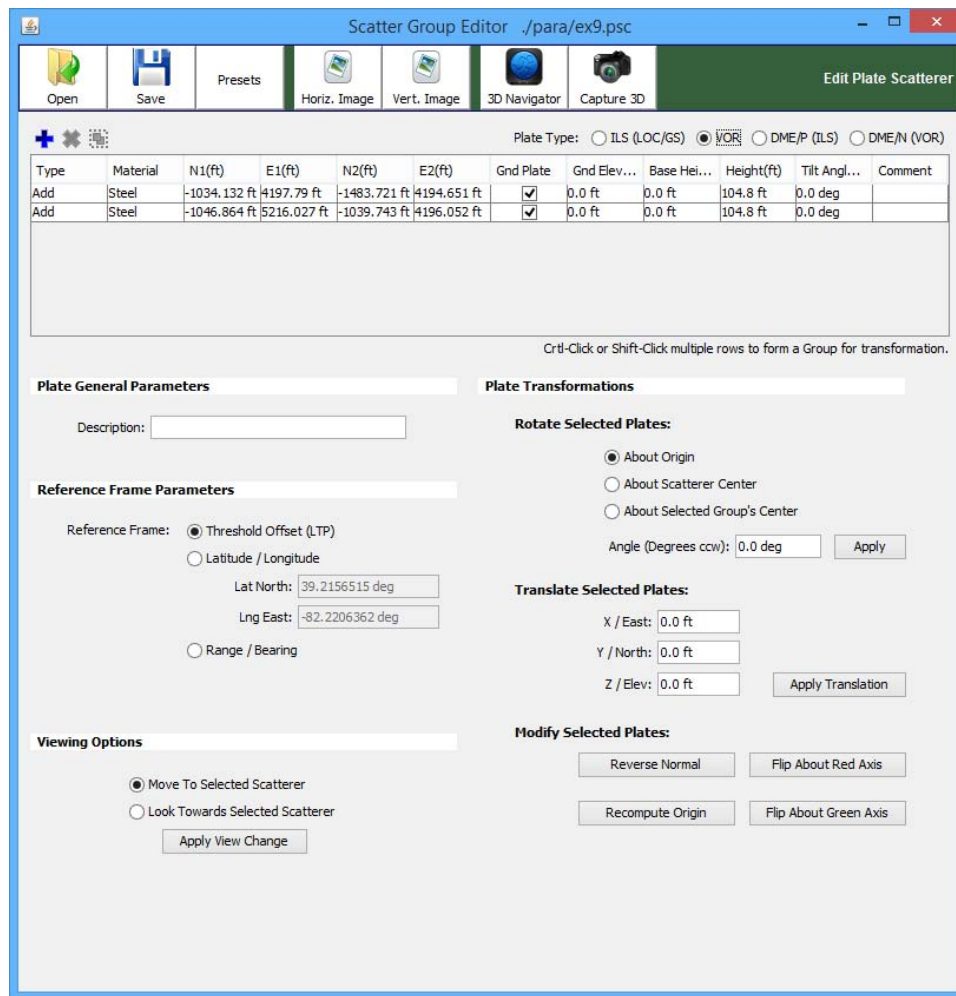


Figure 180: The scatterer (2 plates), for Exercise 9.

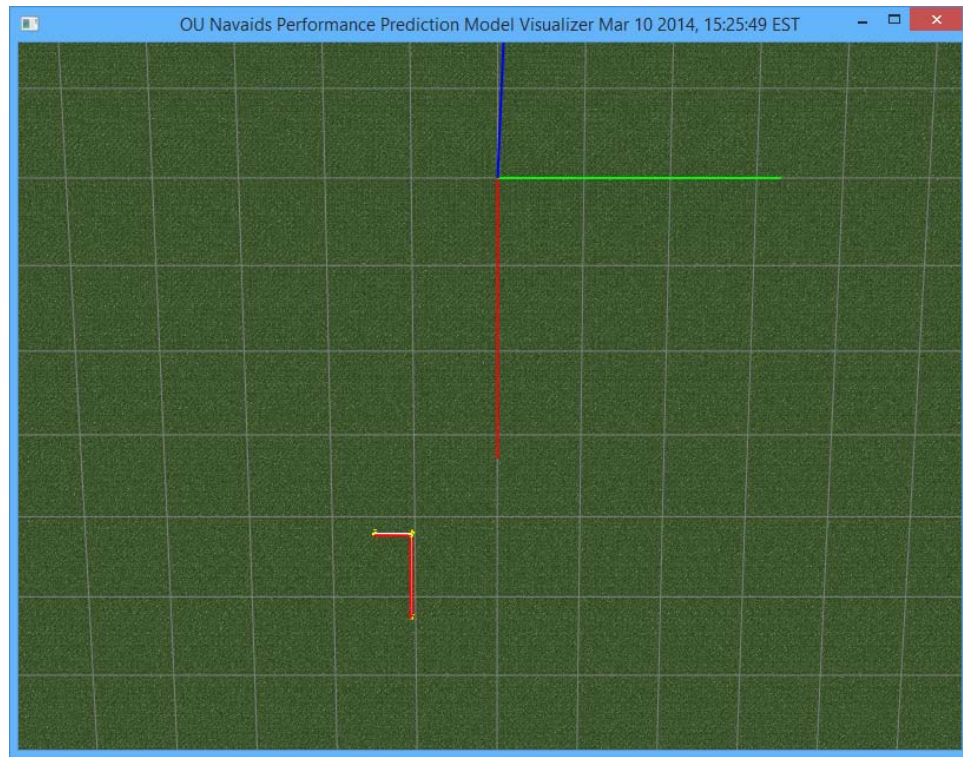


Figure 181: The scatterer (2 plates), for Exercise 9 in the virtual world.

## Results Exercise 9

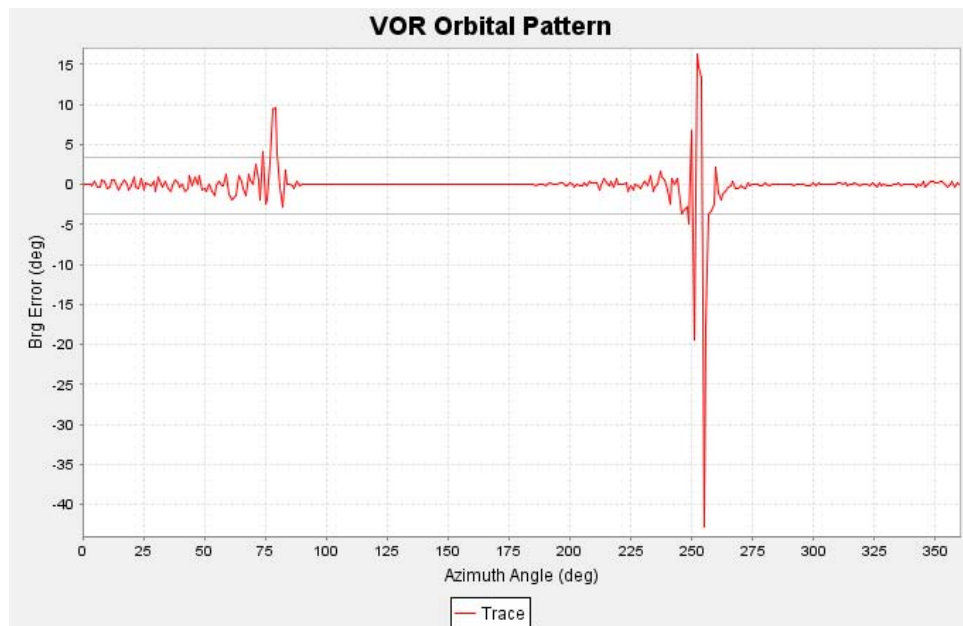


Figure 182: Results for Exercise 9 with both scatterer plates in place.

Extents of X-Axis, min:  $-44^{\circ}$ , max:  $17^{\circ}$

## 23.10 Exercise 10

### Setup Exercise 10

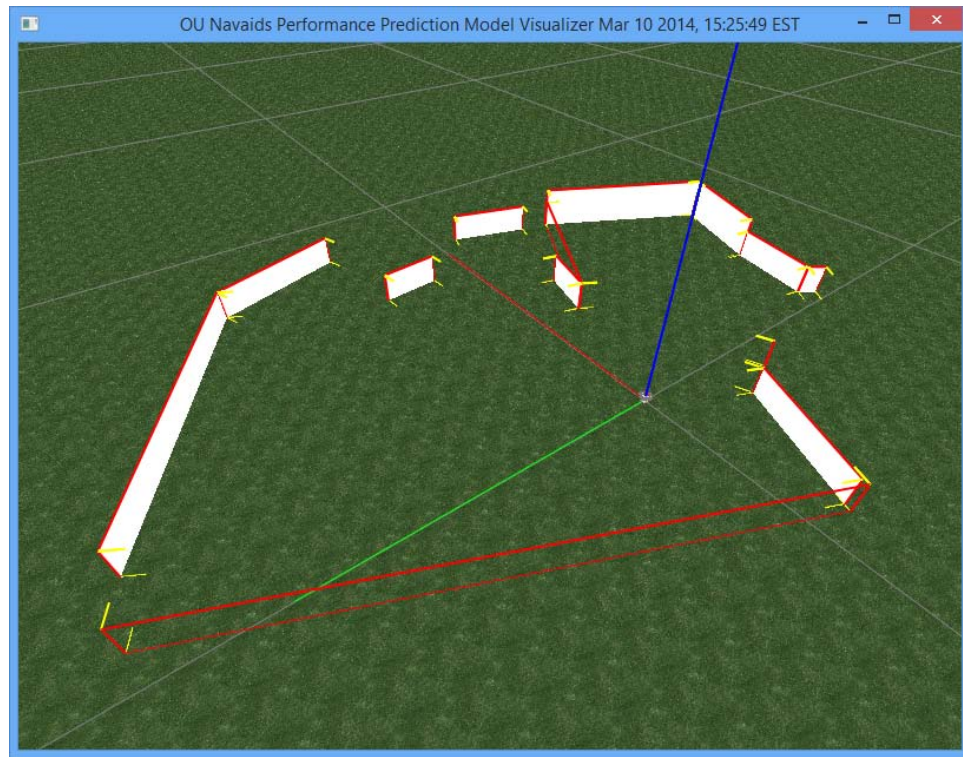


Figure 183: The plates for exercise 10 viewed from the northwest.

## Results Exercise 10

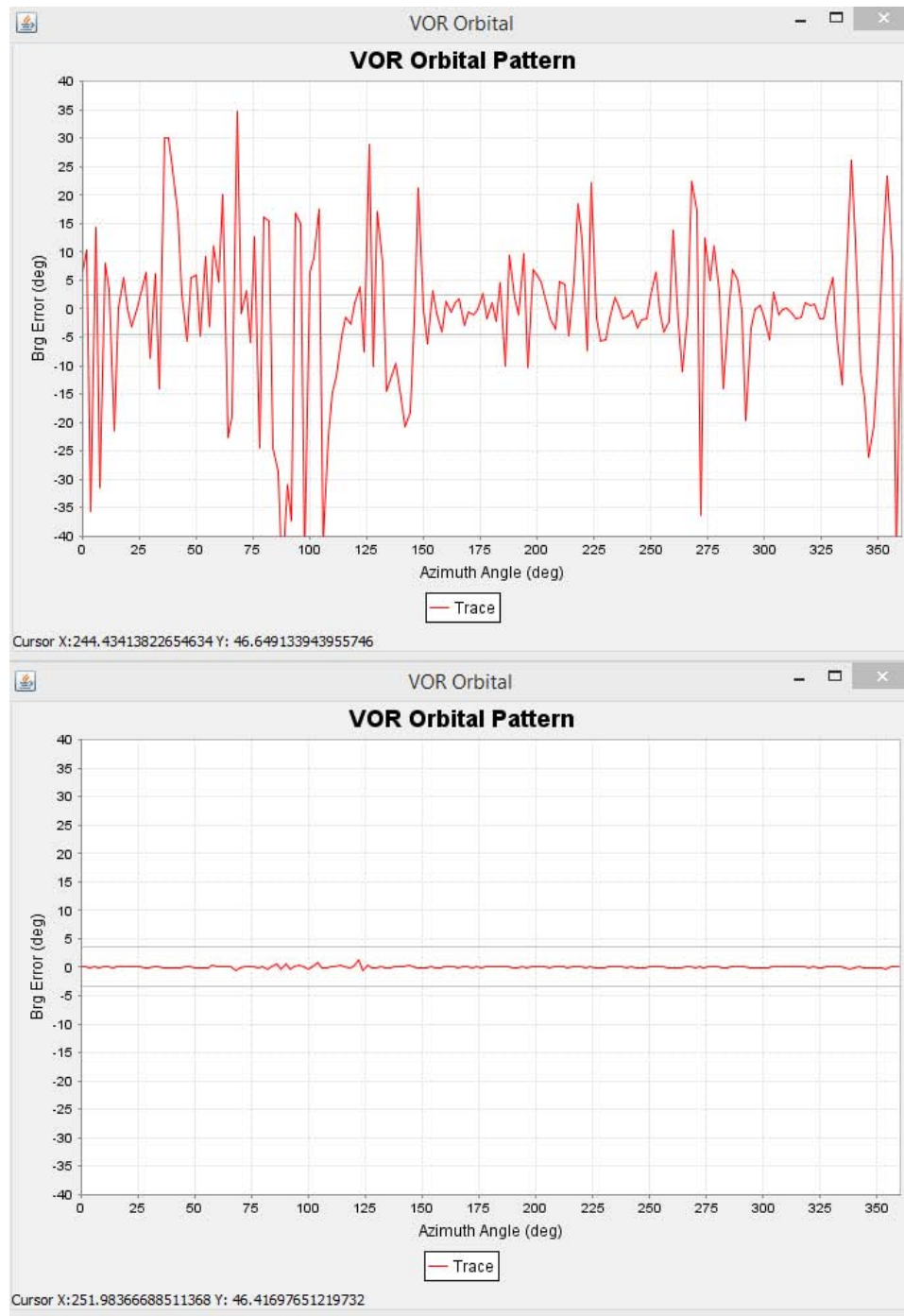


Figure 184: Results for Exercise 10 with all scatterer plates in place. Top is conventional VOR, bottom is doppler.

**Part IX**

**Glossary**

1. CDI - Course Deviation Indicator
2. CSB - Carrier plus side band.
3. SBO - Side band only.

## **Part X**

# **Appendix A: Unit Conversions**



## 24 Introduction

The layout of this appendix is as follows. There shall be 1 section for each unit. For each of these sections, there should be an entry for every other unit. If there is no valid conversion between the units, the value will be listed as “N/A”. Some conversions rely on other configuration parameters. For instance, conversions to and from “wavelengths” require the frequency of the simulation to be known.

Full unit list:

1. Distance Units:
  - a) Feet
  - b) Meters
  - c) Nautical Miles
  - d) Wavelengths
2. Signal Strength Units:
  - a) deciBels
  - b) Normalized power
3. Course Angle Units:
  - a) Degrees
  - b) microAmps
4. Angle Units:
  - a) Degrees
5. Time Units:

## 25 Distance Units

### 25.1 Feet

#### Feet

1 Foot to 1 Foot

#### Meters

1 Foot to .3048 Meters

#### Nautical Miles

1 Foot to  $\frac{1}{6076.11549}$  Nautical Miles

#### Wavelengths

### 25.2 Meters

## **Part XI**

### **Appendix B: Files**

## **26 File Extensions**

- .dat - The data file containing the state of a simulation.
- .ddu - The array parameter file for DME arrays.
- .gdu - The array parameter file for glideslope arrays.
- .ldu - The array parameter file for localizer arrays.
- .pts - The output files of the localizer and glideslope

## **27 File Contents**

### **27.1 Input Files**

x

**Localizer**

**LDU**

**Glideslope**

**GDU**

### **27.2 Intermediate Files**

**Localizer and Glideslope**

**DAT**

### **27.3 Output Files**

**PTS**

## **Part XII**

# **Appendix C: Troubleshooting**

## **28 Issue Reporter**

## **29 Log Files**

### **29.1 Java Log File**

### **29.2 Visualization Log File**

### **29.3 VOR Output File**

## **Part XIII**

### **Appendix D: Known Issues**