#### Ohio University NAVAID Performance Prediction Model User Manual

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October 7, 2023

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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  $\sharp$ . Intended but incomplete features are marked with a  $\diamondsuit$ . Deprecated features intended to be removed, which may or may not ever occur, will be marked with a  $\ddagger$ .

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 with pre-extracted directory.
- 2. Flash Drive during training with installer (deprecated)
- 3. Installer .exe from ounppm.eecs.ohio.edu/ounppm/
- 4. .zip from ounppm.eecs.ohio.edu/ounppm/updates

The following four chapters describe various ways to install the software. Only one applies to whichever setup you chose, but you may wish to familiarize your others for the future.

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

# 2 Flash Drive During Training with pre-extracted directory

#### 2.1 Acquiring .zip

The .zip should be on your dongle provided during training.

#### 2.2 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 24.

#### 2.3 Choose Location

You will be prompted to chose a location for where extracted files should be placed, as seen in figure 25. This will default to a subdirectory in the directory where the file presently is.

#### 2.4 Extraction Compete

When the extraction is complete, the files should look similar to the layout in figure 26.

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

#### **3** Flash Drive During Training with Installer (deprecated)

#### 3.1 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 14. Note: the date will change with future updates, and additional files may be present.

This will launch a standard installer wizard.

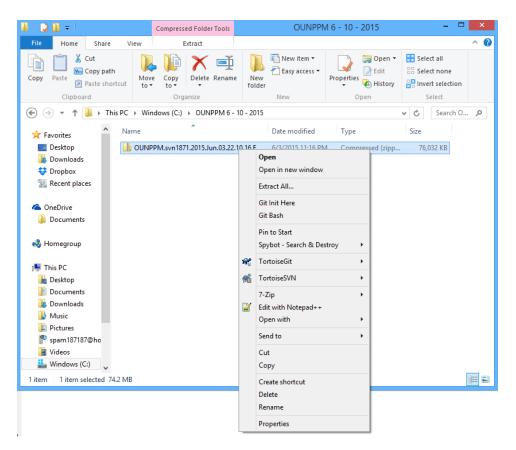


Figure 1: How to extract a .zip.

	×
📀 🍈 Extract Compressed (Zipped) Folders	
Select a Destination and Extract Files	
Files will be extracted to this <u>f</u> older:	
C:\OUNPPM 6 - 10 - 2015\OUNPPM.svn1871.2015Jun.03.22.10.16.EDT Browse	
✓ Show extracted files when complete	
<u>Extract</u> Cano	:el

Figure 2: How to chose a location for the contents of the .zip.

#### 3.2 Slide One

Click Next to continue, as seen in figure 15.

📕   🔒 🔁 =	OUNPPM.svn1871	I.2015.Jun.03.22.10.16.E	TC	- 🗆	x
F Home Share	View				^ <b>e</b>
Copy Paste		New item ▼ → Easy access ▼ Folder	Properties	Select all Select none	
Clipboard	Organize	New	Open	Select	
🛞 🌖 👻 🕇 📙 « Wir	ndows (C:) > OUNPPM 6 - 10 - 2015 >	OUNPPM.svn1871.2015.Jun.0	3.22.10.16.EDT	V C Search O	, p
☆ Favorites	Name	Date modified	Туре	Size	_
Desktop	Duild	6/10/2015 6:23 PM	File folder		
Downloads	data	6/3/2015 11:15 PM			
Stopbox	📕 dist	6/10/2015 6:23 PM	File folder		
🔚 Recent places	DME	6/10/2015 6:23 PM	File folder		
	📕 keys	6/10/2015 6:23 PM	File folder		
🝊 OneDrive	퉬 para	6/10/2015 6:23 PM	File folder		
) Documents	JunalteredPara	6/10/2015 6:23 PM	File folder		
	퉬 updates	6/10/2015 6:23 PM	File folder		
🍓 Homegroup	퉬 viznppm	6/10/2015 6:23 PM	File folder		
	CHANGELOG.txt	5/8/2014 11:13 AM	Text Document	14 KB	
🌉 This PC	🚳 ILS_Mod3_32.dll	3/18/2014 11:17 AM	Application extens	1,683 KB	
膧 Desktop	🚳 ILS_Mod3_64.dll	3/18/2014 11:18 AM	A Application extens	2,263 KB	
Documents	🚳 ILSGraph.dll	2/26/2014 8:30 PM	Application extens	56 KB	
〕 Downloads	jccbi.cache.bz2	3/14/2014 11:21 AM	M BZ2 File	3,171 KB	
🜗 Music	🚳 KL2DLL.DLL	2/26/2014 8:30 PM	Application extens	9 KB	
📔 Pictures	🚳 kl2dll32.dll	2/26/2014 8:30 PM	Application extens	188 KB	
ᢪ spam187187@hotm	🚳 kl2dll64.dll	2/26/2014 8:41 PM	Application extens	226 KB	
📔 Videos	🔁 NAVAID.pdf	3/24/2014 1:05 PM	Adobe Acrobat D	5,989 KB	
🏭 Windows (C:)	NyklKeyAuth.exe	2/26/2014 8:30 PM	Application	34 KB	
👝 Local Disk (D:)	🗿 ounppm.ini	6/3/2015 10:17 PM	2	1 KB	
	📄 ounppm.log	6/3/2015 11:15 PM		1 KB	
📬 Network	🚳 Run OUNPPM.bat	2/26/2014 8:31 PM		1 KB	
	🚳 RunViznppm.BAT	2/26/2014 8:36 PM		1 KB	
	S UpdateClient.bat	2/26/2014 8:31 PM		1 KB	
	VOR_Mod3_new_32.dll	6/23/2014 8:25 PM	1.1	313 KB	
	S VOR_Mod3_new_64.dll	6/23/2014 8:25 PM	11	630 KB	
	VOR_Mod3_old_32.dll	7/2/2014 3:20 PM	Application extens	1,639 KB	
	NOR_Mod3_old_64.dll	7/2/2014 3:20 PM	Application extens	2,233 KB	
28 items					

Figure 3: The files extracted from the .zip.

-	Removable Disk (G	:)		- 🗆 🗙
$\odot$ $\rightarrow$ $\uparrow$ $\blacksquare$ $\rightarrow$ This	s PC → Removable Disk (G:)		v C	Search Remo 🔎
Windows (C:)	Name	Date modified	Туре	Size
□ Local Disk (D:) BD-ROM Drive (F	🔩 OUNPPM Installer 3 - 12 - 2014.exe	3/12/2014 2:21 PM	Application	23,063 KB
👝 Removable Disk i				
🙀 Network				
1 item 1 item selected 22.	.5 MB			

Figure 4: The installation file, as found on your flash drive.

#### 3.3 Slide Two

Here, accept the terms of service, as shown in figure 16, and click next to continue.



Figure 5: Click next to continue.

👃 🛛 OUNPPM Install Program 🚽 🗖 🗙	
License Please read the license agreement below.	
Please read the license agreement below and select "I Agree" if you agree with its terms and conditions.	
The Ohio University NAVAID Performance Prediction Model is a product of Ohio University.	
agree with the above terms and conditions     O I do not agree	
< <u>B</u> ack <u>N</u> ext > E <u>x</u> it	

Figure 6: Accept the terms of service.

#### 3.4 Slide Three

Here, as shown in figure 17, 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.

#### 3.5 Slide Four

This is your last chance to change the install directory, once you click "Start", as shown in figure 18, the installation will begin.

#### 3.6 Slide Five

If you see the screen depicted in figure 19, the installation completed successfully.

4	OUNPPM Install Program	-	□ ×
Directory Choose an installation fol	der and click Next to continue.		•
OUNPPM's files will be ins	stalled in the following directory:		
C:\OUNPPM			
Disk space needed :		77 Mb	
Available disk space :		6300 Mb	
Click 'Next' to continue.			
	< Back	<u>N</u> ext >	E <u>x</u> it

Figure 7: Choose the install location.

👶 OUNPPM Install Program	_ □	×
Confirmation You are now ready to install OUNPPM.		•
This program will install OUNPPM into C:\Program Files (x86)\OUN	IPPM.	
Click 'Start' to install OUNPPM.		
< Back	<u>S</u> tart E <u>x</u>	it

Figure 8: Press start to install.

\$	OUNPPM Install Program	-	□ ×
End Installation completed.			•
OUNPPM has been succe	ssfully installed.		
	< Back		E <u>x</u> it

Figure 9: Press start to install.

#### 3.7 Slide Six

Click the exist button, as seen in the lower right corner of figure 20, to exit the installer.

\$	OUNPPM Install Program	- 🗆 🗙
Clickteam Install Cre Copyright © 1999-2011 http://www.clickteam.c	Clickteam	
This install program has simple and powerful in	s been created with the freeware version of Clickte stall maker.	am Install Creator, a
Visit our <u>Web site</u> and creation tools.	discover Clickteam Install Creator as well as our gar	ne and multimedia
	ve just installed has not been created by Clicktean iblisher for any question about it.	n, please directly
		Exit

Figure 10: Press start to install.

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

🎳 OU Glide Slope Terrain Model	
J OUNPPM	
📅 OUNPPM	
🕉 Uninstall OUNPPM	

Figure 11: OUNPPM in the start menu.

#### 3.9 Running OUNPPM Directly

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

#### 4 Installer from Website

#### 4.1 Acquiring Installer

The executable installers can be acquired from the following url, which looks like figure 13:

```
http:\ounppm.eecs.ohio.edu/ounppm/install/
The recommended installer will be called: "Install.exe".
```

1 💽	🖟 = 1 👘			Application Tools			OUNPP	M Java	-	• ×
	Home	Share	View	Manage						^
Сору	Paste	Eut Eopy path Paste shorte	Mow	Copy Delete	nename	New folder	Prew item •	Properties	Select all	20
	Clipboar		to•	Organize		rolder	New	Open	Select	
20			DC . W.	dows (C:) → OUN	00141					م0
€⊝	т [	jis i⊧ inis	PC F Wir	aows (C:) F OUN	PPINI Java				V G Search	Q D
쑭 Fan	vorites		Name				Date modified	Туре	Size	
	Desktop		鷆 build				5/28/2015 7:43 PN	1 File folder		
ا 🐛 د	Downloads		鷆 dist				5/28/2015 7:43 PN	1 File folder		
÷ 🗘	Dropbox		鷆 DME				5/28/2015 7:43 PN	1 File folder		
93. F	Recent place	5	鷆 keys				5/28/2015 7:43 PN			
			鷆 para				6/3/2015 10:21 PN			
🍊 On			鷆 scratc				6/3/2015 10:21 PN			
۵ 🎼	Documents		-	redPara			5/28/2015 7:43 PN			
			鷆 updat				5/28/2015 7:43 PN			
🤣 Ho	megroup		viznpp				6/5/2015 5:28 PM	File folder		
_			Accessed in the local division of the local	GELOG.txt			5/8/2014 11:13 AN		14 KB	
👰 Th				od3_32.dll			3/18/2014 11:17 A			
_	Desktop			od3_64.dll			3/18/2014 11:18 A			
	Documents		S ILSGra				2/26/2014 9:30 PN			
	Downloads Music		🛕 Install				2/26/2014 8:44 PN		2,333 KB	
	Viusic		🔊 Install				6/9/2015 1:54 PM	Install Creator Proj		
	victures pam187187	Ob et al	KL2DL	ache.bz2			3/14/2014 11:21 A 2/26/2014 9:30 PM		3,171 KB	
	/ideos	whotm	NL2DL				2/26/2014 9:30 PN 2/26/2014 9:30 PN			
_	Vindows (C:		Ni2dile				2/26/2014 9:30 PN 2/26/2014 9:41 PN			
_	ocal Disk (C						2/26/2014 9:41 PN 3/24/2014 1:05 PN		5.989 KB	
_ L	.ocal Disk (L	6)	Course of Course	eyAuth.exe			2/26/2014 1:03 PN		3,909 KB	
📬 Ne	twork		a ounpt				6/8/2015 7:07 PM	Configuration sett		
			and 11	UNPPM.bat			2/26/2013 7:07 PM			
				nppm.BAT			2/26/2014 9:36 PN			
			Temp				6/8/2015 7:07 PM	Text Document	1 KB	
			👗 Uninst				5/28/2015 7:43 PM	1 Application	102 KB	
				eClient.bat			2/26/2014 9:31 PM			
				Aod3_new_32.dll			6/23/2014 8:24 PM	1 Application extens	313 KB	
				/lod3_new_64.dll			6/23/2014 8:25 PN	1 Application extens	630 KB	
			VOR_I	Aod3_old_32.dll			7/2/2014 3:20 PM	Application extens	1,639 KB	
			VOR_	/lod3_old_64.dll			7/2/2014 3:20 PM	Application extens	2,233 KB	
31 items	1.	selected 2	50 buter							8== =

Figure 12: How to run OUNPPM directly.

### Index of /ounppm/install

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

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

Figure 13: The installation file, as found on your flash drive.

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.

#### 4.2 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 14. Note: the date will change with future updates, and additional files may be present.

This will launch a standard installer wizard.

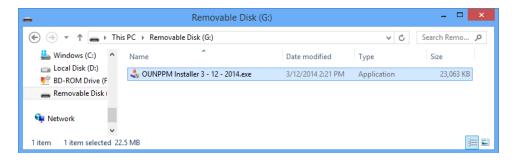


Figure 14: The installation file, as found on your flash drive.

#### 4.3 Slide One

Click Next to continue, as seen in figure 15.



Figure 15: Click next to continue.

#### 4.4 Slide Two

Here, accept the terms of service, as shown in figure 16, and click next to continue.

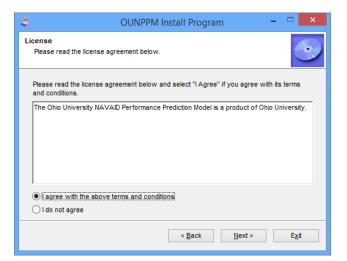


Figure 16: Accept the terms of service.

#### 4.5 Slide Three

Here, as shown in figure 17, 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.

4	OUNPPM Install Program	-	<b>x</b>
Direc Ch	tory pose an installation folder and click Next to continue.		0
_	NPPM's files will be installed in the following directory:		
C	OUNPPM		
Dis	space needed :	77 Mb	
Avi	ilable disk space :	6300 Mb	
Clic	k 'Next' to continue.		
	< <u>B</u> ack <u>N</u> ex	t >	E <u>x</u> it

Figure 17: Choose the install location.

#### 4.6 Slide Four

This is your last chance to change the install directory, once you click "Start", as shown in figure 18, the installation will begin.

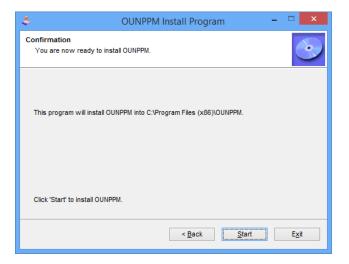


Figure 18: Press start to install.

#### 4.7 Slide Five

If you see the screen depicted in figure 19, the installation completed successfully.

4	OUNPPM Install Program	- 🗆 🗙
End Installation completed.		$\bigcirc$
OUNPPM has been succes	ssfully installed.	
	< <u>B</u> ack <u>Next</u> >	Exit

Figure 19: Press start to install.

#### 4.8 Slide Six

Click the exist button, as seen in the lower right corner of figure 20, to exit the installer.

\$	OUNPPM Install Program 🛛 – 🗖 🗙
Clickteam Install Creat Copyright © 1999-2011 C http://www.clickteam.com	ickteam
This install program has b simple and powerful insta	een created with the freeware version of Clickteam Install Creator, a II maker.
Visit our <u>Web site</u> and dis creation tools.	cover Clickteam Install Creator as well as our game and multimedia
	just installed has not been created by Clickteam, please directly isher for any question about it.
	Exit

Figure 20: Press start to install.

#### 4.9 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 19. Click the "OUNPPM" item to start the application.

#### 4.10 Running OUNPPM Directly

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

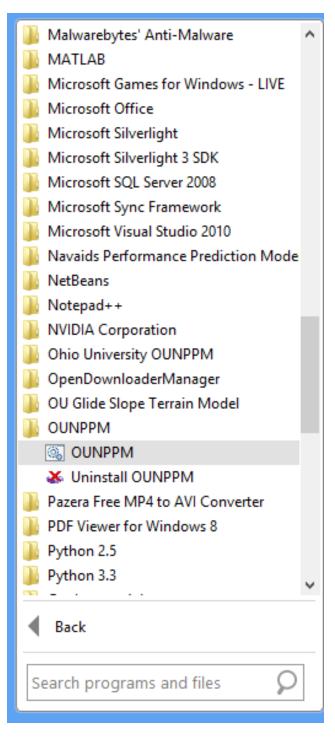


Figure 21: OUNPPM in the start menu.

#### 5 .zip from Website

#### 5.1 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 23. The highest build number and date are the recommended version. Download the .zip of your choosing, and continue to the next section.

1 💽	🖟 🗉 🗍			Application Tools		OUNPP	M Java	- 🗆 🗙
File	Home	Share	View	Manage				^
Сору	Darte	Cut Copy path Paste shorte	ut to	P 🚛 🚺 🚺	ename New folder	New item •	Properties	Select all Select none
	Clipboa	rd		Organize		New	Open	Select
€ ⊝		🍌 🕨 This	PC → Wir	dows (C:) > OUNPP	M Java			v 🖒 Search O ,O
🔆 Fa	vorites		Name	*		Date modified	Туре	Size
	Desktop		退 build			5/28/2015 7:43 PM	File folder	
۱ 🚛	Downloads		📗 dist			5/28/2015 7:43 PM	File folder	
÷.	Dropbox		DME			5/28/2015 7:43 PM	File folder	
93. F	Recent plac	es	📕 keys			5/28/2015 7:43 PM	File folder	
			퉬 para			6/3/2015 10:21 PM	File folder	
i Or	eDrive		📕 scrate	h		6/3/2015 10:21 PM	File folder	
🛛 🏭 C	Documents		鷆 Unalte	redPara		5/28/2015 7:43 PM	File folder	
			鷆 updat	es		5/28/2015 7:43 PM	File folder	
🜏 Ho	megroup		\rm viznpp	m		6/5/2015 5:28 PM	File folder	
			CHAN	GELOG.txt		5/8/2014 11:13 AM	Text Document	14 KB
🎼 Th	is PC		🚳 ILS_M	od3_32.dll		3/18/2014 11:17 Al	Application extens	1,683 KB
- 🕞 C	Desktop		🚳 ILS_M	od3_64.dll		3/18/2014 11:18 AI	Application extens	2,263 KB
) 👔	Documents		🚳 ILSGra	ph.dll		2/26/2014 9:30 PM	Application extens	56 KB
🛛 鷆 (	Downloads		🛕 Install	exe		2/26/2014 8:44 PM	Application	2,333 KB
- 🏬 I	Music		🗷 Install	iit		6/9/2015 1:54 PM	Install Creator Proj	41 KB
) 🗐	lictures		jccbi.o	ache.bz2		3/14/2014 11:21 Al	VI BZ2 File	3,171 KB
P 5	pam187187	7@hotm	🗟 KL2DL	L.DLL		2/26/2014 9:30 PM	Application extens	9 KB
) 📓	lideos		🚳 kl2dll3	2.dll		2/26/2014 9:30 PM	Application extens	188 KB
، 📥	Vindows (C	3)	🚳 kl2dll6	4.dll		2/26/2014 9:41 PM	Application extens	226 KB
👝 l	.ocal Disk (I	D:)	🔁 NAVA	ID.pdf		3/24/2014 1:05 PM	Adobe Acrobat D	5,989 KB
			📧 NyklK	eyAuth.exe		2/26/2014 9:30 PM	Application	34 KB
🖣 Ne	twork		al ounp	im.ini		6/8/2015 7:07 PM	Configuration sett	1 KB
			🚳 Run O	UNPPM.bat		2/26/2014 9:31 PM	Windows Batch File	1 KB
			🚳 RunVi	nppm.BAT		2/26/2014 9:36 PM	Windows Batch File	1 KB
			📄 Temp	ate.txt		6/8/2015 7:07 PM	Text Document	1 KB
			🍇 Uninst			5/28/2015 7:43 PM		102 KB
			🚳 Updat	eClient.bat		2/26/2014 9:31 PM	Windows Batch File	1 KB
			S VOR_I	/lod3_new_32.dll		6/23/2014 8:24 PM	Application extens	313 KB
			S VOR_I	/lod3_new_64.dll		6/23/2014 8:25 PM	Application extens	630 KB
			S VOR_I	/lod3_old_32.dll		7/2/2014 3:20 PM	Application extens	1,639 KB
			S VOR_I	/lod3_old_64.dll		7/2/2014 3:20 PM	Application extens	2,233 KB
31 item	1 item	selected 2	0 buter					

Figure 22: How to run OUNPPM directly.

## Index of /ounppm/updates

Name	Last modified	<u>Size</u>
Parent Directory		-
OUNPPM.svn1335.2013.Jun.25.13.36.07.EDT.zip	26-Feb-2014 15:54	23M
OUNPPM.svn1342.2013.Jun.26.02.15.53.EDT.zip	26-Feb-2014 15:54	23M
OUNPPM.svn1347.2013.Jun.26.17.30.13.EDT.zip	26-Feb-2014 15:54	25 <b>M</b>
OUNPPM.svn1349.2013.Jun.26.18.02.25.EDT.zip	26-Feb-2014 15:54	21M
OUNPPM.svn1350.2013.Jun.26.18.30.56.EDT.zip	26-Feb-2014 15:54	22 <b>M</b>
OUNPPM.svn1352.2013.Jun.27.13.15.28.EDT.zip	26-Feb-2014 15:54	22 <b>M</b>
OUNPPM.svn1357.2013.Jun.28.01.09.25.EDT.zip	26-Feb-2014 15:54	22 <b>M</b>
OUNPPM.svn1363.2013.Jul.02.15.48.41.EDT.zip	26-Feb-2014 15:54	22 <b>M</b>
OUNPPM.svn1366.2013.Jul.03.14.57.19.EDT.zip	26-Feb-2014 15:54	22 <b>M</b>
OUNPPM.svn1377.2013.Jul.17.16.40.10.EDT.zip	26-Feb-2014 15:54	22M

Figure 23: The version repository containing .zips of all versions.

#### 5.2 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 24.

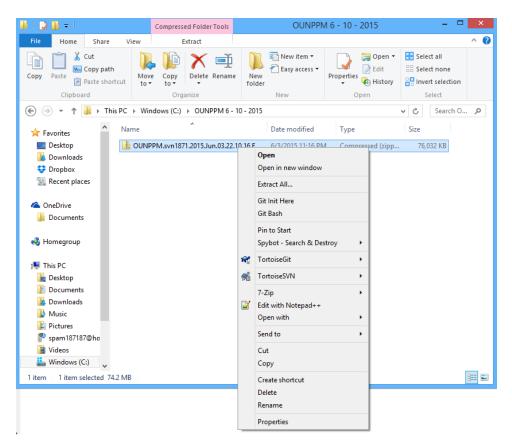


Figure 24: How to extract a .zip.

#### 5.3 Choose Location

You will be prompted to chose a location for where extracted files should be placed, as seen in figure 25. This will default to a subdirectory in the directory where the file presently is.

#### 5.4 Extraction Compete

When the extraction is complete, the files should look similar to the layout in figure 26.

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

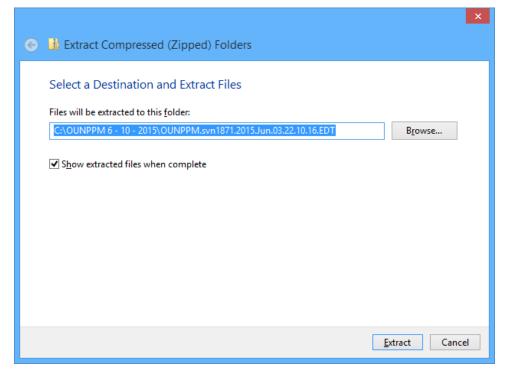


Figure 25: How to chose a location for the contents of the .zip.

L 1 1 2 = L     OUNPPM.svn1871.2015.Jun.03.22.10.16.EDT     - □ ×						
F Home Share	View	New item 🔻	🕥 🔛 Open 🔻	Relect all	^ 🕑	
Copy path		Easy access •	Edit	Select all		
Copy Paste	Move Copy Delete Rename	New	Properties	Invert selection		
Clipboard	organize	folder	Open	Select		
🔄 🏵 🔹 🕇 🕌 « Wi	ndows (C:)   OUNPPM 6 - 10 - 2015	OUNPPM.svn18/1.2015.Jun.0	3.22.10.16.EDT	Search O	<u>р</u>	
🔆 Favorites	Name	Date modified	Туре	Size		
E Desktop	퉬 build	6/10/2015 6:23 PM	File folder			
🐌 Downloads	퉬 data	6/3/2015 11:15 PM	File folder			
💱 Dropbox	鷆 dist	6/10/2015 6:23 PM	File folder			
🔛 Recent places	퉬 DME	6/10/2015 6:23 PM	File folder			
	퉬 keys	6/10/2015 6:23 PM				
ConeDrive	퉬 para	6/10/2015 6:23 PM				
🍌 Documents	퉬 UnalteredPara	6/10/2015 6:23 PM	File folder			
	鷆 updates	6/10/2015 6:23 PM				
🔣 Homegroup	viznppm	6/10/2015 6:23 PM				
	CHANGELOG.txt	5/8/2014 11:13 AM		14 KB		
🌉 This PC	ILS_Mod3_32.dll	3/18/2014 11:17 AM	Application extens	1,683 KB		
📜 Desktop	ILS_Mod3_64.dll	3/18/2014 11:18 AM		2,263 KB		
Documents	ILSGraph.dll	2/26/2014 8:30 PM		56 KB		
Downloads	jccbi.cache.bz2	3/14/2014 11:21 AM		3,171 KB		
Music	KL2DLL.DLL	2/26/2014 8:30 PM		9 KB		
Pictures	🚳 kl2dll32.dll	2/26/2014 8:30 PM		188 KB		
🗭 spam187187@hotm	🚳 kl2dll64.dll	2/26/2014 8:41 PM		226 KB		
🛃 Videos	NAVAID.pdf	3/24/2014 1:05 PM		5,989 KB		
Windows (C:)	NyklKeyAuth.exe	2/26/2014 8:30 PM		34 KB		
👝 Local Disk (D:)	ini ounppm.ini	6/3/2015 10:17 PM	2	1 KB		
<b>0</b>	ounppm.log	6/3/2015 11:15 PM		1 KB		
📬 Network	🚳 Run OUNPPM.bat	2/26/2014 8:31 PM		1 KB		
	🚳 RunViznppm.BAT	2/26/2014 8:36 PM		1 KB		
	UpdateClient.bat	2/26/2014 8:31 PM		1 KB		
	VOR_Mod3_new_32.dll	6/23/2014 8:25 PM		313 KB		
	VOR_Mod3_new_64.dll	6/23/2014 8:25 PM		630 KB		
	VOR_Mod3_old_32.dll	7/2/2014 3:20 PM	Application extens	1,639 KB		
	VOR_Mod3_old_64.dll	7/2/2014 3:20 PM	Application extens	2,233 KB		
28 items					i== 🛋	

Figure 26: The files extracted from the .zip.

# Part III Preliminaries

#### 6 OUNPPM Overview

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

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

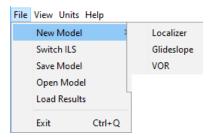


Figure 27: The available models supported by OUNPPM.

One type of system may be modeled at anytime. Figure 27 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 28.

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

Figure 28: Examples of the .dat file indicator. Left) the default, Right) a file saved as temp.dat.

#### 7 System Requirements

- Windows 32-bit/64-bit OS: Windows XP SP3, Vista, 7, 8, 8.1, or 10
- Java SE Runtime Environment (JRE) 7.0 or greater. Free Download at: http://www.oracle.com/technetwork/java/javase/downloads/index. html
- 1GB RAM
- 100MB Disk pace

Note: The default run scripts expect Java 7 or higher to be the first Java installation in your path. The program can still be run by editing the scripts if for some reason Java 7 cannot be the first Java in your path.

#### 8 Coordinate Frames

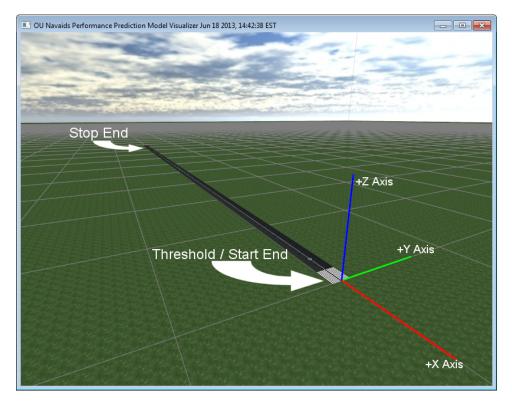


Figure 29: The Localizer / Glideslope reference frame used by OUNPPM.

#### 8.1 Localizer / Glideslope

See Fig.29 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.

#### 8.2 VOR

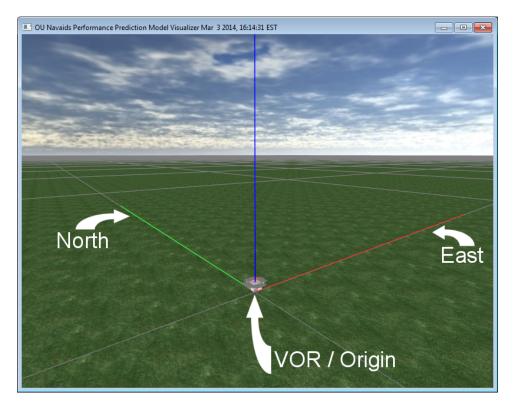


Figure 30: The VOR reference frame used by OUNPPM. The Green Axis is North and the Red Axis is East.

The VOR does not need to have a runway, it simply is positioned relative to some origin, shown in Fig.30, 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.

## **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.

#### 9 General Input

Figure31 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 '1 km', and the corresponding box will change to '3280.84 ft'. Figure 32 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'

Runway Length:	10000.0 ft
Runway Width:	150.0 ft
Runway Heading:	0.0 deg

Figure 31: A typical input box.

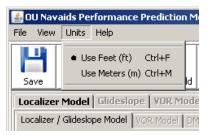


Figure 32: Default Units are either English or Metric.

#### 10 Localizer Model

This section discusses the localizer tab, as seen in figure 33. This tab is only enabled for Localizer models; therefore, it is mutually exclusive with glide slope and VOR models. This chapter will be divided into three sections matching the 3 panels of the localizer tab seen in figure 33: Facility Parameters, Modeling Parameters, and Array Parameters.

\$	OU Navaids Performar	nce Prediction Mode	I, Version: OUNPPM.svn1871	x1877.2015.Jun.16.13.14.45.EDT.zip, UID: 50 –	×
<u>F</u> ile View <u>U</u> nits <u>H</u> elp					
Save Run Sim Run Ite	r. 3D World 3D Nav. Capt	ure JCCBI Updates	Report	Navaids Performance Prediction Model	$IO_{SITY}$
Localizer Model Glideslo	pe VOR Model DME Scatte	erers   Flight Editor   Arr	ray Editor Iterators Traces		
Facility Parameters		Modeling	g Parameters		
Array Type:	WI14-10 ¥	C	Most Recently Applied Airport Navaid	Datasheet	
Center Frequency (MHz):	109.7 🗸		2 🗙		
CLR Frequency (MHz):	109.696 MHz		No Localizer Applied Record. Select fr	om JCCBI Window.	
Runway Heading:	0.0 deg				
Runway Length:	10000.0 ft				
Runway Width:	150.0 ft		Fields to Model: Automatic 🗸		
ILS Pt. C.:	1000.0 ft		Include Random DU Errors		
Array Parameters					
Array Farameters					
Element Type:	Course Array:	Clearance Array:			
Main Setback:		LPD v 1000.0 ft			
Main Offset:		0.0 ft			
Main Height:		5.57 ft			
Array Rotation:		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 Cleara	nce Params			
<u></u>					
Current Data File: [NEW MOD	DEL NOT SAVED]				0

Figure 33: The localizer tab.

#### **10.1 Facility Parameters**

This section discusses the *facility parameters*, as shown in figure 60. This section is divided into 6 subsections describing the component groups found in figure 60: Array Type, Center Frequency, CLR Frequency, Runway Heading, Runway Length, and Runway Width.

#### 10.1.1 Array Type

#### 10.1.1.1 Overview

The array type selection consists of two main components, as seen in figure 61: 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.

Facility Parameters			
Array Type:	WI14-10	¥	C
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 34: The facility parameters component group.

Array Type:	WI14-10	v	C
	TH13-11	>	
	TH13		
	TH25-21		
	WI14-10		
	WI14-6		
	WI14		
	WI16-8		
	WI20-10	•	

Figure 35: The array type components.

#### 10.1.1.2 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 more elements have lower error. The refresh C button, assigns the previous state of the run to the array paremters. 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 28.

#### 10.1.1.3 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 57; if an array is selected containing both sets of elements all components will be active, as seen in figure 72. Similarly, the CLR Frequency component will also be deactivated when only the course array is used, as seen in figure 65; if an array is selected containing both sets of elements will be active only the course array is used, as seen in figure 65; if an array is selected containing both sets of elements all the CLR Frequency will be active, as seen in figure 64.

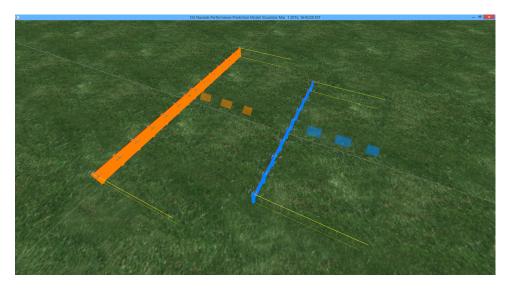


Figure 36: The array in the virtual world.

The depiction of the array in the virtual world is shown in figure 62. The elements of the course and clearance arrays are represented by vertical hexagons of the array 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.

## **10.1.2** Center Frequency

## 10.1.2.1 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 63.

Center Frequency (MHz):	109.7	-
	109.35	^
	109.5	
	109.55	
	109.7	
	109.75	
	109.9	
	109.95	
	110.1	$\mathbf{v}$

Figure 37: The center frequency component.

#### 10.1.2.2 Effect on the Model

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

#### 10.1.2.3 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 10.3, as seen in figure 38, then the CLR frequency as described in section 10.1.3 will be updated to be 4kHz less than the center frequency.

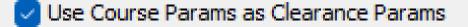


Figure 38: The course clearance checkbox.

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

This component has no effect on the virtual world.

#### **10.1.3 CLR Frequency**

#### **10.1.3.1** 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

```
CLR Frequency (MHz): 109.696 MHz
```

Figure 39: The clearance frequency component.

Figure 64 shows the CLR Frequency component when it is active. Figure 65 shows the CLR Frequency component when it is deactivated.

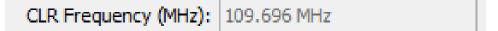


Figure 40: The clearance frequency component deactivated.

If the course and clearance arrays are locked, as indicated by the checkbox in the array parameters, as described in section 10.3, as seen in figure 38, 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.<sup>#</sup>

#### **10.1.3.2** 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 10.1.2. The clearance frequency,  $v_{-}$  is specified by the value in this component. Equations (4) and (5) provide two (2) separate derivations for the course frequency,  $v_{+}$ .

$$v_{+} = v_{c} + (v_{c} - v_{-}) \tag{1}$$

$$\mathbf{v}_{+} = 2\mathbf{v}_{c} - \mathbf{v}_{-} \tag{2}$$

#### 10.1.3.3 Effect on the GUI

This component has no effect on the other GUI widgets.

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

This component has no effect on the virtual world.

#### 10.1.4 Runway Heading

#### 10.1.4.1 Overview

The runway heading component, as seen in figure 41, is used to update the heading of the runway.

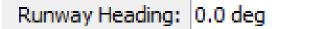


Figure 41: The runway heading component.

Because the localizer coordinate system, as described in section 8.1, and shown in figure 29 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.

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

This has no known effect on the model.

#### 10.1.4.3 Effect on the GUI

This has no effect on other GUI components.

#### 10.1.4.4 Effect on the Virtual World

The runway number will change to reflect the new heading, as seen in figures 42 and **??**. Figure 42 shows a runway with a heading of  $40^{\circ}$ ; figure 43 shows a runway with a heading of  $120^{\circ}$ .

#### **10.1.5 Runway Length**

#### 10.1.5.1 Overview

The runway heading component, as seen in figure 44, is used to update the length of the runway.

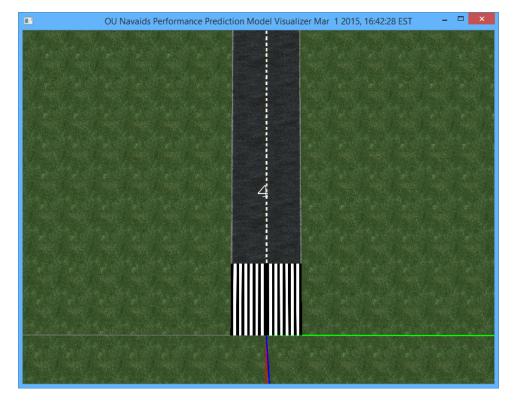


Figure 42: The runway with a heading of 40 degrees.

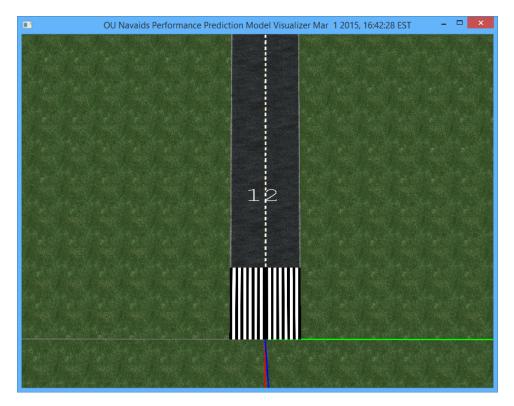


Figure 43: The runway with a heading of 120 degrees.

## 10.1.5.2 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.

# Runway Length: 10000.0 ft

Figure 44: The runway length component.

### 10.1.5.3 Effect on the GUI

The component should not have any effect on other components.

## 10.1.5.4 Effect on the Virtual World

This component effects the runway model in the virtual world. Figure 45 shows a runway with a length of 10000 feet; figure 46 shows an 8500 foot runway. One should notice that the runway in figure 45 extends the length of 10 grid units exactly, whereas the runway in figure 46 ends in the center of a grid cell.

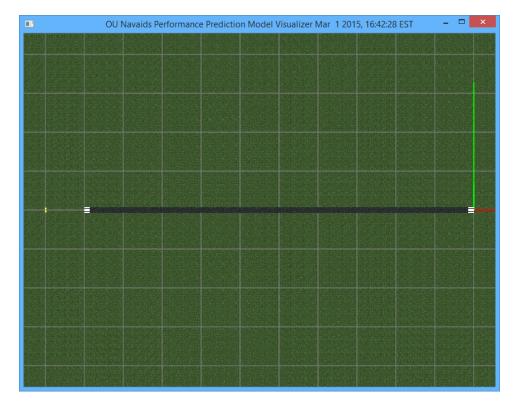


Figure 45: A runway with length 10000ft.

### 10.1.6 Runway Width

## 10.1.6.1 Overview

The runway heading component, as seen in figure 47, is used to update the width of the runway.

#### 10.1.6.2 Effect on the Model

This component has no effect on the model.

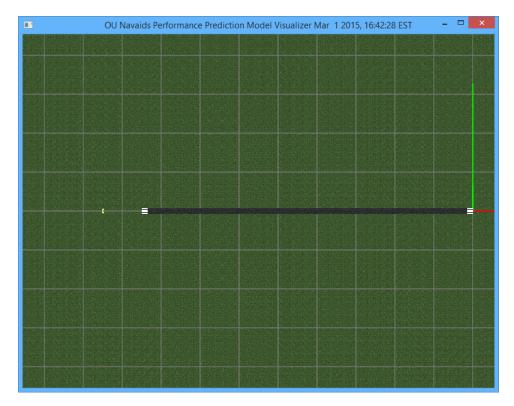


Figure 46: A runway with length of 8500ft.

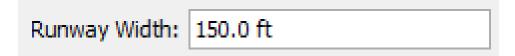


Figure 47: The runway width component.

## 10.1.6.3 Effect on the GUI

This component has no effect on other components.

## 10.1.6.4 Effect on the Virtual World

This component effects the runway model in the virtual world. Figure 45 shows a runway with a width of 150 feet; figure 46 shows a runway with a width of 450 feet.

## **10.2 Modeling Parameters**

This section discusses the *modeling parameters*, as shown in figures 66 and 67. Figure 66 shows the modeling parameters group if no JCCBI datasheet is loaded; figure 67 shows the modeling parameters group if a JCCBI datasheet has been loaded. See chapter 19 for more information about OUNPPM's interface to the JCCBI. This section is divided into 3 subsections describing the component groups found in figure 60: Datasheet, Field, and DU Error.

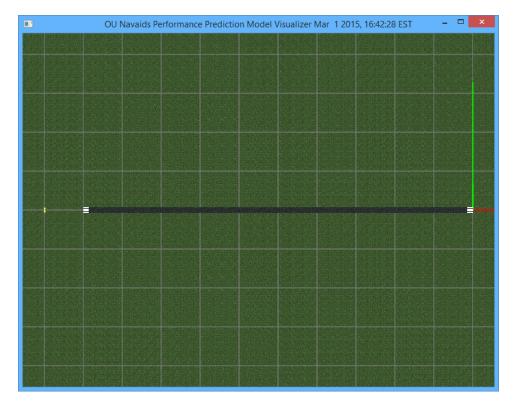


Figure 48: A runway with width 150ft.

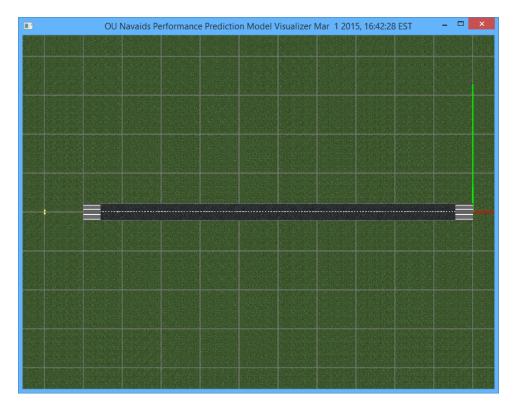


Figure 49: A runway with width of 450ft.

Modelin	g Parameters
	Most Recently Applied Airport Navaid Datasheet
	No Localizer Applied Record. Select from JCCBI Window.
	Fields to Model: Automatic v Include Random DU Errors

Figure 50: The localizer tab.

Modelin	g 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 51: The localizer tab.

## 10.2.1 Datasheet

## 10.2.1.1 Overview

The JCCBI datasheet display consists of three main components, as seen in figures 68 and 69: the view button, cancel button, and the summary box. Figure 68 shows the summary box if a no datasheet has been loaded.

Figure 69 shows an example summary box if a databox had been loaded with the KUNI JCCBI datasheet.

The view button a opens the datasheet for the currently loaded JCCBI entry in a new window, as seen in figure 70. If no JCCBI entry is currently loaded this button has no effect.

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

Most Recently Applied Airport Navaid Datasheet

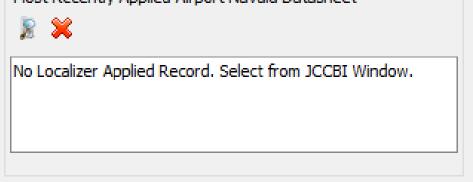


Figure 52: The datasheet group without a JCCBI datasheet loaded.

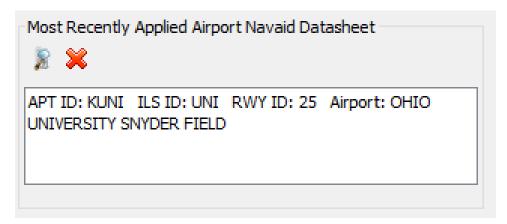


Figure 53: The datasheet group with a JCCBI datasheet loaded.

## **10.2.1.2** Effect on the Model

The JCCBI interface itself, as described in chapter 19, 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.

## 10.2.1.3 Effect on the GUI

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

## 10.2.1.4 Effect on the Virtual World

Altering the attached datasheet via The JCCBI interface itself, as described in chapter 19, will have several possible changes on the virtual world state, but viewing the JCCBI summary through these components should have no effect.

## 10.2.2 Field

## 10.2.2.1 Overview

There are two different models of scatterer field interaction: near and far. The combo box shown in figure 71 has three options: near, far, and automatic. It defaults to automatic, which will use the nearfield equations when less than some fixed number of

ate:03/12/14 16:50pm				***	ILS INQUIR	Y - ACTIVE *	* *	D.4	TUMS Horz:	NAD83 V	ert: NAVI	DSS CTRY	/: US
IRPORT: OHIO UNIV	ERSITY SN	YDER FIELD	ARPT-IE	: KUNI	RWY: 25 AL# 5861	LCTN: ATH	ENS/ALBANY	ST: 0	н	RI	G: GL	FIFO: BTL O	WN: S
* * AFIS DATA * * *												* * * AIRPORT	DATA * * *
LS-ID	UNI	GS-ALN		3.00	OM-DIS		28996	FC-ALN		1.5 - 0.5	ARP-L	AT	N39-12-42.81
PT-ID	KUNI	GS-WID		0.70	RW-BR	G	240.73	BC-ALN			ARP-LO	DN	W082-13-45.32
'H-HGT	761	TH-DIS		932	RW-LE	4	5600	UPDATE	-DIS	4700	FIELD-		765.7
E HGT	765	TH-LAT	N39	-12-56.35	COUNT	RY-CODE	US	UPDATE	-ELV_MLS	762.9	FLD-EL	LIP-ELEV	653.8 E N39-12-56.35
WY-ID	25	TH-LON	W82	-13-14.29	ACTIV	-FLAG	А	TH-ELLI	P-HGT	648.6	TH-LA		W082-13-14.29
:AT	I	DME-DIS			LC-OFF			GEOID-S	EP	111.9	TH-ELI	EV	760.5
	-12-49.61	DME-OFF			LC-DIS		4773				TH-ELI	P-ELEV	648.6 E
	-13-23.01	DME HOT			LC-FCE		240.73				RE-LAT	г	N39-12-29.28
											RE-LO	N	W082-14-16.35
S-HGT	757	FREQ		108.750	LC-BCI	3	60.72				RE-ELE		765.4
S-OFF	L259	MVAR	1	995/W06	LC-WIE	•	6.00					P-ELEV	653.5 E
**LOCALIZER **	•	(DFL C	CODE - ILS/	L)								.GTH/WIDT D-TH-DIST	5600/100
NT LAT	N39-12-2	28.76 XMT	TR	SINGLE		LOC-RE	105/ 0.017	L	CW-TAIL	NO		D-TH-LAT	
NT LON	W082-14	4-17.51 EQU	IP-TYPE	MK20A		LOC-TH	5705/ 0.939	L	W-FT-TH	598			
LEV	760.2	STB	Y-POWER			LOC-IM		D.	ATE-COMM	10/30/87		D-TH-LON	
NT-TYPE	LOG-PE	R ESV		N		LOC-MM		D.	ATE-RECON	05/15/03		D-TH-ELEV	
UAL-FREQ	NO	RES	TRICTED	Y		LOC-OM		ST	JRVEY-ACCY	8T		H-ELIP-ELEV	
IS-DIST: FC	5260/18		BC			LOC-FAF	36500/ 6.007		DICE	NONE	RWY-L TDZ-EI	.DG-LGTH	5600 764.7
LRNC-CVG:FC	90/35 15		вс				W 7.02 N 4.9		BC TYPE			ART 139	No
KPT-DESC: FC	UGS NE		50			BC			DO TTPE				
KPT-DESC: FC	UGS NL	18				BC					DECIS	ION-HEIGHTS: DIST/RALT	

Figure 54: The datasheet for KUNI loaded view the datasheet view button.

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.

Fields to Model:	Automatic 🗸 🗸 🗸	
	Automatic	
	Near	
	Far	

Figure 55: The field combo box options.

## 10.2.2.2 Effect on the Model

Can be used to force the model to use near field, or far field calculations. When set to "automatic" the model will automatically choose near or far field calculations based on a distance heuristic.

## 10.2.2.3 Effect on the GUI

This component has no effect on other GUI components.

## 10.2.2.4 Effect on the Virtual World

This selection has no effect on the virtual world.

### 10.2.3 DU Error

10.2.3.1 Overview

TODO

#### 10.2.3.2 Effect on the Model

TODO

### 10.2.3.3 Effect on the GUI

No effect on the GUI.

### 10.2.3.4 Effect on the Virtual World

No effect on the virtual world.

## **10.3** Array Parameters

This section discusses the *array parameters*, as shown in figure 57. This section is divided into 9 subsections describing the component groups found in figures 72 and 57: Element Type, Main Setback, Main Offset, Main Height, Array Rotation, and Antenna Rotation. Figure 72 shows the array parameters when both a course and clearance array are active; figure 57 show the array parameters when using an array type with only a course array.

Array Parameters				
	Course Array:		Clearance Array	:
Element Type:	LPD 🗸	<sup>1</sup> .	LPD	$\checkmark$
Main Setback:	1000.0 ft	L.	1000.0 ft	
Main Offset:	0.0 ft	L.	0.0 ft	
Main Height:	5.57 ft	L.	5.57 ft	
Array Rotation:	0.0 deg	L.	0.0 deg	
Antenna Rotation:	0.0 deg	L.	0.0 deg	
	Cleara	ance Width:	2.2 deg	
	CLR / CRS	Separation:	-17.0 dB	
	✓ <u>U</u> se Course Param	s as Clearan	ce Params	

Figure 56: The array parameters components fully activated.

	Course Array:		Clearance Ar	ray:
Element Type:	LPD v	L.	LPD	
Main Setback:	500.0 ft	<b>.</b>	500.0 ft	
Main Offset:	0.0 ft	L.,	0.0 ft	
Main Height:	5.57 ft	L.,	5.57 ft	
Array Rotation:	0.0 deg		0.0 deg	
Antenna Rotation:	0.0 deg		0.0 deg	
	Cleara	nce Width:	11.5 deg	
	CLR / CRS	Separation:	-10.0 dB	

Figure 57: The array parameters components with course array components activated only.

## 10.3.1 Element Type

## 10.3.1.1 Overview

The element type affects the element pattern which affects the directionality of the signal. Figure 58 shows the example of two different patterns. By default, the model contains 6 element types for localizers:

- LPD
- Bi-LPD
- ISO
- O-Ring
- Twin\_T
- V-Ring

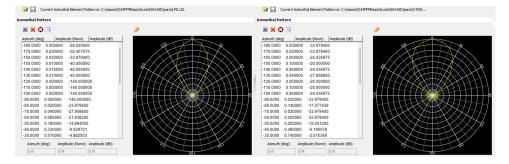


Figure 58: Left) the LPD pattern. Right) The O-Ring pattern.

The user is able to create their own element type with its own pattern using the element editor discussed in chapter 15.3.

#### 10.3.1.2 Effect on the Model

Changing the element changes the directionality of the signal which can increase or decrease the effect of the clearance array, for instance.

#### 10.3.1.3 Effect on the GUI

This has no effect on other widgets.

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

None at this time.

### 10.3.2 Main Setback

#### 10.3.2.1 Overview

The setback affects the x-coordinate of the antenna array. Because of the nomenclature, a positive "setback" is actually a translation in the negative-x direction. The array x-coordinate,  $A_x$ , can be found using equation 3.

$$A_x = -1 * (length_{runway} + setback) \tag{3}$$

#### 10.3.2.2 Effect on the Model

Adjusting the setback will also affect the value of a tailored course width.

#### 10.3.2.3 Effect on the GUI

If the arrays are locked, changing the course setback will change the clearance setback.

#### 10.3.2.4 Effect on the Virtual World

This changes the position of the corresponding array in the virtual world. Figures ?? and ?? show the virtual world with a 10,000 foot runway and an array with 2 different setbacks. Figure ?? shows a setback of 1000 feet, and figure ?? shows a setback of 1500 feet. You will notice that the 1000 foot setback (plus 10,000 foot runway) is grid cell aligned, whereas the 1500 setback is half way between cells.

### 10.3.3 Main Offset

10.3.3.1 Overview

TODO

- 10.3.3.2 Effect on the Model
- 10.3.3.3 Effect on the GUI
- 10.3.3.4 Effect on the Virtual World
- **10.3.4** Main Height
- 10.3.4.1 Overview

TODO

- **10.3.4.2** Effect on the Model
- 10.3.4.3 Effect on the GUI
- 10.3.4.4 Effect on the Virtual World
- **10.3.5** Array Rotation
- 10.3.5.1 Overview

TODO

- **10.3.5.2** Effect on the Model
- 10.3.5.3 Effect on the GUI
- 10.3.5.4 Effect on the Virtual World
- **10.3.6** Antenna Rotation
- 10.3.6.1 Overview

TODO

- **10.3.6.2** Effect on the Model
- **10.3.6.3** Effect on the GUI
- 10.3.6.4 Effect on the Virtual World
- 10.3.7 Elevation
- 10.3.7.1 Overview

If you want to see the effect of an elevated localizer, you can use this method. However, the reflecting ground plane is still even with the localizer. If you want truly elevated localizer elements, you should edit the array elements directly. It would be possible to do that here instead if it is preferable.

#### 10.3.7.2 Effect on the Model

This will effective subtract the elevation from each scatterer, maintaining a consistent reference frame.

#### 10.3.7.3 Effect on the GUI

The component does not have any effect on other components.

## 10.3.7.4 Effect on the Virtual World

This is not currently reflected in the virtual world. This may be added in the future.

## **10.3.8** Clearance Width

10.3.8.1 Overview

TODO

- 10.3.8.2 Effect on the Model
- **10.3.8.3** Effect on the GUI
- 10.3.8.4 Effect on the Virtual World
- 10.3.9 CLR / CRS Separation
- 10.3.9.1 Overview

TODO

- 10.3.9.2 Effect on the Model
- **10.3.9.3** Effect on the GUI
- 10.3.9.4 Effect on the Virtual World
- 10.3.10 Course / Clearance Lock
- 10.3.10.1 Overview

TODO

- 10.3.10.2 Effect on the Model
- 10.3.10.3 Effect on the GUI
- 10.3.10.4 Effect on the Virtual World

## 11 Glide Slope Model

This section discusses the glideslope tab, as seen in figure 59. This tab is only enabled for Glideslope models; therefore, it is mutually exclusive with the localizer and VOR 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.

## **11.1 Facility Parameters**

This section discusses the *facility parameters*, as shown in figure 60. This section is divided into 3 subsections describing the component groups found in figure 60: Array Type, Course Frequency, and CLR Frequency.

MOU Navaids Performance Prediction Model, Version: OUNPP	M.svn1885.2015.Jun.28.20.07.49.EDT.zip, UID: 5	
Save         Run Sim         Save         Save         Capture           Localizzer/Model         Glideslope         VOR Model         DME         Scatterers	CCBI Updates Report Constraints Performance Updates Report Traces	
Facility Parameters Array Type: CAPT_EFF	Modeling Parameters Most Recently Applied Airport Navaid Datasheet	
Course Frequency (MHz): 333.2	No Gildeslope Applied Record. Select from JCCBI Window. Fields to Model: Automatic Include Random DU Errors	
Array Parameters	Array Auto-Adjust	
Element Type: FA-8976	Glide Path Angle: 3.0 deg Antenna Height Ratio: 2.0 As-Is Calculate heights based on current glide-path angle Adjust Adjust setback to achieve 55' TCH at desired angle If Automatically Update Glideslope Positions on Offset Change	
Current Data File: [NEW MODEL NOT SAVED]		0

Figure 59: The glideslope tab.

Facility Parameters		
Array Type:	CAPT_EFF	]
Course Frequency (MHz):	333.2	]
CLR Frequency (MHz):	333.196 MHz	

Figure 60: The facility parameters component group.

## 11.1.1 Array Type

## 11.1.1.1 Overview

The array type selection consists of two main components, as seen in figure 61: 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.

## 11.1.1.2 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 C 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 28.

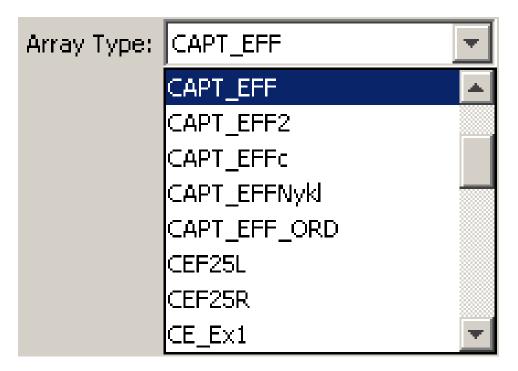


Figure 61: The array type components.

## 11.1.1.3 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 11.3. If an array is selected containing only one (1) set of elements, the clearance components will become deactivated, as seen in figure 57; if an array is selected containing both sets of elements all components will be active, as seen in figure 72. Similarly, the CLR Frequency component will also be deactivated when only the course array is used, as seen in figure 65; if an array is selected containing both sets of elements will be active as seen in figure 64.

## 11.1.1.4 Effect on the Virtual World

The depiction of the array in the virtual world is shown in figure 62. 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.

## 11.1.2 Center Frequency

## 11.1.2.1 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 63.

## 11.1.2.2 Effect on the Model

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

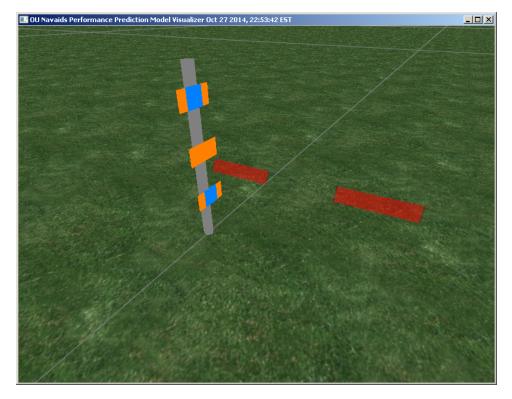


Figure 62: The array in the virtual world.

Course Frequency (MHz):	333.2
	333.2 🔼
	333.35
	333.5
	333.65
	333.8
	333.95
	334.1
	334.25 🗾

Figure 63: The center frequency component.

## 11.1.2.3 Effect on the GUI

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

## 11.1.2.4 Effect on the Virtual World

This component has no effect on the virtual world.

## 11.1.3 CLR Frequency

#### 11.1.3.1 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

CLR Frequency (MHz): 109.696 MHz

Figure 64: The clearance frequency component.

Figure 64 shows the CLR Frequency component when it is active. Figure 65 shows the CLR Frequency component when it is deactivated.



Figure 65: 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 10.3, as seen in figure 38, 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.<sup>#</sup>

#### 11.1.3.2 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 10.1.2. The clearance frequency,  $v_-$  is specified by the value in this component. Equations (4) and (5) provide two (2) separate derivations for the course frequency,  $v_+$ .

$$v_{+} = v_{c} + (v_{c} - v_{-})$$
 (4)

$$\mathbf{v}_{+} = 2\mathbf{v}_{c} - \mathbf{v}_{-} \tag{5}$$

#### 11.1.3.3 Effect on the GUI

This component has no effect on the other GUI widgets.

#### 11.1.3.4 Effect on the Virtual World

This component has no effect on the virtual world. s

## **11.2 Modeling Parameters**

This section discusses the *modeling parameters*, as shown in figures 66 and 67. Figure 66 shows the modeling parameters group if no JCCBI datasheet is loaded; figure 67 shows the modeling parameters group if a JCCBI datasheet has been loaded. See

chapter 19 for more information about OUNPPM's interface to the JCCBI. This section is divided into 3 subsections describing the component groups found in figure 60: Datasheet, Field, and DU Error.

Modelin	g Parameters
	Most Recently Applied Airport Navaid Datasheet
	No Localizer Applied Record. Select from JCCBI Window.
	Fields to Model: Automatic V Include Random DU Errors

Figure 66: The localizer tab.

Modelin	ig 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 67: The localizer tab.

## 11.2.1 Datasheet

## 11.2.1.1 Overview

The JCCBI datasheet display consists of three main components, as seen in figures 68 and 69: the view button, cancel button, and the summary box. Figure 68 shows the summary box if a no datasheet has been loaded.

Figure 69 shows an example summary box if a databox had been loaded with the KUNI JCCBI datasheet.

Most Recently Applied Airport Navaid Datasheet

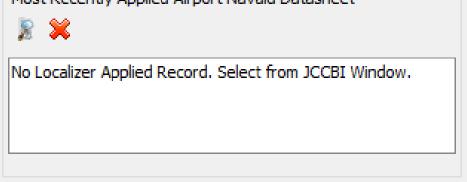


Figure 68: The datasheet group without a JCCBI datasheet loaded.

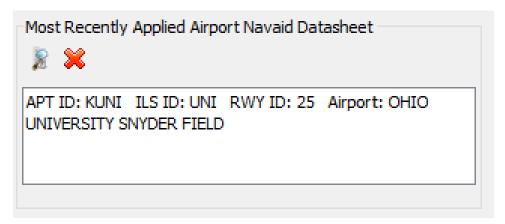


Figure 69: The datasheet group with a JCCBI datasheet loaded.

The view button so opens the datasheet for the currently loaded JCCBI entry in a new window, as seen in figure 70. If no JCCBI entry is currently loaded this button has no effect.

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

## 11.2.1.2 Effect on the Model

The JCCBI interface itself, as described in chapter 19, 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.

## 11.2.1.3 Effect on the GUI

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

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

Altering the attached datasheet via The JCCBI interface itself, as described in chapter 19, will have several possible changes on the virtual world state, but viewing the JCCBI summary through these components should have no effect.

Date:03/12/14 16:5	0pm				***	ILS INQUIR	Y - ACTIVE *	• •		DATUMS Horz:	NAD83 V	ert: NAVI	088 CTRY	r: US
AIRPORT: OHIO	UNIVER	SITY SNYE	DER FIEL	D ARPT-II	D: KUNI	RWY: 25 AL# 5861	LCTN: ATH	ENS/ALBANY	ST	: OH	RI	E <b>G</b> : GL	FIFO: BTL O	WN: S
* * * AFIS DATA	***												* * * AIRPORT	DATA * * *
ILS-ID		UNI	GS-ALN		3.00	OM-DIS		28996	FC-AI	.N	1.5 - 0.5	ARP-L	АT	N39-12-42.81
APT-ID		KUNI	GS-WID		0.70	RW-BR	G	240.73	BC-AI	LN .		ARP-LO		W082-13-45.32
TH-HGT		761	TH-DIS		932	RW-LE	N	5600	UPDA	TE-DIS	4700	FIELD-		765.7
RE HGT		765	TH-LAT	N39	-12-56.35	COUNT	RY-CODE	US	UPDATE-ELV_MLS 7			TH-LA	.IP-ELEV T	653.8 E N39-12-56.35
RWY-ID		25	TH-LON	WS	1-13-14.29	ACTIV	E-FLAG	А	TH-ELLIP-HGT		648.6	TH-LO		W082-13-14.29
CAT		I	DME-DIS		LC-OFF		,		GEOII	D-SEP	111.9	TH-ELI	ev	760.5
GS-LAT	N39-12-49.61 DME-OFF		F		LC-DIS		4773				TH-ELI	P-ELEV	648.6 E	
GS-LON	W082-13	3-23.01	DME HG	т	LC-FC			240.73				RE-LAT		N39-12-29.28
GS-HGT		757	FREO		108.750 LC-BC		B 60.72						4	W082-14-16.35
GS-OFF			MVAR		1995/W06	LC-WI					RE-ELE RE-ELI			765.4 653.5 B
CO-OFF			MITAIC			20-11		0.00					.GTH/WIDT	5600/100
* * * LOCALIZEI	***		(D)	FL CODE - ILS	/L)							DSPLC	D-TH-DIST	
ANT LAT		N39-12-28	.76 3	IMTR	SINGLE		LOC-RE	105/ 0.017		LCW-TAIL	NO	DSPLC	D-TH-LAT	
ANT LON		W082-14-1	17.51 E	QUIP-TYPE	MK20A		LOC-TH	5705/ 0.939		LCW-FT-TH	598	DSPLC	D-TH-LON	
ELEV		760.2	5	TBY-POWER			LOC-IM			DATE-COMM	10/30/87	DSPLC	D-TH-ELEV	
ANT-TYPE		LOG-PER	E	sv	N		LOC-MM			DATE-RECON	05/15/03		H-ELIP-ELEV	
DUAL-FREQ		NO	F	RESTRICTED	Y		LOC-OM			SURVEY-ACCY	8T		DG-LGTH	5600
US-DIST: FC		5260/ 18.0		BC			LOC-FAF	36500/ 6.007		VOICE	NONE	TDZ-EI	LEV	764.7
CLRNC-CVG:FC		90/35 150/	35	BC			MON-AL-WID	W 7.02 N 4.9	8	REC TYPE		FAR P	ART 139	No
CKPT-DESC: FC		UGS NDB					BC					DECIS	ION-HEIGHTS:	
LOC-WIDTH-MX-		6.61/	6.20		100.41	AX-ALERT:		ROLLOUT:	NR			DH	DIST/RALT	

Figure 70: The datasheet for KUNI loaded view the datasheet view button.

## 11.2.2 Field

## 11.2.2.1 Overview

There are two different models of scatterer field interaction: near and far. The combo box shown in figure 71 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.

Fields to Model:	Automatic 🗸 🗸
	Automatic
	Near
	Far

Figure 71: The field combo box options.

## 11.2.2.2 Effect on the Model

Can be used to force the model to use near field, or far field calculations. When set to "automatic" the model will automatically choose near or far field calculations based on a distance heuristic.

## 11.2.2.3 Effect on the GUI

This component has no effect on other GUI components.

### 11.2.2.4 Effect on the Virtual World

This selection has no effect on the virtual world.

## **11.3** Array Parameters

This section discusses the *array parameters*, as shown in figure 72. This section is divided into 6 subsections describing the component groups found in figure 60: Element Type, Main Setback, Main Offset, Array Rotation, Clearance Width, CLR/CRS Separation.

Array Parameters	
Element Type:	FA-8976
Main Setback:	1000.0 ft
Main Offset:	400.0 ft
Array Rotation:	0.0 deg
Clearance Width:	0.7 deg
CLR/CRS Separation:	1.0 dB

Figure 72: The array parameters components.

## **11.3.1** Element Type

#### 11.3.1.1 Overview

Select the glideslope element type to be used for all glideslope antennas from the drop-down list as shown in figure 73.

#### 11.3.1.2 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 glideslope signal.

#### 11.3.1.3 Effect on the GUI

This component has no effect on other GUI components.

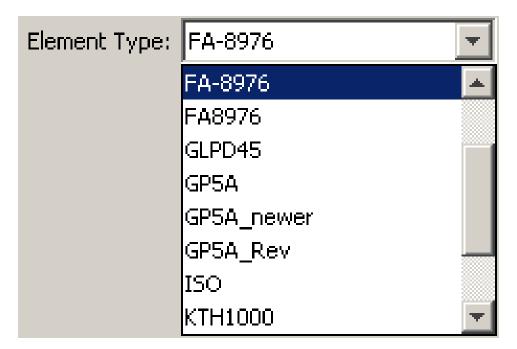


Figure 73: The Element Type component.

## 11.3.1.4 Effect on the Virtual World

This component has no effect on the virtual world.

## 11.3.2 Main Setback

## 11.3.2.1 Overview

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

## **11.3.2.2** Effect on the Model

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

## 11.3.2.3 Effect on the GUI

This component has no effect on other GUI components.

## 11.3.2.4 Effect on the Virtual World

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

## 11.3.3 Main Offset

## 11.3.3.1 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.

### 11.3.3.2 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.

### 11.3.3.3 Effect on the GUI

This component has no effect on other GUI components.

#### 11.3.3.4 Effect on the Virtual World

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

## 11.3.4 Array Rotation

#### 11.3.4.1 Overview

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

#### 11.3.4.2 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.

#### 11.3.4.3 Effect on the GUI

This component has no effect on other GUI components.

#### 11.3.4.4 Effect on the Virtual World

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

### 11.3.5 Clearance Width

#### 11.3.5.1 Overview

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

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

Initial value for the clearance width is 0.7deg.

### 11.3.5.3 Effect on the GUI

This component has no effect on other GUI components.

### 11.3.5.4 Effect on the Virtual World

This component has no effect on the virtual world.

## 11.3.6 CLR / CRS Separation

## 11.3.6.1 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.

## 11.3.6.2 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.

## 11.3.6.3 Effect on the GUI

This component has no effect on other GUI components.

## 11.3.6.4 Effect on the Virtual World

This component has no effect on the virtual world.

## 11.4 Array Auto-Adjust

This section discusses the *array auto-adjust* This section is divided into 6 subsections describing the component groups found in figure 60: 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: 3.0 deg
Antenna Height Ratio: 2.0
As-Is Calculate heights based on current glide-path angle
Adjust Adjust setback to achieve 55' TCH at desired angle
Automatically Update Glideslope Positions on Offset Change

Figure 74: The array auto-adjust components.

## 11.4.1 Glide Path Angle

## 11.4.1.1 Overview

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

#### 11.4.1.2 Effect on the Model

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

#### 11.4.1.3 Effect on the GUI

This component has no effect on other GUI components.

#### 11.4.1.4 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.

#### 11.4.2 Antenna Height Ratio

#### 11.4.2.1 Overview

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

#### 11.4.2.2 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  $H_u a$  will be set based on the Lower antenna height  $H_l a$  and the Antenna Height Ratio  $R_a h$  according to the following formula:

$$H_{ua} = H_{la} * (3 * \frac{R_{ah}}{2}) \tag{6}$$

#### 11.4.2.3 Effect on the GUI

This component has no effect on other GUI components.

#### 11.4.2.4 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.

#### 11.4.3 'As-Is' Button

#### 11.4.3.1 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.

#### **11.4.3.2** 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  $H_u a$  will be set as follows:

$$H_{ua} = H_{la} * R_{ah} \tag{7}$$

For a Capture-Effect system, the Middle  $H_m a$  and Upper  $H_u a$  antenna heights will be set as follows:

$$H_{ma} = H_{la} * R_{ah} \tag{8}$$

$$H_{ua} = H_{la} * (3 * \frac{R_{ah}}{2}) \tag{9}$$

#### 11.4.3.3 Effect on the GUI

This component has no effect on other GUI components.

#### 11.4.3.4 Effect on the Virtual World

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

#### 11.4.4 'Adjust' Button

#### 11.4.4.1 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.

#### 11.4.4.2 Effect on the Model

The new glideslope tower location is calculated as follows:

$$SB = \frac{55'}{tan(\theta_{gp})} \tag{10}$$

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

#### 11.4.4.3 Effect on the GUI

This component has no effect on other GUI components.

#### 11.4.4.4 Effect on the Virtual World

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

#### 11.4.5 'Automatically Adjust Antenna Offsets for Main Offset' Button

#### 11.4.5.1 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.

#### **11.4.5.2** 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.

#### 11.4.5.3 Effect on the GUI

This component has no effect on other GUI components.

### 11.4.5.4 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 the localizer and VOR models.

## 12 VOR Model

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

## **13** Scatterers

This section describes the widgets on the scatterers tab.

## 13.1 Scatterer Group

### **13.1.1** Plate Group Editor

There are two ways to access the plate editor. To edit a scatterer group, such as the Boeing 707, one may click the *Plate Group Editor* Button located in this section as shown in Fig. 75. Alternatively, one may click the *Edit Selected* button when the desired scatterer group is selected within the main table, see Fig. 75.

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Localize	r Model	Glideslope	VOR Mod	el DME	Scatterers	Flight
Plate	Scatterer					
	Plate Group	<b>~</b>		oup Editor	Group	
Group	Scattere	rs				
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	In Use		Туре		5catterer	D
	V	IP		./para	707.psc	707 (PA

Figure 75: 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 76 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), or VOR, 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 accidently overwrite existing scatterers. Saving each scatterer using a unique filename will ensure this.* 

🕌 Scatter G	oup Editor ./	/para/707.psc							_1	
Qpen	H Save	🔶 Presets	Presets Horiz. Image Ve		Plate Type: • LS (LOC/GSS) C VOR C DME/P (ILS) C DME/N (VOR)         X2(ft)       Y2(ft)       Base Elevati       Height(ft)       Tilt Angle(deg)       Comment         67.5 ft       0.0 ft       4.4 ft       15.0 ft       0.0 deg       707 fuselage         45.6 ft       0.0 ft       19.4 ft       5.6 ft       0.0 deg       707 tail sect         50.3 ft       0.0 ft       25.0 ft       5.6 ft       0.0 deg       707 tail sect         57.9 ft       0.0 ft       30.6 ft       5.6 ft       0.0 deg       707 tail sect         57.9 ft       0.0 ft       4.4 ft       5.6 ft       0.0 deg       707 tail sect         42.5 ft       0.0 ft       4.4 ft       5.6 ft       0.0 deg       707 tail sect         42.5 ft       0.0 ft       4.4 ft       5.6 ft       0.0 deg       707 tail sect         42.5 ft       0.0 ft       4.4 ft       5.6 ft       0.0 deg       707 tail sect       #         CrtH-Click or Shift-Click multiple rows to form a Group for transformation.         CrtH-Click or Shift-Click multiple rows to form a Group for transformation.         Plate Transformations         Motot Selected Plates:         • About Selected Group's Center       Angle					
+ *					Plate Typ	e: 🛈 115 (LOC	(GS) C VOR	C DME/P (ILS)	O DME/N (V	OR)
Туре	Material	×1(ft)	¥1(ft)	X2(ft)	¥2(ft)	Base Elevati	Height(ft)	Tilt Angle(deg)	Comment	
Add	Steel	-67.5 ft	0.0 ft	67.5 ft	0.0 ft	4.4 ft	15.0 ft	0.0 deg	707 fuselage	
Add	Steel	-66.8 ft	0.0 ft	-45.6 ft	0.0 ft	19.4 ft	5.6 ft	0.0 deg	707 tail sect	
Add	Steel	-67.8 ft	0.0 ft	-50.3 ft	0.0 ft	25.0 ft	5.6 ft	0.0 deg	707 tail sect	
Add	Steel	-68.7 ft	0.0 ft	-53.7 ft	0.0 ft	30.6 ft	5.6 ft	0.0 deg 1	707 tail sect	
Add	Steel	-70.4 ft	0.0 ft	-57.9 ft	0.0 ft	36.2 ft	5.6 ft	0.0 deg	707 tail sect	
Subtract	Steel	-67.5 ft	0.0 ft	-42.5 ft	0.0 ft	4.4 ft	5.6 ft	0.0 deg	707 tail cone	
Add	Steel	67.5 ft	0.0 ft	-67.5 ft	0.0 ft	4.4 ft	15.0 ft	0.0 deg	707 fuselage	
Add	Steel	-45.6 ft	0.0 ft					0.0 deg	707 tail sect	Ţ
Desc Reference Refere	Frame Param nce Frame: G	RA, TAIL TOWA neters Threshold Offs Latitude / Long Lat North	et (LTP) jitude : 39.2156515 d : -82.2206362 d		Rotate : Translat	Selected Plate C Aboul Aboul Angle (D X / East: Y / North: Z / Elev:	: Origin : Scatterer Cent : Selected Group egrees ccw): 0 ates: 0.0 ft 0.0 ft 0.0 ft	o's Center		
Viewing Op	tions				i iouiry .					
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Figure 76: The *Scatterer Group Editor* opens a window enabling creation/modification of Scatterer groups.

#### 13.1.1.1 The Toolbar

**13.1.1.1.0.0.1 Open** Pressing the button will open a file browser as shown in figure 79. When you select a .psc file to open, one row will be added to the scatterer editor table for each each scatterer plate in the scatterer group. If there are already scatterer plates in the table when a file is loaded, the new plates will be appended into the tables bottommost rows.

**13.1.1.1.0.0.2** Save Pressing the **Ind** button will open a file browser as shown in figure **??**.

You can select an existing plate scatterer to save over it; you will be prompted to confirm as seen in figure **??**. Selecting "Yes" or (pressing Alt+Y) will overwrite the existing file, which is an irreversible operation; selecting "No" will return to the save dialog. Alternatively, you can enter a new name into the dialog box; if the manually entered name does not end in .psc, it will be appended.

**13.1.1.1.0.0.3 Presets** There are two "cookie cutter" scatterers that can be created to model advanced objects: the ellipse and the wind turbine.

				Scatter	Group Editor	-			-				
		Presets				•		dit Plate Scatte					
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╋ <b>*</b> # ⊞					Plate Type	:      ILS (LOC)	GS) OVOR	O DME/P (ILS	) O DME/N (VC				
Туре	Material	X1(ft)	Y1(ft)	X2(ft)	Y2(ft)	Base Elevat	. Height(ft)	Tilt Angle(d	Comment				
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Descriptio	_		727.psc		Aus C VB	B.psc							
o coo po			727_DME.	psc	Aus_D_VB	7.psc							
	D	esktop	727_VOR.		Aus_E_VB6			l.psc					
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Viewing Option	۲ <u> </u>	_											
	Move To	Selected Sca	itterer			Reverse	vormal	Flip About	Red Axis				
	-	wards Selecte				Recomput	e Origin	Flip About G	ireen Axis				
	Ap	ply View Char	nae				-						
		and a second											

Figure 77: Open scatterer dialog.

2		Scatter Grou	p Editor ./para/1.test.psc	_ 🗆 🗡
Open	Pres Save	ets Noriz. Image Vert. Image	age 3D Navigator Capture 3D	Edit Plate Scattere
+*8			Plate Type:   ILS (LOC/GS)   VOR	DME/P (ILS) OME/N (VOR)
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	This PC	777-200.psc A320.psc A330-200.psc	Aus_G_VB6.PSC ConcN Aus_H_VB6.PSC cube.p	/ix.PSC
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	Move To Selecter	d Scatterer	Reverse Normal	Hip About Red Axis
	<ul> <li>Hove To Selecte</li> <li>Look Towards Se</li> </ul>		Recompute Origin	Flip About Green Axis
	Apply View	Change		

Figure 78: Open scatterer dialog.

## 13.1.1.1.0.1 Ellipse

The lefthand tab, as seen in Figure 80, 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. An example of a complex

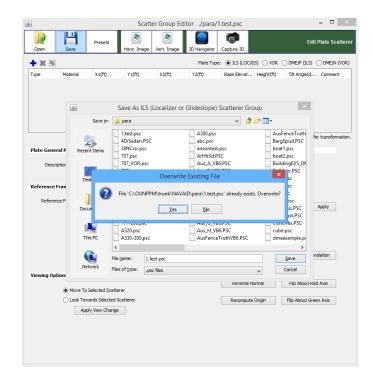


Figure 79: Open scatterer dialog.

ellipse is shown in Figure 81. This example was created with the first origin at 0,0 and the first radii set to 250, with the second origin at 1000,0 and the second radii set to 500.

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.

**13.1.1.1.0.1.4** 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.

**13.1.1.1.0.1.5 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 facts of the cylinder is illuminated.

**13.1.1.0.1.6 Make Horizontal Cylinder** Effectively rotates the entire cylinder 90 degrees.

#### 13.1.1.1.0.2 Windmill

The righthand tab, as seen in Figure 92, controls the preset that allows for easy creation of windmills. The following describe each text box and check box on this page.

<u>\$</u>			- 🗆 🗙
Ellipse Windmill			
	(X,Y)	270°	0° Y X 90° 180°
Origin - X	0.0 ft	Origin - Y	0.0 ft
Axis - A	0.0 ft	Axis - B	0.0 ft
Origin - X2	0.0 ft	Origin - Y2	0.0 ft
Axis - A2	0.0 ft	Axis - B2	0.0 ft
Angle Start	0.0 deg	Angle Stop	360.0 deg
Rotation Angle	0.0 deg	Height is vertical reg	pardless of angle
Number of Segments	3.0	Illuminate outside	
Base Elevation	0.0 ft	Make Horizontal Cyli	inder
Plate Height	0.0 ft		
Plate Tilt	0.0 ft		

Figure 80: The ellipse preset window.

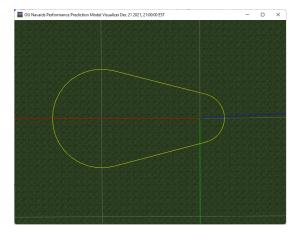


Figure 81: The ellipse preset window.

**13.1.1.1.0.2.7 Preset Wind Turbine** The model contains several built-in windmills based on publicly released specifications. You can select an entry from the drop down list to populate all the parameters in the following sections.

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.
- 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.
- Siemans 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 uses width of Vestas V90-2.0MW (probably too small).

This list can be extended by the user by editing the file located at "/para/WindTurbinePresets.CSV". This file can be edited via any text editor, or in Microsoft Excel. Figure 82 shows an example of this file on in Microsoft Excel.

*NOTE:* This file is currently overwritten on updates so any additions will not be saved. This will be resolved in a future update.

There is one entry for each of the following sections, as well as two for organizational purposes.

**Name** The name that appears in the drop down list; uniqueness is not enforced, but is recommended.

**Description** This section incomplete.

**13.1.1.1.0.2.8 Go** Pressing this button will populate the field below. This action needs confirmed.

**13.1.1.1.0.2.9** + Pressing this button will add the current values to the preset spreadsheet.

This action needs confirmed.

) <u>M</u> n - (n - ) =										WindTurb	inePresets.CS	/ - Micros	oft Excel												
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ste J Format Painter	I U - 🖽	- 3.	- A -		en en ini	Merge & Cent	er - S -	· · · A /	(Conditional	Format	Check Cell	Explana	ory Inp	ıt		Note		in in	sert Deleti	Format	FIL*	Sort-&	Find &		
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A		D	E	F	G		1	J	K	L	M	N	0	Р	Q	R	S	т	U	v	W	х	Y	Z	A
											h NumBlades														
Vestas V110-2.0 MW	0		311.68		13.779528			0	11.48294	34.1207		0													
Vestas V100-2.6 MW	0		311.68		13.779528			0	11.48294	34.1207		0													
Vestas V100-2.0 MW	0		262.4672		13.779528			0	12.631234	31.6601		0													
Vestas V100-1.8 MW	0		262.4672		13.779528			0	11.154856	34.1207		0													
Vestas V90-3.0 MW	0		195.8504	0		0		0	12.631234	31.6601															
Vestas V90-2.0 MW	0		262.4672	0		0		0	11.48294	34.1207															
Goldwind \$70/1500	0		213.2546		13.779528			0	11.48294	34.1207					0										
Enercon E-48 / 800kW Siemans SWT-2.3-108	0		164.042		13.779528 13.779528			0	11.48294	34.1207 34.1207		0			0										
Siemans SW1-2.3-108	0	0	164.042	0	13.779528	20.341208	13.779528	0	11.48294	34.1207	56 5	0	1/3.8845.	11,48294	0										

Figure 82: The windmill preset file being edited in Microsoft Excel.

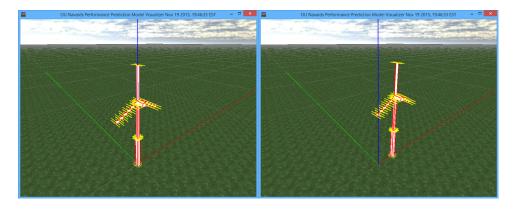


Figure 83: Left) A Windmill at the origin. Right) A windmill with an embedded x offset of 100.

**13.1.1.1.0.2.10 X Offset** This value embeds as X offset into the model. It is recommended that a scatterer be positioned around (0,0), but in case you want an x offset it can be put here.

Figure 83 shows the difference between a windmill with an x offset of 0, and a windmill with an x offset of 100.

**13.1.1.1.0.2.11 Y** Offset This value embeds as X offset into the model. It is recommended that a scatterer be positioned around (0,0), but in case you want an x offset it can be put here.

Figure 84 shows the difference between a windmill with an y offset of 0, and a windmill with an y offset of 100.

**13.1.1.1.0.2.12 Height** The height value represents the z-axis height of the base from ground to bottom of the nacelle (the model assumes the nacelle rests strictly on top of the base).

Figure 85 shows the difference between the default windmill with height 344.5ft (105m) and one with half the height. Notice, this effects only the height of the base, the blade lengths and nacelle size are the same.

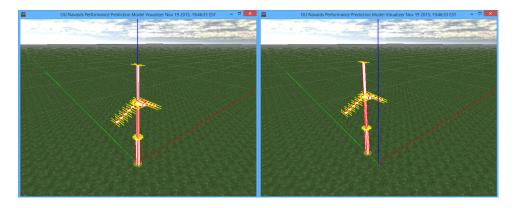


Figure 84: Left) A Windmill at the origin. Right) A windmill with an embedded y offset of 100.

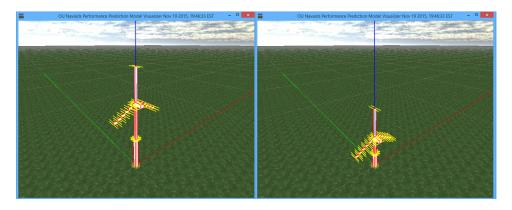


Figure 85: Left) The default windmill. Right) A windmill with half height.

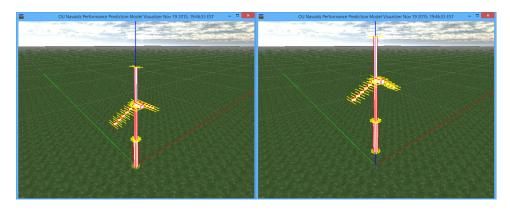


Figure 86: Left) The default windmill at base elevation 0. Right) A windmill with base elevation 100.

**13.1.1.1.0.2.13 Base Elevation** The base elevation moves the lowest point of the windmill model up (positive values) or down (negative values) in the z direction.

Figure 86 shows the difference between a windmill with a base elevation of 0, and a windmill with a base elevation of 100.

**13.1.1.1.0.2.14 Base Width** The base width of the bottom half of the vertical support. The main support structure is split into two halves, this value only controls the bottom half. To adjust the top half refer to the "top width" values (section 13.1.1.1.0.2.16).

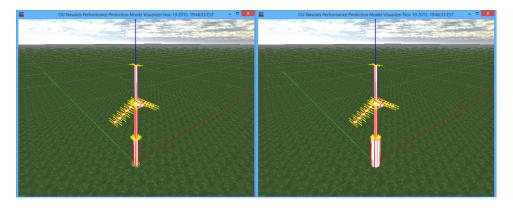


Figure 87: Left) The default windmill with base width of 22.6ft. Right) A windmill with base width of 45.2ft.

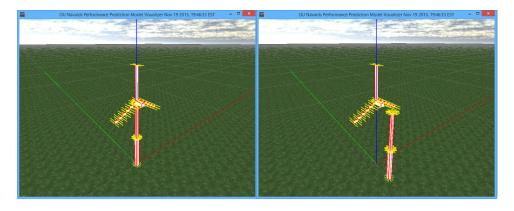


Figure 88: Left) The default windmill with base offset of 0. Right) A windmill with base offset of 100.

Figure 87 shows the difference between a windmill with a base width of 22.6ft (6.89m), and a windmill with a base width of 45.2ft.

**13.1.1.1.0.2.15 Base Offset** This value adds a -y offset to the vertical support. This will create a separation between nacelle and the support unless the nacelle length is also changed. This also means that the support will no longer be at the world space point specified in the main scatterer table, unless an equal and opposite y offset is embedded.

Figure 88 shows the difference between a windmill with a base offset of 0, and a windmill with a base width of 100.

**13.1.1.1.0.2.16** Top Width This value adjusts the width of the top half of the vertical support. The main support structure is split into two halves, this value only controls the top half. To adjust the bottom half refer to the "base width" values (section 13.1.1.1.0.2.14).

Figure 89 shows the difference between a default windmill with a top width of 14.1ft (4.3m), and a windmill with a base width of 28.2ft (8.6m).

**13.1.1.1.0.2.17 Heading** This value adjusts the rotation angle of the windmill. Rotations are counter-clockwise.

Figure 91 shows the difference between a default windmill and a windmill rotated 45°.

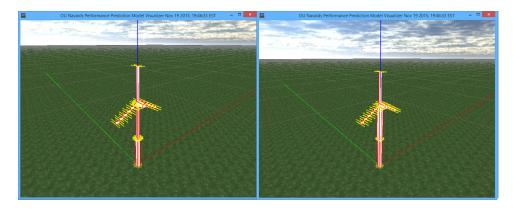


Figure 89: Left) The default windmill with top width of 14.1ft. Right) A windmill with top width of 28.2ft.

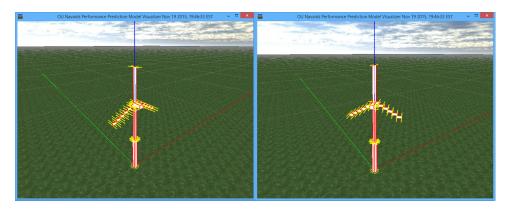


Figure 90: Left) The default windmill position. Right) The windmill rotated 45°.

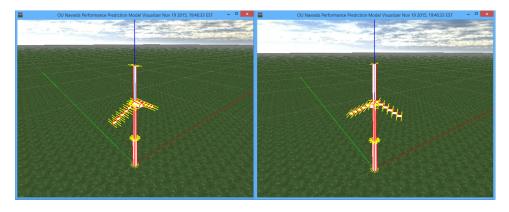


Figure 91: Left) The default windmill with nacelle radius . Right) The windmill rotated  $45^\circ.$ 

**13.1.1.1.0.2.18** Nacelle Radius This value adjusts the width of the nacelle of the windmill (the horizontal portion). The main support structure is split into two halves, this value only controls the top half. To adjust the bottom half refer to the "base width" values (section 13.1.1.1.0.2.14).

Figure 91 shows the difference between a default windmill and a windmill rotated  $45^{\circ}$ .

13.1.1.1.0.2.19 Nacelle Length This section incomplete.

13.1.1.1.0.2.20 Number of Blades This section incomplete.

13.1.1.1.0.2.21 Rotation Angle This section incomplete.

13.1.1.1.0.2.22 Blade Length This section incomplete.

13.1.1.1.0.2.23 Blade Width This section incomplete.

13.1.1.1.0.2.24 Revolutions per Minute This section incomplete.

**13.1.1.1.0.2.25 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.

**13.1.1.1.0.2.26** Use cylindrical base If this is checked a cylindrical base is used, otherwise it is rectangular.

**13.1.1.1.0.2.27** Facing Array This check box is mutually exclusive with the box in section 13.1.1.1.0.2.28. Rotates the windmill such that the nacelle point along the vector from the antenna array towards the windmill offset.

**13.1.1.1.0.2.28 Parallel to flight path** This check box is mutually exclusive with the box in section 13.1.1.1.0.2.27. 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.

**13.1.1.1.0.2.29** Horizontal 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.

13.1.1.1.0.2.30	Vertical Pull Fi	rom Image	This section is incomplete.	
13.1.1.1.0.2.31	3D Navigator	This section	is incomplete.	

13.1.1.1.0.2.32 Capture 3D This section is incomplete.

<u>é</u>			
Ellipse Wind Tur	bine		
Base Top Width	-	Nacelle Rot. Ang. Length Radius	Other
Preset Wind Tu	irbine: Vest	a 2000	▼ <u>Go</u> +
X Offset	0 ft	Y Offset	0 ft
Height	344.5 ft	Base Elevation	0 ft
Base Width	22.6 ft	Base Offset	0 ft
Top Width	14.1 ft	Heading	0.0 deg
Nacelle Radius	7.5 ft	Nacelle Length	41.3 ft
# of Blades	3.0	Rotation Angle	0.0 deg
Blade Length	148.0 ft	🔽 Draw both sid	des of rotor blades
Blade Width	14.3 ft	🔽 Use cylindrica	al base
Rev / Min	0.0	🥅 Facing array	
		🔲 Parallel to flig	jht path

Figure 92: The windmill preset window.



Figure 93: Add plates by pulling from image.

#### **13.1.1.2** The Table

This section

### 13.1.1.2.0.0.1 For All Types

🛓 Scatter G	roup Editor							-		×
<b>Open</b>	H Save	Presets	Noriz. Image	Street. Image	3D Navigator	Capture 3D		Edit	Plate Sca	atterer
<b>+ *</b>					Pl	ate Type: 🧿 ILS (	oc/gs) 🔿 v			(VOR)
Type Add Add	Material Steel Steel	X1(ft) 0.0 ft 0.0 ft	Y1(ft) 0.0 ft 0.0 ft	X2(ft) 0.0 ft 0.0 ft	Y2(ft) 0.0 ft 0.0 ft	Base Elevati. 0.0 ft 0.0 ft	Height(ft) 1.0 ft 1.0 ft	Tilt Angle(deg) 0.0 deg 0.0 deg	Comment	
Permiability (µ	) 0.0	Permitivity (a	) 0.0	Conductivity (	Σ) 0.0 Plate Transfo		-Click multiple n	ows to form a Group fc	r transform	nation.
		rs		_		elected Plates:				
Reference	C	Threshold Offs ) Latitude / Long Lat North	itude : 39.2156515 de : -82.2206362 d			E Selected Plates:           X / East:         0.0 f           Y / North:         0.0 f           Z / Elev:         0.0 f	terer Center cted Group's Ce is ccw): 0.0 de t			
Viewing Op	tions				Modify Se	elected Plates:				
	O Look Tov	Selected Scatte wards Selected S ply View Change	catterer			Reverse Norm		Flip About Red Axis		

Figure 94: The scatterer plate editor table for localizer and glideslope scatterers.

### 13.1.1.2.0.0.2 Localizer and Glideslope

13.1.1.2.0.0.3 Type Possible values are:

1. IP

13.1.1.2.0.0.4 Material The following materials are selectable for scatterers.

- Steel
- Aluminum
- Concrete
- Brick
- Vinyl

- Glass
- Plexigas
- Wood
- Trees
- Rock
- Soil

Each material specifies a relative permeability ( $\mu$ ), relative permittivity ( $\varepsilon$ ), and slab conductivity ( $\sigma$ ), which can be found below.

- $\mu_{Steel}$  2000.0
- μ<sub>Aluminum</sub> 1.00002
- *μ<sub>Concrete</sub>* 1.0
- μ<sub>Brick</sub> 1.0
- $\mu_{Vinyl}$  1.0
- $\mu_{Glass}$  1.0
- *µ*<sub>Plexigas</sub> 1.0
- μ<sub>Wood</sub> 1.0
- μ<sub>Trees</sub> 1.0
- $\mu_{Rock}$  1.0
- *µSoil* 1.0
- ε<sub>Steel</sub> 1.0
- *E*<sub>Aluminum</sub> 1.0
- *E*<sub>Concrete</sub> 10.0
- *ε*<sub>Brick</sub> 10.0
- ε<sub>Vinyl</sub> 2.8
- *ε*<sub>*Glass*</sub> 6.0
- *ε*<sub>Plexigas</sub> 3.4
- ε<sub>Wood</sub> 2.1
- *ε*<sub>Trees</sub> 12.0
- ε<sub>Rock</sub> 10.0
- *εsoil* 5.0
- $\sigma_{Steel}$  2.0e+6
- *σ*<sub>*Aluminum*</sub> 3.96e+7

- *σ*<sub>Concrete</sub> 1.0e-4
- σ<sub>Brick</sub> 0.5e-5
- σ<sub>Vinyl</sub> 1.0e-14
- *σ<sub>Glass</sub>* 1.0e-12
- *σ<sub>Plexigas</sub>* 5.1e-3
- *σ*<sub>Wood</sub> 8.0e-3
- σ<sub>Trees</sub> 2.0e-3
- *σ<sub>Rock</sub>* 2.0e-3
- *σ*<sub>Soil</sub> 1.0e-3

**13.1.1.2.0.0.5 Scatterer** This element shows the path to the scatter information for this row.

This section is incomplete.

**13.1.1.2.0.0.6 Description** The user-entered description for this scatterer. This can be

This section is incomplete.

13.1.1.2.0.0.7	X Offset	This section is incomplete.
13.1.1.2.0.0.8	Y Offset	This section is incomplete.
13.1.1.2.0.0.9	Z Offset	This section is incomplete.
13.1.1.2.0.0.10	Angle	This section is incomplete.
13.1.1.2.0.0.11	Iterate	This section is incomplete.

In Use Type Scatterer Description N Offset (ft) E Offset (ft) Z Offset (ft) Angle(deg) Iterate

Figure 95: The scatterer editor table for VOR scatterers.

13.1.1.2.0.0.12 VOR

Plate Transformations					
Rotate Selected Plates:					
About Origin					
C About Scatterer Center					
C About Selected Group's Center					
Angle (Degrees ccw): 0.0 deg Apply					
Translate Selected Plates:					
X / East: 0.0 m					
Y / North: 0.0 m					
Z / Elev: 0.0 m Apply Translation					
Modify Selected Plates:					
Reverse Normal Flip About Red Axis					
Recompute Origin Flip About Green					

Figure 96: The operations that may be applied to a plate or group of plates.

Figure 96 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.

Figure 97 shows an example of a VOR scatterer. VOR scatterers have an additional parameter that lets the user set a ground plane for terrain differences near the VOR itself. These are indicated by the small green planes beneath the white scatterer plates.

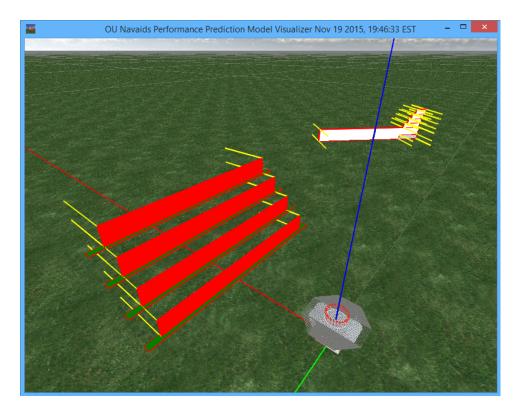


Figure 97: An example of a VOR scatterer with ground planes.

- 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  $(100, \vec{1}00, 0)$ ; pressing *Recompute Origin* will then adjust the corresponding scatterer group points such that they are centered about  $0, \vec{0}, 0$ . 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.100, one may choose to *Open* the newly created/modified Scatterer Group.

#### 13.1.1.4 The 3D World

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.98.

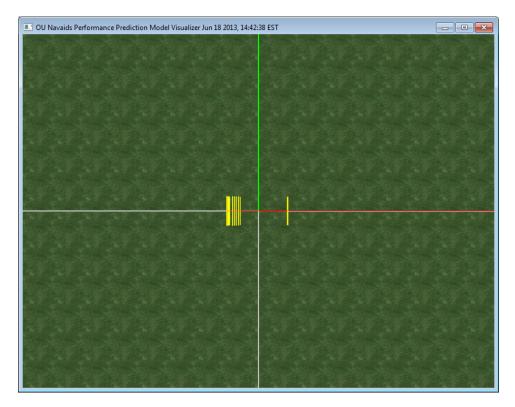


Figure 98: The default top-down *Scatterer Group Editor* 3D Visualization. The user may navigate the camera to any desired orientation.

The user may navigate the 3D Visualization to place the camera at any desired position. See Fig.99. See Chapter VI for a description about using and navigating the 3D Virtual World.

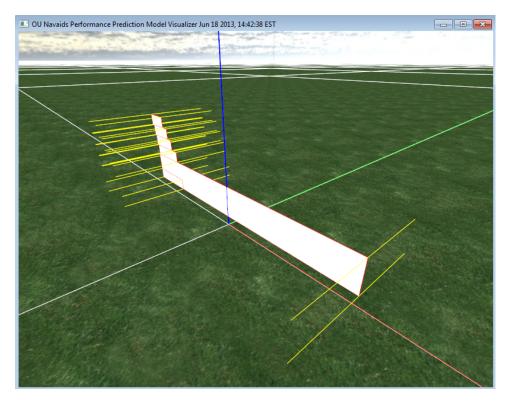


Figure 99: The user has navigated from the top-down view to a different view. Exact same Scatterer Group as shown in Fig.98.

## 13.1.2 Wire Group Editor

Similar to plate group editor. This section is incomplete.

## **13.2** Scatterer Point of Rotation

These ten This section is incomplete.

## **13.3** Iteration Operations

## 13.3.1 Iterate Individually

This section is incomplete.

### 13.3.2 Iterate as Group

This section is incomplete.

## **13.4** Group Scatterers (Table)

## 13.4.1 Add

Figure 100 shows how to insert a scatterer group into the model. In this case a Boeing 707 is being loaded.

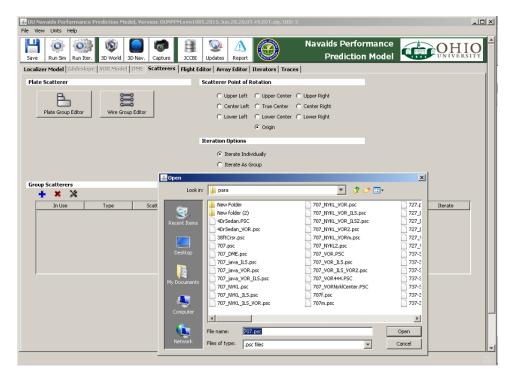


Figure 100: The main scatterer editor window. Groups of scatterer plates are loaded here.

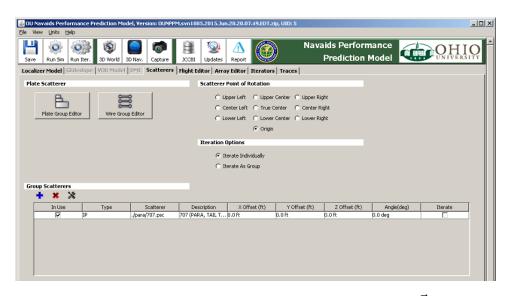


Figure 101: A Boeing 707 has been loaded and positioned at (0, 200, 50) with a rotation of  $45^{\circ}$ .

Figure 102 shows a Boeing 707 has been loaded and positioned at (0, 200, 50) with a rotation of  $45^{\circ}$ .

#### 13.4.1.1 Effect on the Simulation

This section is incomplete.

#### 13.4.1.2 Effect on the 3D World

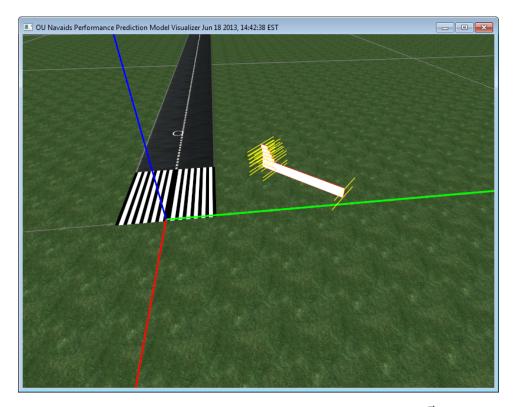


Figure 102: The 3D Visualization of the Boeing 707 positioned at  $(0,2\vec{00},50)$  with a rotation of 45°. Notice its position relative to the *threshold / start end / origin*.

Figure 102 shows the 3D Visualization of the Boeing 707 positioned at (0, 200, 50) with a rotation of 45°. Notice its position relative to the *threshold / start end / origin*.

### 13.4.2 Remove

This section is incomplete.

#### 13.4.3 Edit

This section is incomplete.

### 13.4.4 The Table

This section is incomplete.

#### 13.4.4.1 In Use

This section is incomplete.

## 13.4.4.2 Туре

This section is incomplete.

### 13.4.4.3 Scatterer

This section is incomplete.

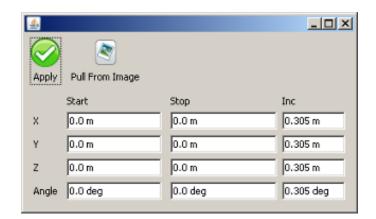


Figure 103: A panel that lets the user set the start, stop, and increment for iteration for scatterers.

#### 13.4.4.4 Description

This section is incomplete.

#### 13.4.4.5 X Offset

This section is incomplete.

#### 13.4.4.6 Y Offset

This section is incomplete.

### 13.4.4.7 Z Offset

This section is incomplete.

#### 13.4.4.8 Angle

This section is incomplete.

#### 13.4.4.9 Iterate

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 103

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  $\heartsuit$  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.

# 14 Flight Parameters

## 14.1 Localizer Flight Paths

The section describes the supported Localizer Flight Paths.

## 14.1.1 Localizer ILS 3 / Approach

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Save Run Sim Run Iter.	· · · · · · · · · · · · · · · · · · ·	apture JCCBI Updat		Navaids Performance Prediction Model	
		atterers Flight Editor 4	Array Editor   Iterators   Traces	5	1
Localizer / Glideslope Model	JR. Model   DME Model				
Flight Configuration					
Last Saved as:			🔉 🖬		
Flight Type: 👖	5.3 / Approach	न			
Approach: F		 뒷			
ILS 3 / Approach ILS 2 / Leve	Run II.S I / Orbit User I	refined			
Flight Parameters			z		
Range at Start: 24	1304.0 ft			~	
Range at Stop: -1	0000.0 ft				
Linear Increment: 50	0.0 ft				
Azimuth Angle: 0.	0 dec		Alt. at Threshold		
Elevation Angle: 3.		Min. Altitude	Linear Inc.		
				X	
Range at Intercept: 24		Range at Stop	<ul> <li>Range at Intercept –</li> <li>Range at Start</li> </ul>		
Altitude at Threshold: 59					
Minimum Altitude: 20	1.0 ft				
Velocity: 11	8.5 knots				
<u>    </u>					

Figure 104: The default ILS 3 / Approach Flight Path for a Localizer.

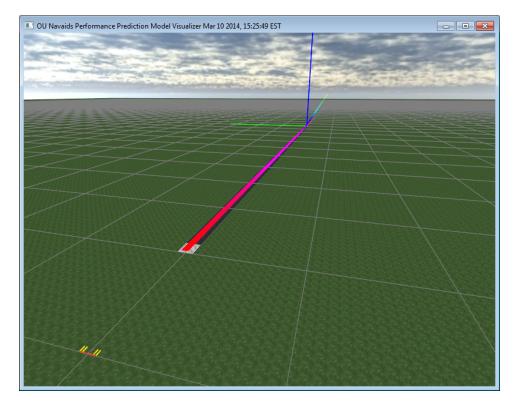


Figure 105: The 3D Virtual World depicting the ILS 3 / Approach Flight Path in Fig.104.

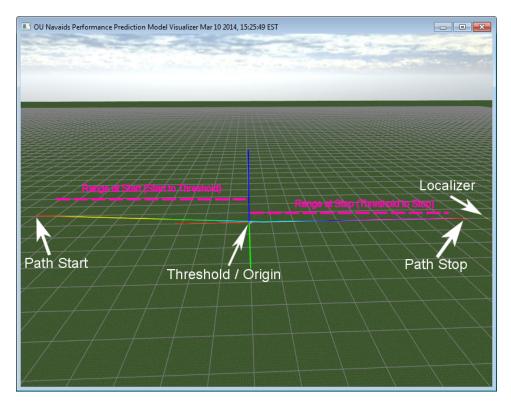


Figure 106: ILS 3 / Approach Flight Path Nomenclature.

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

Fig.106, 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*° 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 107 shows a rotated ILS 3 Approach.

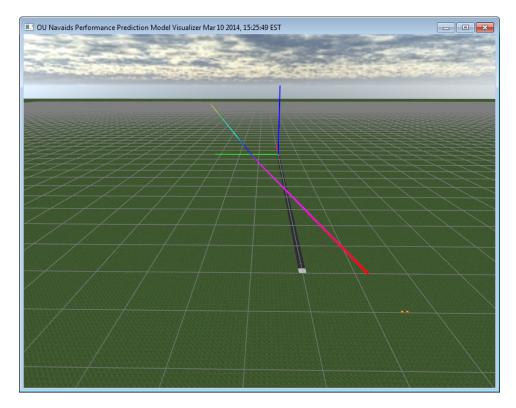


Figure 107: ILS 3 Flight Path with an *Azimuth Angle* of  $15^{\circ}$  and a Localizer *Main Offset* of -1500 ft and an *Ant. Setback* of 1000 ft.

## 14.1.2 Localizer ILS 2 / Level Run

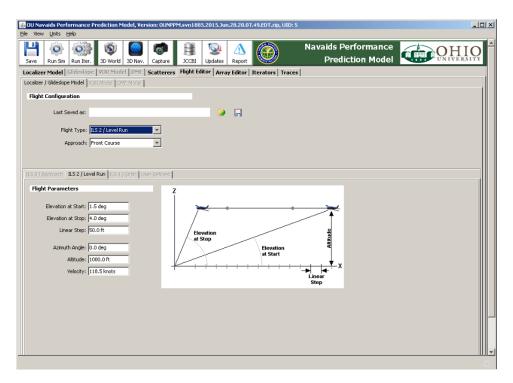


Figure 108: ILS 2 / Level Run Flight Path for a Localizer.

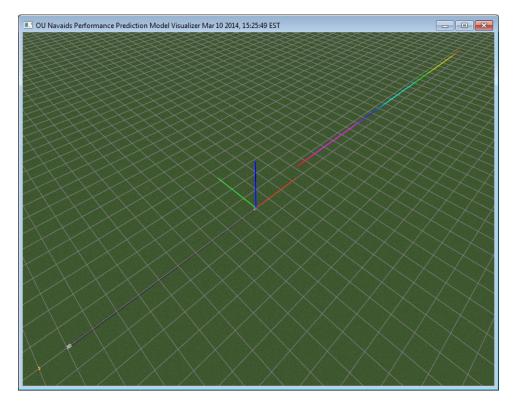


Figure 109: ILS 2 / Level Run Flight Path visualizing the parameter from Fig.108.

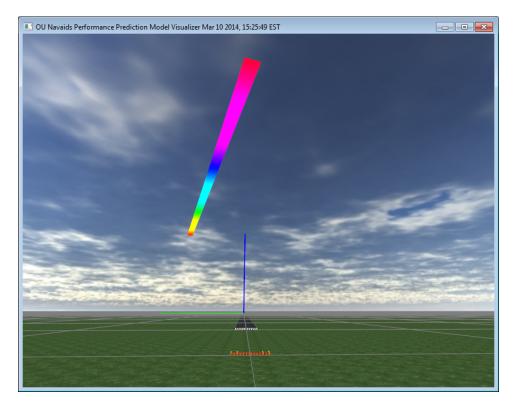


Figure 110: ILS 2 / Level Run Flight Path with a *Elevation at Start* of  $20^{\circ}$ , an *Elevation at Stop* of  $90^{\circ}$  at an *Altitude* of 1000 ft with an *Azimuth Angle* of  $15^{\circ}$ .

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.108, 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.109.

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 110 shows a rotated ILS 2 Approach.

## 14.1.3 Localizer ILS 1 / Orbit

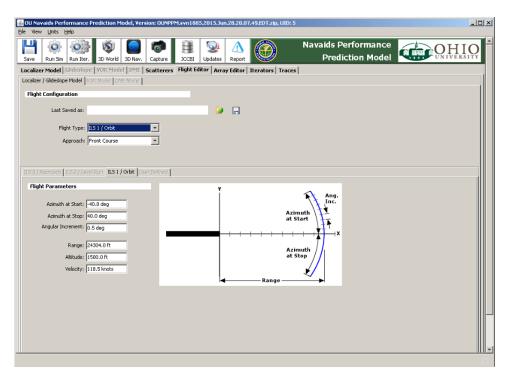


Figure 111: ILS 1 / Orbit Flight Path for a Localizer.

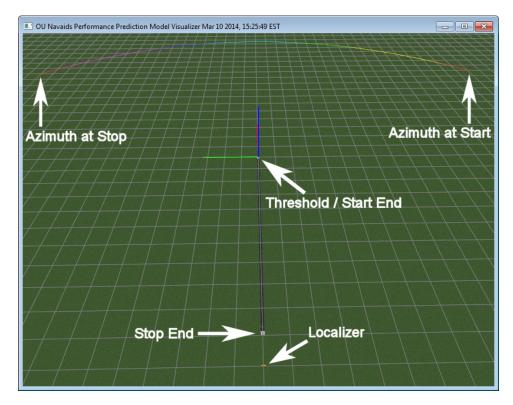


Figure 112: 3D Virtual World corresponding to the ILS 1 / Orbit Flight Path parameters from Fig.111.

Figure 111 shows the parameters for an ILS 1 / Orbital Flight Path. Figure 112 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

## 15 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.

## 15.1 Localizer Array Editor

• [[]	0	) 🔇 🖗	S 🔊	9		Nav Nav	aids Performance	
	kun Sim   Run Ib			JCCBI Updates			Prediction Model	UNIVERSIT
		eslope Array Editor	DME Scatterers	Flight Editor Arr	ay color   If	erators   Traces		
			Contra Cartor I					
	Current I	LDU Hile:						
calize	r Course Arra	v					V	Vorking Units: C w C m 📀 ft
	× 🙁		urse Freq (MHz): 109.	7		Course Array Descrip	tion: Unnamed	
			· · · · · · · · · · · · · · · · · · ·					
	Num	Side	X(ft)	Y(ft)	Z(ft)	CSB Amplitude(no	. CSB Phase(deg) SBO Amp	litude(no SBO Phase(deg)
calizer	r Clearance Ar	ray						
calizer	r Clearance Ar	rray						
calizer 📧	r Clearance Ar	rray				Clearance Array Descrip	tion: Unnamed	
calizer		rray Side	X(ft)	Y(ft)	Z(ft)		, <u>, , , , , , , , , , , , , , , , , , </u>	Itude(no   SBO Phase(deg)
calizer	× 0		X(Ft)	¥(ft)	Z(ft)		, <u>, , , , , , , , , , , , , , , , , , </u>	Nude(no   SBO Phase(deg)
calizer	× 0		X(ft)	Y(ft)	Z(ft)		, <u>, , , , , , , , , , , , , , , , , , </u>	Itude(no SBO Phase(deg)
calizer	× 0		X(Ft)	Y(ft)	Z(ft)		, <u>, , , , , , , , , , , , , , , , , , </u>	Itude(no   SBO Phase(deg)
calizer	× 0		X(Ft)	Y(ft)	Z(ft)		, <u>, , , , , , , , , , , , , , , , , , </u>	Itude(no  SBO Phase(deg)
calizer	× 0		x(ħ)	Y(it)	Z(ft)		, <u>, , , , , , , , , , , , , , , , , , </u>	Ikude(no   SBO Phase(deg)
calizer	× 0		X(Pt)	Y(ft)	Z(ft)		, <u>, , , , , , , , , , , , , , , , , , </u>	ltude(no  SBO Phase(deg) [
calizer	× 0		X(R)	y(it)	Z(ft)		, <u>, , , , , , , , , , , , , , , , , , </u>	Itude(no   SBO Phase(deg)
calizer	× 0		x(R)	Y(ft)	2(ft)		, <u>, , , , , , , , , , , , , , , , , , </u>	Rude(no   SBO Phase(deg)

Figure 113: The Localizer Array Editor.

Figure 113 shows the Array Editor for all Localizer arrays. Clicking the will open a File Chooser where any .LDU file may be selected. Figure 114 shows an opened "WI14-10.LDU" array. Both the Course and Clearance array are shown.

Run Sim	Run Iter.	3D World 3	D Nav. Capture		lates Report	Na Na	vaids Perfor Predictior		<b>O</b>	HI
				rs   Flight Editor	Array Editor	Iterators   Traces				
r Array Editor	Glideslope	Array Editor	Element Editor							
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	and a coor	io. c. tooni n	1000011_10.000							
								Working	Units: 🔿 w 🔿 m (	€ ft
alizer Course	Array									
a 🗶 👩		Localizer Co	rse Freg (MHz):	109.7	ส	Course Array Descr	ription: 14/10 Capture	e-Effect Cou	rse Array	_
- <b>-</b> •	·				-			,		_
Num		Side	X(ft)	Y(ft)	Z(R			SBO Amplitude(no		
	7 L		0.0 ft	-49.717 ft	0.0 ft	0.0	0.0 deg	0.307	180.0 deg	-
	6 L		0.0 ft	-41.324 ft	0.0 ft	0.034	0.0 deg	0.605	180.0 deg	- 11
	5 L		0.0 ft	-33.425 ft	0.0 ft	0.222	0.0 deg	0.846	180.0 deg	- 11
	4 L		0.0 ft	-25.526 ft	0.0 ft	0.439	0.0 deg	1.0	180.0 deg	- 11
	3 L		0.0 ft	-17.636 ft	0.0 ft	0.775	0.0 deg	0.95	180.0 deg	- 11
	2 L		0.0 ft	-9.737 ft	0.0 ft	1.0	0.0 deg	0.597	180.0 deg	
	1 L		0.0 ft	-2.699 ft	0.0 ft	0.853	0.0 deg	0.122	180.0 deg	_
	1 R		0.0 ft	2.699 ft	0.0 ft	0.853	0.0 deg	0.122	0.0 deg	
	2 R		0.0 ft	9.737 ft	0.0 ft	1.0	0.0 deg	0.597	0.0 deg	-
lizer Clearan	ce Array									
-						Clearance Array Descr	In the cash of	- File-a	rance Array	_
🔹 🗶 🙁						Clearance Array Desci	nption: [14/10 Captur	e-Errect Uea	rance Array	
Num		Side	X(ft)	Y(ft)	Z(ft			SBO Amplitude(no		
	5 L		0.0 ft	-33.425 ft	0.0 ft	0.079	180.0 deg	0.05	0.0 deg	*
	4 L		0.0 ft	-25.526 ft	0.0 ft	0.27	180.0 deg	0.18	180.0 deg	
	3 L		0.0 ft	-17.636 ft	0.0 ft	0.0	180.0 deg	0.28	180.0 deg	
	2 L		0.0 ft	-9.737 ft	0.0 ft	0.144	180.0 deg	0.5	180.0 deg	
	1 L		0.0 ft	-2.69 ft	0.0 ft	1.0	0.0 deg	1.0	180.0 deg	
	1 R		0.0 ft	2.69 ft	0.0 ft	1.0	0.0 deg	1.0	0.0 deg	
	2 R		0.0 ft	9.737 ft	0.0 ft	0.144	180.0 deg	0.5	0.0 deg	
	3 R		0.0 ft	17.636 ft	0.0 ft	0.0	180.0 deg	0.28	0.0 deg	
			0.0 ft	25.526 ft	0.0 ft	0.27	180.0 deg	0.18	0.0 deg	
	4 R		0.010							

Figure 114: 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 in 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.* 

## 15.2 Glideslope Array Editor

## **15.3** Azimuthal Element Pattern

To draw your own pattern, click the 🖄 icon.

## 15.3.1 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.
- Set scale <sup>≇</sup> (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.

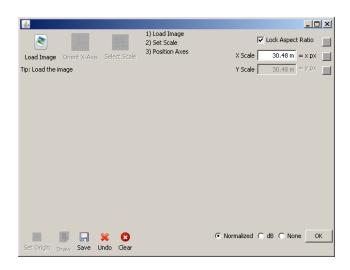


Figure 115: A freshly opened draw element pattern pane.

- 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.
- 4. Click the "set origin" button  $\vdash$  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

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

again.

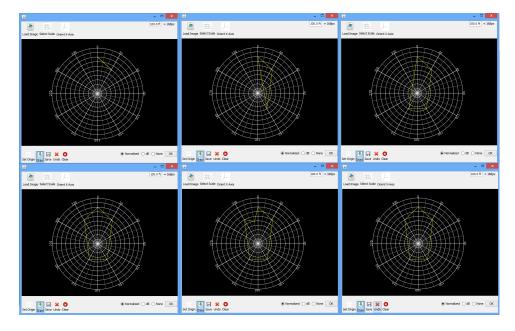


Figure 116: An example of a 5 point element pattern, and using the undo button to fix a mistake.

## **16** 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.

## 16.1 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 11.

$$X = \prod_{i=1}^{x} i_n \tag{11}$$

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 out output. The first is the table, which outlines every iteration and it's 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 axis are iterator values, and analysis results are shown as points on the plots. More information these outputs can be found on in sections ?? and ??.

## **16.2** 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.

## 16.3 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.

## 16.4 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" **5** (lower toolbar) – Merges two CAS files.

## 16.5 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

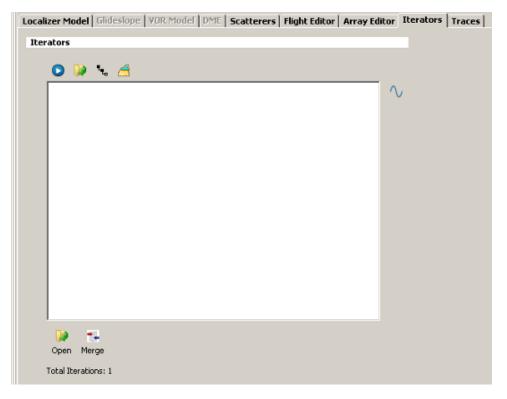


Figure 117: The iteration tab.

.itl file will be created. "Run and Get Results"  $\mathbf{L}$  (upper toolbar) – This button is functionally equivalent to the icon on the main toolbar.

## 16.6 Sidebar

The sidebar contains access to iterators that do not fall under the scope of any other area.  $\wedge$  - 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.

## 16.7 Plots

Iterator plots are discussed later in section ??.

## 17 Traces

## **17.1** Localizer Traces

## **17.1.1 Output Parameter**

## 17.1.1.1 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

## 17.1.1.2 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.

## 17.1.2 Switches

### 17.1.2.1 Filtering

### 17.1.2.2 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.

### 17.1.2.2.0.0.1 Use Course

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

## 17.1.3 Course Parameters

### 17.1.3.1 Course Width

Recommended values fall between 3 and 6 degrees.

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

- 17.1.3.2 Mod. Balance
- 17.1.3.3 SBO Phase
- **17.1.4** Clearance Parameters
- 17.1.4.1 Course Width
- 17.1.4.2 Mod. Balance
- 17.1.4.3 SBO Phase
- 17.1.4.4 Clr/Crs Sep.
- 17.1.4.5 Capture Ang.

## **17.2 Glideslope Traces**

## **17.3 VOR Traces**

17.3.1 Flight Type

### 17.3.2 SS Units

- 1. dB deciBels
- 2. Relative relative power

## 17.3.3 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 -

### 17.3.4 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.

### 17.3.5 Trace Name

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

## 18 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.118.

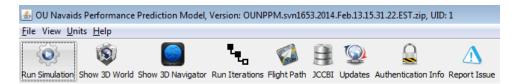


Figure 118: The Title Bar always displays the current version of OUNPPM. The version above is OUNPPM.svn1653.2014.Feb.13.15.31.22.EST.zip. This version number is 1653 and was built on February 13, at 3:31:22 PM EST.

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

🛓 OUNPPM Auto Update Manager	
See New See	Update Server URL (ex: "http://ounppm.eecs.ohio.edu/ounppm/updates/" ):
Check For Update View New Features	http://ounppm.nykl.net/ounppm/updates/
Currently Installed Version:	
OUNPPM.svn1653.2014.Feb.1	3.15.31.22.EST.zip
Latest Available Version:	
Message	
Down	PPM is available, please consider updating for improved features. 4.Mar.12.17.49.49.EDT.zip
000000000000000000000000000000000000000	OK
	Download Status:
Begin Downloading Update	None
Update Error Log:	
L	

Figure 119: 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, then updates can be achieved as follows:

CU Navaids Performance Prediction 7	todel, Version: 0UNPPM.svn1885.2015lun.28.20.07.49.EDT.zip, UID: 5	_10 ×
H 0 00 0	Navaids Performance	
Localizer Model   Glidestope   VOR Mo Plate Scatterer	Check For Update Server URL (es: "http://ounpom.escs.ohio.edu/ounpom/updates/"):	
Plate Group Editor Wre-	Control (bataline) Control (bata	
	Latest Acadable Version:	
Group Scatterers	Downloaded Update to be applied on Restart:	
In Use Type		(deg) Rerate
	Coverload Status: Name	

Figure 120: 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.120.
- 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.121.
- 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.122.

🙆 OUNPPM Auto Update Manager	
Several Activity of the several se	Update Server URL (ex: "http://ounppm.eecs.ohio.edu/ounppm/updates/" ):
Check For Update View New Features	http://ounppm.nykl.net/ounppm/updates/
Currently Installed Version:	
OUNPPM.svn1653.2014.Feb.1	3.15.31.22.EST.zip
Latest Available Version:	, ,
OUNPPM.svn1745.2014.Mar.1	2.17.49.49.EDT.zip
Downloaded Update to be applied on Resta	art:
	be applied next time program is started:
OUNFPM.svn1745.2014.Mar.1	
	Download Status:
Begin Downloading Update	Downloading Complete - SUCCESS Fri Mar 14 16:51:31 EDT 2014
Update Error Log:	wnloading Update
SUCCESSFUL Update	
L	

Figure 121: After a successfully downloaded update, OUNPPM must be exited and reopened for the updates to take effect.



Figure 122: Upon restarting OUNPPM, the new Version is displayed.

# 19 JCCBI Database

Stuff about JCCBI.

## **20** 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, 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 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 123 shows the OUNPPM Authentication Window and provides the user with specific client information including the *Remaining Grace Period*.

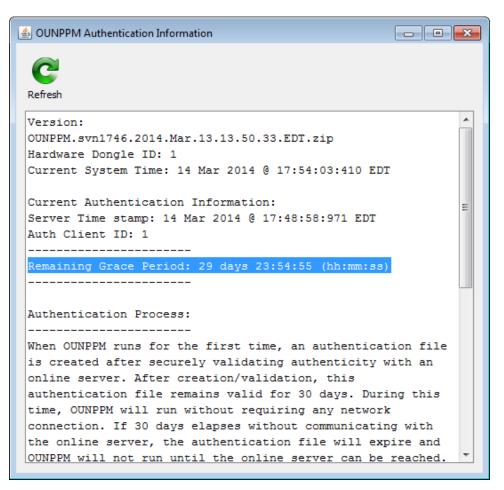


Figure 123: Clicking *Authentication Info* displays client-specific information including the *Remaining Grace Period* before contacting the update server. Clicking the *Refresh* button updates the *Grace Period Remaining* to the nearest Day Hour:Minute:Second.

The following text is taken from the Authentication Information Window and

describes, in detail, how the authentication system works.

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.

## 21 Localizer

### 21.1 The Plot

#### 21.1.1 Axes

#### 21.1.1.1 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.

#### 21.1.1.2 Y-Axis

For each trace a value can be plotted, refer to section 17.1 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.

#### 21.1.2 CAT III

Figure 138 shows an example of a CAT III plot.

#### 21.1.3 CATII

Figure 139 shows an example of a CAT II plot.

#### 21.1.4 CATI

Figure 140 shows an example of a CAT I plot.

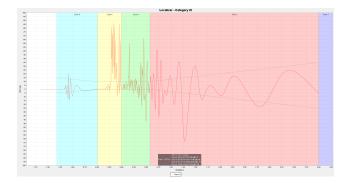


Figure 124: An example of a CATIII analysis.

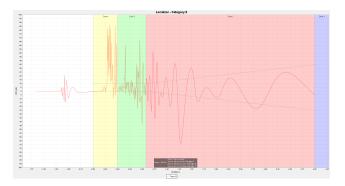


Figure 125: An example of a CATII analysis.

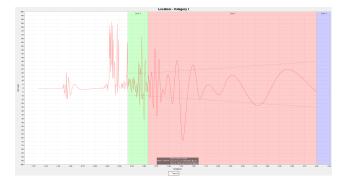


Figure 126: An example of a CATI analysis.

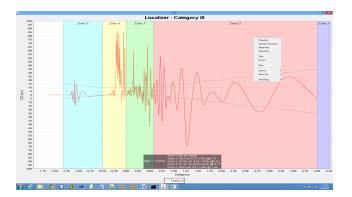


Figure 127: An example of the context menu displayed on a plot.

Jeneral:		Title Pict Other	Title Plot Other		
how Title:	1	Domain Axis Range Axis Appearance	Draw anti-alased		
fext: Localizer Lower	Approach	General:	Background paint:		Select
Font: SansSerif.bold,	33 Select	Label: Distance	Series Paint:	No editor implemented	Edit
Color:	Select	Font: SansSerif,plain, 12 Select	Series Stroke:	No editor implemented	Edt
		Paint: Select	Series Outline Paint:	No editor implemented	Edt
		Other Tida Range	Series Outline Stroke:	No editor implemented	Edit
		Show tok labels           Tok label font:         SamSenf.plan, 10           Steve tok marks			

Figure 128: Features supported by the context menu.

E - • • • •		
(dwitcher) (02F) (H02, 1408 (128))	pasters (12) (40, 108 (29%)	Snappes (Rin) up (Rin)
* (m   08) • Mayeria   08) • Mate   083 Bata   083 # May   083	Bas         00	9 MA         00           0 MARIA         000           0 Aprime         000           3500000         000           35000000         000
Support Text Support Text Support	Pender	Protein
	taor 0 v	taut .
8 Arr (10) 0 Base (10) 0 Arr	penergi (k) (k) (2010*)  Recue   163  Recue	
Serie Teol Serie Teol Serie Teol	Penker	

Figure 129: The different color types that are supported.

<u>\$</u>			- 🗆 🗙
X Min	-1.927 nm	Y Min	-100.0 ua
X Max	4.282 nm	Y Max	100.0 ua
Nautical Miles 🗸		uA 🗸	

Figure 130: The different color types that are supported.

## 21.1.5 Context Menu

The context menu, as seen in figure 141, spawns when you right click on a plot. It has the following options:

## 21.1.5.1 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 need to use the "Adjust Axes" feature described in section 23.5.0.3.

#### 21.1.5.2 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.

#### 21.1.5.3 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.

#### 21.1.5.4 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.

#### 21.1.5.5 Copy

Copies the contents of the graph to the clipboard.

#### 21.1.5.6 Save As

Saves the plot as a .png image.

#### 21.1.5.7 Print

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

#### 21.1.5.8 Zoom In

Zooms in one or both axes.

#### 21.1.5.9 Zoom Out

Zooms out one or both axes.

#### 21.1.5.10 Auto Range

Reverts one or both axes to their default values.

# 21.2 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.

# 21.3 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.

				(	Chart				
425									
400	-2,9	-3.8	-4.7	-5,4	-5.9	-6.2	-6.4	-0,1	-5.2
375									
350	-6,2	-4.7	3,3	4.3	5,4	6,3	7,3	8.0	8,7
325									
300	5.4	6,4	7,4	8.2	8.8	9.0	8.9	8.5	7.7
275									
250	5.5	6.1	6.6	6.9	7.1	7.1	7.0	6.8	6.5
220									
175		1.5	1.7	2.0	2.3	2.5	2.8	3.1	3.3
5 150	-2.7	-2.6	-2.6	-2.6	-2.5	-2.5	-2.4	-2.4	-2.3
0 300 275 250 225 200 175 150 150 150	-2.7	-2.0	-2.0	-2.0	-2.0	-2.0	-2.4	-2.4	-2.3
100	1.2	1.2	- 11			1.1	1.1	1.0	1.0
75									
50	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
25									
-25	0.0	0,0	0.0	0.0	0.0	0.0	0.0	0.0	0,0
	-9,100	-9,075	-9,050	-9.025 X Iterati	-9,000 or for Scattere	-8,975 r in row 0	-8,950	-8,925	-8,900
	# = Abs 0% 20% 40% 60% 80% 100%	olute error in "	ıAmps		Date: 2015/0 Array Type W CRS Elem LPD CRS Width 3.4 <b>Runway Lem</b> TCH: Path Ang Trace 1	lilcox 8 Elemer 645°	it A CLR/CI CLR Ele CLR W Setbac Offset	25 Sep: -00dB sm: LPD idth: 2.2deg 2 k 1000.0ft	
	neter: (* Struc				.N C N% C	Contour			

Figure 131: The default iteration plot, a structure plot showing decimal values.

# 21.4 Mouse Interaction

The right mouse button will spawn the context menu which is to be covered in section 23.5.

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.

## 21.5 Localizer Iterator Plots

#### 21.5.1 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 131. 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> $\Diamond$ </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.

#### 21.5.2 Structure Plots

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

				Chart				
×								
		×						
	-							
	+	+	+	+	×	×	×	×
×	×	×	×	×	+	+	+	+
.9.100			.9.025	.9.000	.8.975	.8.950	-8.925	-8.90
-9,100 Percentage > 25% > 50% > 75% > 100%	-9,075 of Category II > 100%, but p			Array Type V CRS Elem LPD CRS Width 3.	)7/09 20:43:39 Vilcox 8 Elemen D	t A CLR/CR CLR Ele CLR Wi Setbad Offset	- t5 Sep: -00dB m: LPD dth: 2.2deg 2 k 1000.0ft	

Figure 132: The default iteration plot, a structure plot showing decimal values.

#### 21.5.2.1 Decimal

The decimal structure plot is shown in figure 131. The plot and legend are described below.

**21.5.2.1.0.0.1 Plot** The plot contains one value at the X,Y location for each datapoint. How iteration cooridinates are determined are explained in more detail in chapter 16. Each of these datapoints shows a decimal value representing

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

#### 21.5.3 Percentage

The decimal structure plot is shown in figure 136. The plot and legend are described below.

21.5.3.0.0.0.1 Plot

21.5.3.0.0.0.2 Legend

#### 21.5.4 Contour

The decimal structure plot is shown in figure 137. The plot and legend are described below.

#### 21.5.4.0.0.0.1 Plot

#### 21.5.4.0.0.0.2 Legend

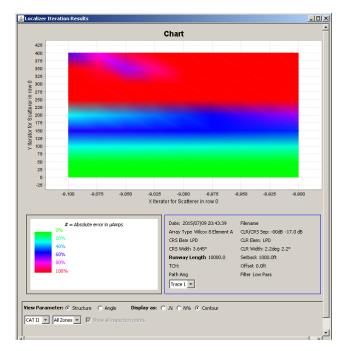


Figure 133: The default iteration plot, a structure plot showing decimal values.

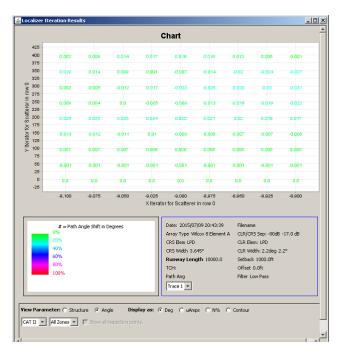


Figure 134: The default iteration plot, an angle plot showing decimal values.

#### 21.5.5 Angle Plots

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

#### 21.5.5.1 Degree

The decimal structure plot is shown in figure 131. The plot and legend are described below.

					Chart				
425									
400	0.177	0.712	1.148	1.412	1.408	1.311	0.97	0.492	-0.058
375									
350	1.596	1.188	0.657	0.057	-0.553	-1.124	-1.811	-1.982	-2.216
325									
300	0.165	-0.407	-0.948	-1.432	-1.841	-2.159	-2.381	-2.503	-2.53
275									
230	0.758	0.357	-0.033	-0.405	-0.752	-1.067	-1.348	-1.585	-1.785
200	2,118	2.079	2.019	1,942	1.851	1,748	1.030	1.510	1.392
175	2.110	2.0/10	2.019	1.842	1.001	1.6790	1.030	1.310	1.392
300 275 250 225 200 175 150 125 100	-1.075	-0.992	-0.911	-0.832	-0.755	-0.681	-0.609	-0.541	-0.476
125									
100	0.608	0.583	0.559	0.535	0.513	0.491	0.47	0.45	0.431
75									
50	-0.12	-0.118	-0.115	-0.112	-0.11	-0.107	-0.105	-0.103	-0.1
25									
-25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0,0
	-9,100	-9,075	-9,050	-9.025 X Iterati	-9,000 or for Scattere	-8,975 r in row 0	-8,950	-8,925	-8,900
	# = Path 0% 20% 40% 60% 80% 100%	Angle Shift in	μAmps		Date: 2015/0 Array Type W CRS Elem LPC CRS Width 3. Runway Len TCH: Path Ang Trace 1	lilcox 8 Elemer 645°	it A CLR/CF CLR EM CLR W Setbac Offset	25 Sep: -00dB sm: LPD idth: 2.2deg 2 k 1000.0ft	
	All Zones 💌				Deg 🕞 uAn	ps C N%	C Contour		

Figure 135: The default iteration plot, an angle plot showing decimal values.

**21.5.5.1.0.0.1 Plot** The plot contains one value at the X,Y location for each datapoint. How iteration cooridinates are determined are explained in more detail in chapter 16. Each of these datapoints shows a decimal value representing

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

#### **21.5.5.2** μ**Amps**

The decimal structure plot is shown in figure 131. The plot and legend are described below.

**21.5.5.2.0.0.1 Plot** The plot contains one value at the X,Y location for each datapoint. How iteration cooridinates are determined are explained in more detail in chapter 16. Each of these datapoints shows a decimal value representing

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

#### 21.5.6 Percentage

The decimal structure plot is shown in figure 136. The plot and legend are described below.

21.5.6.0.0.1 Plot

21.5.6.0.0.2 Legend

					Chart				
					Unalt				
425									
400									
375									
350									
275									
250									
225									
200									
175									
300 275 250 225 200 175 150 125 100									
125									
75									
50 25									
20									
-25									
+>: ×>! =>'	50%	Category III	Tolerences	X Itera	Array Type CRS Elem LF CRS Width	07/09 20:43:39 Wilcox 8 Element 10 3.645° 2ngth 10000.0	CLR Elem CLR Widt	: LPD h: 2.2deg 2.2 1000.0ft Oft	
w Param	All Zones 💌					vmps (® N% )	C Contour		

Figure 136: The default iteration plot, an angle plot showing decimal values.

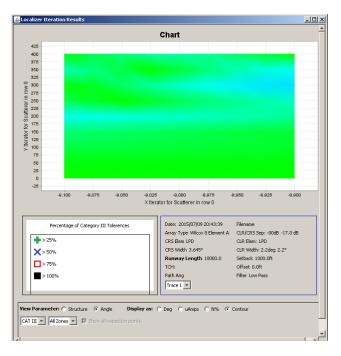


Figure 137: The default iteration plot, an angle plot showing decimal values.

#### 21.5.7 Contour

The decimal structure plot is shown in figure 137. The plot and legend are described below.

#### 21.5.7.0.0.1 Plot

#### 21.5.7.0.0.0.2 Legend 22 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.

## 22.1 ILS3

#### 22.1.1 Axes

#### 22.1.1.1 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.

#### 22.1.1.2 Y-Axis

For each trace a value can be plotted, refer to section 17.1 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.

#### 22.1.2 The Plot

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

#### 22.1.2.1 ILS3

**22.1.2.1.0.0.1** CAT III Figure 138 shows an example of a CAT III plot.

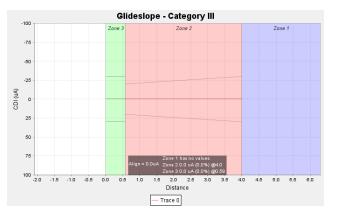


Figure 138: An example of a CATIII analysis.

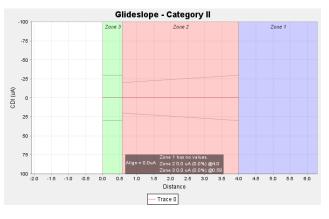


Figure 139: An example of a CATII analysis.

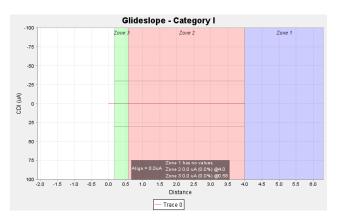


Figure 140: An example of a CATI analysis.

#### 22.1.2.2 CATII

Figure 139 shows an example of a CAT II plot.

#### 22.1.2.3 CATI

Figure 140 shows an example of a CAT I plot.

#### 22.1.2.4 Context Menu

The context menu, as seen in figure 141, spawns when you right click on a plot. It has the following options:

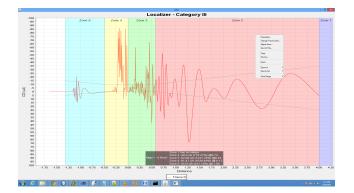


Figure 141: An example of the context menu displayed on a plot.

Chart Properties	×	Chart Properties	Chart Properties
ter Lockiter Lover Approach Somsteret basis, 38	Select	Total (and (and (and (and (and (and (and (and	Table (a)         Other           General         General           General         General           Holgsschule         Belen           Holgsschule         Belen           Here Dete         Nachter Ingelmersch         Belen
OK Cancel		OK Cancel	OK Cancel

Figure 142: Features supported by the context menu.

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Sweether   157   156   458   59%		Summer 101 HQ, Ingl. Opt.	Souther (Str.) 45, 100 (OSK)
4	In Care         0 (2)           Oragenia         00 (2)           Order         00 (2)           Deb         00 (2)           Beb         00 (2)           Able         00 (2)	O 386/889	10 10 10 10 10 10 10 10 10 10
	Begin Test Servic Test     Begin Test Service Test     Begin Test Service Test	Peter	Place
haar 0		19860	v famb
	- *		
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+	item         2018           Other         110           Other         110           Item         120	Charts a	4
	E Sangle Text Sangle Text	Peder	
	Sargie Text Sangle Text		

Figure 143: The different color types that are supported.

<u>\$</u>			- 🗆 🗙
X Min	-1.927 nm	Y Min	-100.0 ua
X Max	4.282 nm	Y Max	100.0 ua
Nautical Miles 🖌		uA 🗸	

Figure 144: The different color types that are supported.

**22.1.2.4.0.0.1 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 need to use the "Adjust Axes" feature described in section 23.5.0.3.

**22.1.2.4.0.0.2** 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.

**22.1.2.4.0.0.3** 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.

**22.1.2.4.0.0.4** 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.

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

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

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

22.1.2.4.0.0.8 Zoom In Zooms in one or both axes.

22.1.2.4.0.0.9 Zoom Out Zooms out one or both axes.

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

#### 22.1.3 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.

#### 22.1.4 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.

#### 22.1.5 Mouse Interaction

The right mouse button will spawn the context menu which is to be covered in section 23.5.

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.

# 22.2 ILS2

#### 22.2.1 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.
- 5. BP Stuct: The point at which the value will hit a CDI of 190 uA

# 22.3 ILS1

## 23 VOR

### 23.1 Axes

#### 23.1.1 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 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.

#### 23.1.2 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 17.3 for more details on what each option means. You can find the units for each section below:

- 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.

#### 23.2 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.

## 23.3 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 145, and can be isolated and displayed.

An example of a VOR plot is shown in figure 146. 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).

## 23.4 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)

## 23.5 Context Menu

The context menu, as seen in figure 147, spawns when you right click on a plot. It has the following options:

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

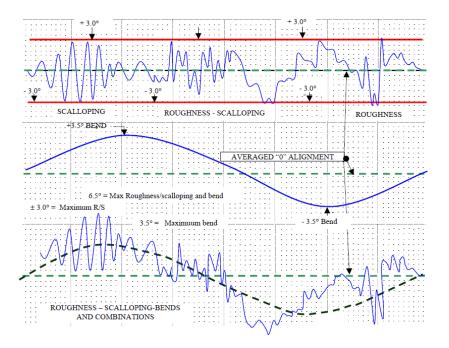


Figure 145: An example of roughness, scalloping, and bends. Taken from FAA 8200.1C page 11-18.

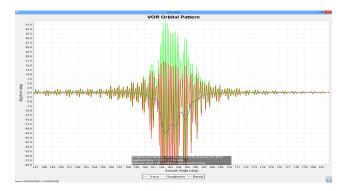


Figure 146: An example of a VOR plot.

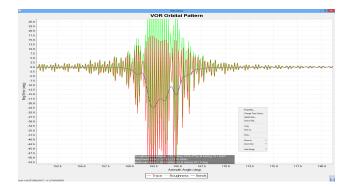


Figure 147: An example of the context menu displayed on a plot.

e Plot Other		Tide Plot Other	Title Plot Other		
Pot Other enerative Rew Title: Localizer Lower Approach Fent: SansSerf Bold, 18 Color:	Select	121 PR0- Dona Nas Range Asis General: Lidel: Distance Fett: Sandonf Slan, 12 Select Parb: Select	Title (Plac) Uniter General: Convert-blosed Bockground paint: Series Paint: Series Stroke: Series Outline Paint:	No editor implemented No editor implemented No editor implemented	Select Edt Edt
		Oter Tote Kang ⊘ Den to label Tot kiele font:	Series Outline Stroke:	No editor implemented	Edt

Figure 148: Features supported by the context menu.

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* Gree	• • • • • • • • • • • • • • • • • • •	File         0           Classin         1           Classin         6           Statem         6           Statem         1
Carden	Protein	Proces
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8 - P 💌		
Swether (USF) (HSL) (HSF) (USF)	Designed Reg and Laboration and Labo	
8 Kor 098 0 Sam 68 0 Ke 088 160 100	8 Gan 00000000000000000000000000000000000	
Q44 G44 (******		
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The sector for the se	3mm)	

Figure 149: The different color types that are supported.

<u>\$</u>			- 🗆 🗙
X Min	-1.927 nm	Y Min	-100.0 ua
X Max	4.282 nm	Y Max	100.0 ua
Nautical Miles 🗸		uA v	

Figure 150: The different color types that are supported.

#### 23.5.0.1 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 need to use the "Adjust Axes" feature described in section 23.5.0.3.

#### 23.5.0.2 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.

#### 23.5.0.3 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.

#### 23.5.0.4 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.

#### 23.5.0.5 Copy

Copies the contents of the graph to the clipboard.

#### 23.5.0.6 Save As

Saves the plot as a .png image.

#### 23.5.0.7 Print

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

#### 23.5.0.8 Zoom In

Zooms in one or both axes.

#### 23.5.0.9 Zoom Out

Zooms out one or both axes.

#### 23.5.0.10 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

### 23.6 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)

## 23.7 Mouse Interaction

The right mouse button will spawn the context menu which is to be covered in section 23.5.

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 151 shows an example. The 3D world consists of 3D Objects, such as scatterers, a runway, flight paths, visual indicators, etc, see Fig. 29. 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 29. By moving this eyeball around the world, one may traverse through the visualization.

# 23.8 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.

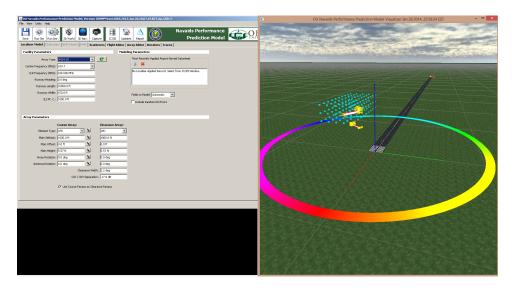


Figure 151: The GUI window used for inputting a navaid model (left). The 3D Visualization graphically depicting the navaid model (right).

## **23.9** 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 151. 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.

# 23.10 Elements of the Virtual World

## 23.10.1 Shared Elements

- 23.10.1.1 The Grid
- 23.10.1.2 The Runway

Present in Localizer and Glideslope.

### 23.10.2 Localizer Elements

- 23.10.2.1 The Array
- 23.10.3 Glideslope Elements
- 23.10.3.1 The Array
- 23.10.4 VOR Elements
- 23.10.4.1 The Array

# 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 0.1-10degrees

2



# Exercise 2 Transmitter Adjustments

- Determine the maximum CRS-CLR ratio on centerline to obtain acceptable clearance (> 200 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'



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# 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



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# 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.

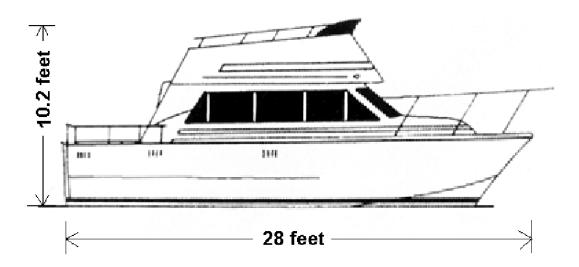


# Exercise 4 (cont'd) FLL Small Boat Club





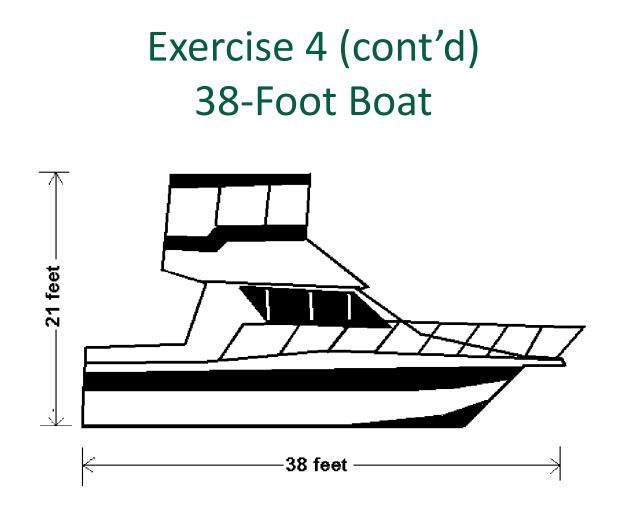
# Exercise 4 (cont'd) 28-Foot Boat





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9

# Exercise 4 (cont'd) Parameters

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



10

# 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

11



# 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



12

# Exercise 5 Max Building Height

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



13

# 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



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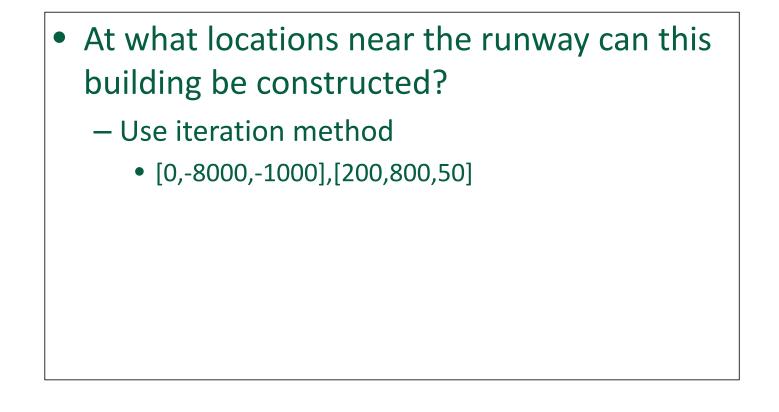
14

### Exercise 5 (cont'd) Building Information

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



15





16

### 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?



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### Exercise 6 (cont'd) Limo Center Information Distance from Rwy 27R Threshold

Distance nonninvy Z/M nneshola								
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				



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### Exercise 6 (cont'd) GS Information

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



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### 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



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#### Exercise 7 Evaluating Airport Environments IND 23R • Determine possible solutions to obtain

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



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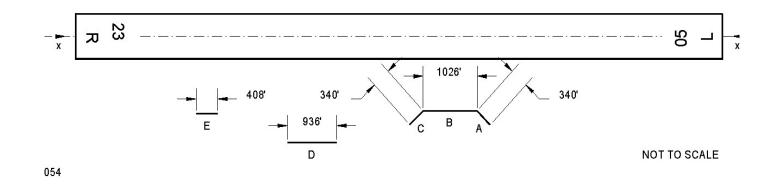
### **Exercise** 7

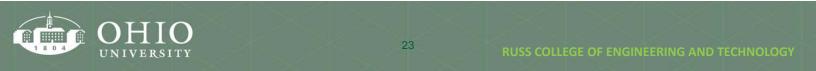
# **Evaluating Airport Environments** IND 23R Localizer Configuration:

- - 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





#### Exercise 7 Evaluating Airport Environments IND 23R – Structure Dimensions

Table 1. Scatterer Dimensions as Modeled.

Scattere Referen (ft)		Positior	n of	Scatterer Re	lative to	23R Loc.	(ft)	Dimensions of Scatterer
	Х	Y	Z	Length	Height			
A	5528	1440	0	340	72			
В	6160	1320	0	1026	72			
С	6800	1440	0	340	72			
D	8776	1880	0	936	80			
E	10768	1368	0	408	75			
Note:	A,B,C	Uni	ted A	Airlines MOC	II Facility			
		D		Postal Serv	/			
				ir Maintenand	0	,		
	DHI	0		$> \langle$	$\geq$	24		XXXX

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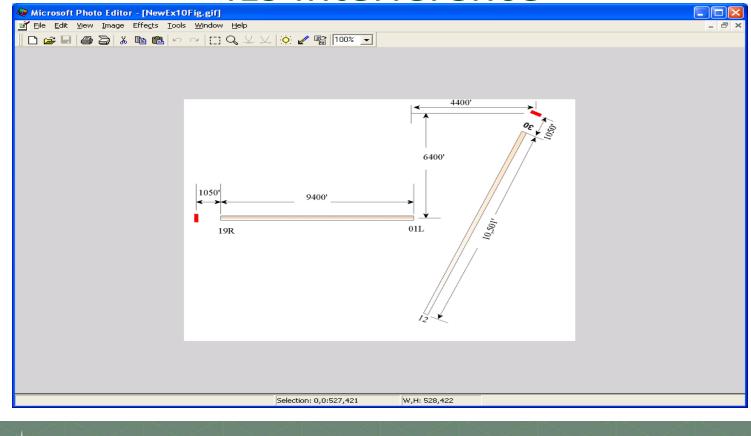
### Exercise 8 ILS Interference

 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?



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### Exercise 8 ILS Interference



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## Exercise 8 ILS Interference

**Desired Localizer 01L** 

Setback: 1050'

Offset: 0.0'

Runway Length:

9,400'

Array: 14-10

IAD Interfering Localizer 12

- Setback: 13,800
- Offset: 6,400
- Width: 3.0 degrees
- Array: 14-10



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### 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



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#### 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) =
  - Radial Step (Deg) = 1.000



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360.0

- Scatterers
- Scatterer 1: Rectangle
- Range (Ft) = 4381.0
- Ground Elevation (Ft) = 0.0 Base Height (Ft) = 0.0
- Length (Ft) = 449.6
- Rotation (Deg) = 0.40
- Material is Steel
- Scatterer 2: Rectangle
- Range (Ft) = 4820.3
- Ground Elevation (Ft) = 0.0
- Length (Ft) = 1020.0
- Rotation (Deg) = 90.40
- Material is Steel

Azimuth (Deg) = 106.70 Base Height (Ft) = 0.0 Height (Ft) = 104.8 Tilt (Deg) = 0.00 Ground Plane Present

Azimuth (Deg) = 102.50 Base Height (Ft) = 0.0 Height (Ft) = 104.8 Tilt (Deg) = 0.00 Ground Plane Present



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#### 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





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- ORF Model Input Parameters -- Input File
- VOR Parameters
- Conventional VOR
- Frequency (MHz) = 113.00
- Antenna Height (Ft) = 4.00
- Offset North (Ft) = 0.0
- Ground Elevation (Ft) = 0.0
- Flight Path
- Segment 1: Orbital
- Base Range (NMi) = 25.00
- Altitude (Ft MSL) = 3000.0
- Radial Step (Deg) = 0.500

- CP Radius (Ft) = 26.0 CP Height (Ft) = 12.0
- Offset East (Ft) = 0.0
- Ground is Perfectly Conducting

Radial Start (Deg) = 0.0 Radial End (Deg) = 360.0



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- Scatterers
- Scatterer 1: Rectangle
- Range (Ft) = 251.2
- Ground Elevation (Ft) = 0.0
- Length (Ft) = 252.9
- Rotation (Deg) = 113.90
- Material is Trees
- Scatterer 2: Rectangle
- Range (Ft) = 233.8
- Ground Elevation (Ft) = 0.0
- Length (Ft) = 91.4
- Rotation (Deg) = 157.10
- Material is Trees
- Scatterer 3: Rectangle
- Range (Ft) = 572.0
- Ground Elevation (Ft) = 0.0
- Length (Ft) = 39.3
- Rotation (Deg) = 36.30
- Material is Trees



Azimuth (Deg) = 240.20Base Height (Ft) = 0.0Height (Ft) = 60.0Tilt (Deg) = 0.00Ground Plane Present

Azimuth (Deg) = 201.20Base Height (Ft) = 0.0Height (Ft) = 60.0Tilt (Deg) = 0.00Ground Plane Present

Azimuth (Deg) = 176.40 Base Height (Ft) = 0.0 Height (Ft) = 64.0 Tilt (Deg) = 0.00 Ground Plane Present

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•	Scatterer 7: Rectangle	
•	Range (Ft) = 508.2	Azimuth (Deg) = 113.60
٠	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
٠	Material is Trees Gro	und Plane Present
٠	Scatterer 8: Rectangle	
•	Range (Ft) = 367.5	Azimuth (Deg) = 108.80
٠	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 Gro	und 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 Gro	und Plane Present
	OHIO	36

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•	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 Til	t (Deg) = 0.00
•	Material is Trees Gr	ound 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 He	eight (Ft) = 64.0
•	Rotation (Deg) = -95.60	Tilt (Deg) = 0.00
•	Material is Trees Gr	ound 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 He	eight (Ft) = 64.0
•	Rotation (Deg) = -62.80	Tilt (Deg) = 0.00
•	Material is Trees Gr	round Plane Present
		37 RUSS COLLEGE OF ENGINEERING AND

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٠	Scatterer 13: Rectangle
٠	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
٠	Rotation (Deg) = -5.40 Tilt (Deg) = 0.00
•	Material is Trees Ground Plane Present
٠	Scatterer 14: Rectangle
٠	Range (Ft) = 415.4 Azimuth (Deg) = 339.60
٠	Ground Elevation (Ft) = 0.0 Base Height (Ft) = 0.0
٠	Length (Ft) = 997.4 Height (Ft) = 65.0
٠	Rotation (Deg) = -156.30 Tilt (Deg) = 0.00
٠	Material is Trees Ground Plane Present
٠	Scatterer 15: Rectangle
٠	Range (Ft) = 811.1 Azimuth (Deg) = 32.50
•	Ground Elevation (Ft) = 0.0 Base Height (Ft) = 0.0
•	Length (Ft) = $608.7$ Height (Ft) = $64.0$
٠	Rotation (Deg) = -60.70 Tilt (Deg) = 0.00
•	Material is Trees Ground Plane Present
	방문성 방문성 (1992년 1992년

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- 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



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#### Part VIII

#### **Solutions**

#### 24 Exercises

This section provides step-by-step instructions on how to complete the exercises assigned during the standard OUNPPM training. As revisions are made to the software, screenshots may become out of date. The version used to create the instructions can usually be seen in the first screenshot of each example in the titlebar of the application.

#### 24.1 Exercise 1

This example demonstrates how to use the OUNPPM to model the elevation pattern of a glideslope array.

#### 24.1.1 Setup Exercise 1

When the application beings, you should see something resembling figure 152.

_	ce Prediction Model,	Version: O	UNPPM.1932.2	017.Jan.31.19.04.20.ES	T.zip, UID: 48		-	
e View Units Help	r. 3D World 3D N	av. Capt	ture JCCBI	Updates Report		Navaids Performa Prediction M		HI
ocalizer Model Glideslo			_	1	Iterators Tra			
Facility Parameters				Modeling Paramet				
Array Type:	WI14-10	~	C	Most Rece	ntly Applied Airpor	t Navaid Datasheet		
Center Frequency (MHz):		~		2 🔀				
CLR Frequency (MHz):	109.696 MHz			No Localize	r Applied Record.	Select from JCCBI Window.		
Runway Heading:	0.0 deg							
Runway Length:	10000.0 ft							
Runway Width:	150.0 ft			Fields to Mo	del: Automatic	~		
ILS Pt. C.:	1000.0 ft				Random DU Errors			
					mate Mutual Coupl			
Array Parameters								
-	Course Array:	151	Clearance A					
Element Type: Main Setback:			LPD 1000.0 ft	~				
Main Setback: Main Offset:			0.0 ft					
Main Height:			5.57 ft					
Array Rotation:			0.0 deg					
Antenna Rotation:		1	0.0 deg					
		rance Width	_					
		Separation						
	_							
	Use Course Parar	ms as Cleara	ance Params					

Figure 152: Exercise 1: Startup.

This is a glideslope example, so select File  $\rightarrow$  New Model  $\rightarrow$  Glideslope, as shown in figure 153, to change the model to a glideslope simulation.

🔬 OU Navaids Performant	e Prediction Model, Version	n: OUNPPM.1932.2017.Jan.31.19.04.20.EST.zip, UID: 48	- 🗆 ×
ile View Units Help			
New Model	Localizer	👼 🔋 👰 🔥 🏹 Navaids Performance 🏹	OHIO
Switch ILS	Glideslope	Capture JCCBI Updates Report Prediction Model	UNIVERSITY
Save Model	VOR	atterers Flight Editor Array Editor Iterators Traces User Properties	
Open Model	DME ME SC		
Load Results	-	Modeling Parameters	
Exit Ctrl+Q	WI14-10 🔨	Most Recently Applied Airport Navaid Datasheet	
Center Frequency (MHz):	109.7		
CLR Frequency (MHz):	109.696 MHz	No Localizer Applied Record. Select from JCCBI Window.	
Runway Heading:	0.0 deg		
Runway Length:	10000.0 ft		
Runway Width:	150.0 ft	Fields to Model: Automatic 🗸	
ILS Pt. C.:	1000.0 ft		
		Include Random DU Errors Approximate Mutual Coupling (if available)	
Array Parameters			
	Course Array:	Clearance Array:	
Element Type:	LPD v	LPD v	
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 W	idth: 2.2 deg	
	CLR / CRS Separa	tion: -17.0 dB	
	_		
	Use Course Params as Cl	zarance Params	

Figure 153: Exercise 1: Switching to glideslope.

Your interface should now resemble figure 154.

🙆 OU Navaids Performance	Prediction Model, Versio	n: OUNPPM.1932.20	17.Jan.31.19.04.20.ES	T.zip, UID: 48		_	
<u>F</u> ile View <u>U</u> nits <u>H</u> elp							
Save Run Sim Run Iter.	3D World 3D Nav.	Capture JCCBI	Updates Report		Navaids Performanc Prediction Mode		HIO
Localizer Model Glideslope	VOR Model DME S	catterers Flight Ed	itor Array Editor	Iterators Trac	ces User Properties		
Facility Parameters			Modeling Param	eters			
Array Type:	CAPT_EFF	$\sim$	Most Re	ently Applied Airpo	rt Navaid Datasheet		
Course Frequency (MHz):	333.2	~	8 💥				
CLR Frequency (MHz):	333.196 MHz		Windov Fields to		Record. Select from JCCBI		
Array Parameters			Array Auto-Adj	ust			
Slamash Turan	EA 0070						
Element Type: Main Setback:		~	Glide Path /	Angle: 3.0 deg			
Main Setback: Main Offset:			Antenna Height	Ratio: 2.0			
Array Rotation:			As-Is Ca	lculate heights base	ed on current glide-path angle		
Clearance Width:							
CLR/CRS Separation:					ieve 55.0 ft TCH at desired angle		
CLR/CRS Separation:	1.0 05		Automatical	y Update Glideslope	e Positions on Offset Change		
Current Data File: [NEW MODE	L NOT SAVED]						

Figure 154: Exercise 1: Default Facility Info.

Using the description of the facility information in the slides, in the facility info tab adjust the glide slope frequency, glide slope offset, and setback. Because the setback is specified in the problem description, use the "As-Is" option when updating the glide path angle. The resulting facility information can be seen in figure 155.

🚳 OU Navaids Performance	Prediction Model, Version	OUNPPM.1932.201	7.Jan.31.19.04.20.ES	T.zip, UID: 48		– 🗆 X
<u>F</u> ile View <u>U</u> nits <u>H</u> elp						
Save Run Sim Run Iter.	3D World 3D Nav. C	apture JCCBI	Updates Report		Navaids Performan Prediction Mo	OHIO UNIVERSITY
Localizer Model Glideslope	VOR Model DME Sca	tterers Flight Ed	itor Array Editor	Iterators Trace	es User Properties	
Facility Parameters			Modeling Param	eters		
Array Type:	CAPT_EFF	~	Most Rec	ently Applied Airpor	t Navaid Datasheet	
Course Frequency (MHz):	331.4	~	2 💥			
CLR Frequency (MHz):	331.396 MHz		Window Fields to I		acord. Select from JCCBI	
Array Parameters			Array Auto-Adj	ust		
Element Type:	EA.9076					
Main Setback:		~		Angle: 2.6 deg		
Main Offset:			Antenna Height I	Ratio: 2.0		
Array Rotation:			As-Is Ca	lculate heights base	d on current glide-path angle	
Clearance Width:	-					
CLR/CRS Separation:					eve 55.0 ft TCH at desired angle	
CENTERS SEparation.	1.0 00		Automatical	y Update Glideslope	Positions on Offset Change	
Current Data File: [NEW MODE	L NOT SAVED]					

Figure 155: Exercise 1: Facility Info as Described in the Problem Description.

Select the Flight Editor tab to change the flight to match the specifications of the problem description. Figure 156 shows the default Flight Editor tab.

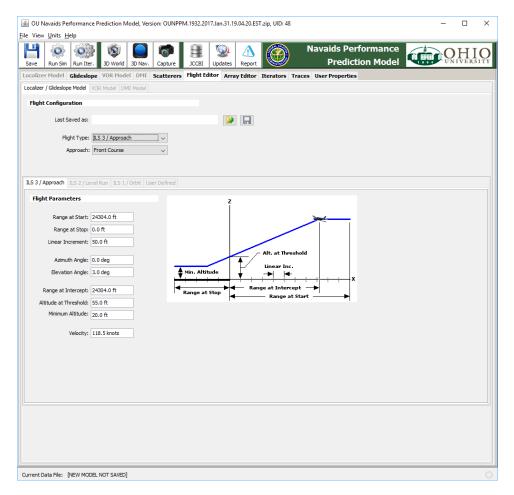


Figure 156: Exercise 1: Default Flight Path.

Using the "Flight Type" combo box, select the "User Defined" option, as shown in figure 157.

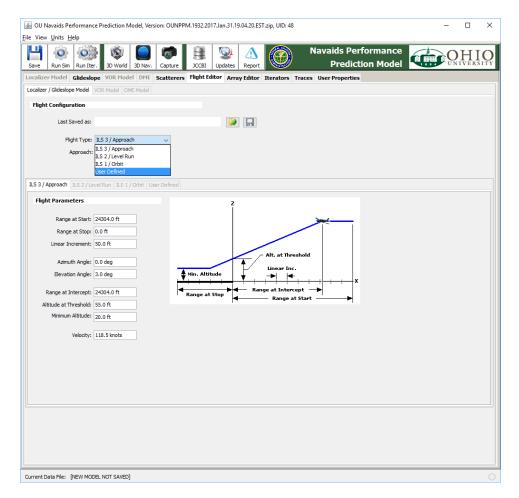


Figure 157: Exercise 1: Select User Defined.

Because the problem description specifies a constant range and elevation angle, a spherical coordinate system is ideal. The range and azimuth are constant, so we will use Elevation as the Domain Variable. Either a linear or angular increment can provide correct results, but this document will select an angular increment of .1 degrees. The three default ILS flight types are relative to the navaid, but by default User Defined flight paths are relative to origin (threshold). In order to analyze the elevation pattern relative to navaid, the X and Y offset must be set to the location of the navaid. Because the X parameter is an "offset" and not a "setback" the sign is inverted from the value on the facility info tab.

To test the elevation pattern, add two points to the flight path both with range 20000, and varying elevation from .1 to 10 degrees. The resulting flight path interface can be seen in figure 158. The virtual world representation of this flight path can be found in figure 159; this is not a realistic flightpath, but this example shows how the model can be used to simulated various other scenarios. Figure 160 shows the flightPath from the perspective of the navaid.

🚳 OU Navaids Performance Prediction Model, Version	OUNPPM.1932.2017.Jan.31.19.04.20.EST.2	zip, UID: 48	– 🗆 X
<u>File View Units H</u> elp			
Save Run Sim Sim Run Iter. Si SU World SD Nav. C	apture JCCBI Updates Report	Navaids Perfor Prediction	
Localizer Model Glideslope VOR Model DME Sci	atterers Flight Editor Array Editor I	terators Traces User Properties	
Localizer / Glideslope Model VOR Model DME Model			
Flight Configuration			
Last Saved as: ./para/ex1.flt			
Flight Type: User Defined	~		
Approach: Front Course	~		
ILS 3 / Approach ILS 2 / Level Run ILS 1 / Orbit User E	efined		
Flight Parameters			
Current FLT File: ./para/ex1.fit			
Coordinate System: Spherical $\sim$	🗴 Ø Ø	× 0	
Increment Type: Angular 🗸	Append Point Insert Above Insert Below	Remove Selected Remove All	
Domain Variable: Elevation 🗸	Rho (Range) (ft)	Theta (Elevation) (deg)	Phi (Azimuth) (deg)
X Offset: -1010.0 ft	20000.0 ft 20000.0 ft	0.1 deg 10.0 deg	0.0 deg
Y Offset: 380.0 ft			
Linear Increment: 50.0 ft			
Angular Increment: 0.01 deg			
Velocity: 118.5 knots			
Plot Options			
Analyze Flight Path As: O ILS 1 O ILS 2	ILS 3 ( ) Generic		
	0		
Current Data File: C:\gitRepo\repo\trunk\WAVAID\data\tem	p.dat		

Figure 158: Exercise 1: Flight Path Matching the Problem Description.

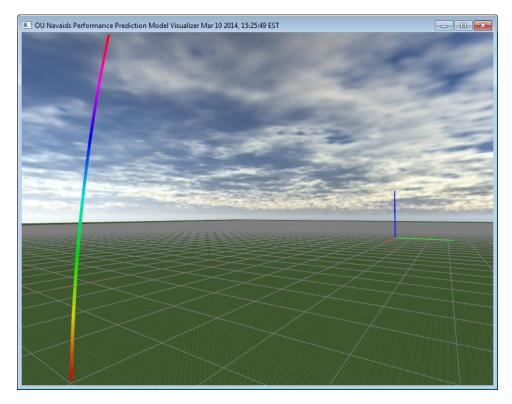


Figure 159: Exercise 1: Flight Path close up.

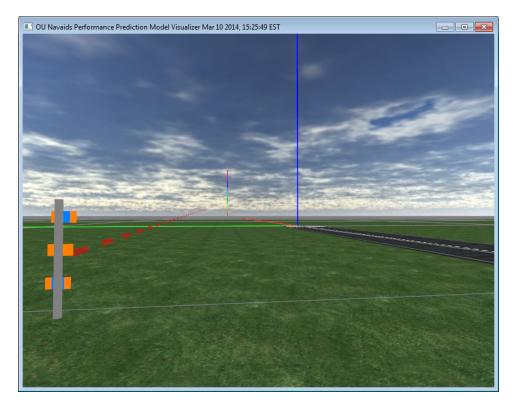


Figure 160: Exercise 1: Flight Path from the perspective of the navaid.

Finally, set up your traces to plot both the CSB and SBO of the course array. Your traces tab should resemble figure 161.

OU Navaids Performance Prediction Model, Version: OUNPPM.1932.20 The state of the state of th	17.Jan.31.19.04.20.EST.zip, UID: 48	- 🗆 X
Eile View Units Help		
Save Run Sim Run Iter. 3D World 3D Nav. Capture JCCBI	Updates Report Of Report O	
Localizer Model Glideslope VOR Model DME Scatterers Flight E	ditor Array Editor Iterators Traces User Properties	
Localizer / Glideslope Model VOR Model DME Model		
Localizer / Glideslope Trace Parameters		
<b>+ * 0</b>		
CDI, CDI Dgital, None, CRS Width: 0.624, CLS Width: 0.7, Sep: 1.0, Cap CSB, CSB gS SF, None, CRS Width: 0.624, CLS Width: 0.7, Sep: 1.0, Cap SBO, SBO Sig Str, None, CRS Width: 0.624, CLS Width: 0.7, Sep: 1.0, Cap	Ang: 1.7	
Trace Meta Information	Course Parameters	
Trace Name: CDI	Course Width: 0.624 deg	
	Mod. Balance: 0.0 uA	
Output Parameters	SBO Phase: 0.0 deg	
Parameter: CDI Digital 🗸	Tailored Course Width	
Use Cls/Crs: Both V		
Modeling Parameters	Clearance Parameters	
	Clearance Width: 0.7 deg	
Filtering: None ~	Mod. Balance: 0.0 uA	
Fields: Total	SBO Phase: 0.0 deg	
Switches	Clr/Crs Sep.: 1.0 dB	
Use ICAO Tolerences (No Zone 4 in CATII)	Capture Angle: 1.7 deg	
Always reference 0mA		
Maintain Axes Limits Between Plots		
Current Data File: C:\gitRepo\repo\trunk\NAVAID\data\temp.dat		0

Figure 161: Exercise 1 Traces.

#### 24.1.2 Results Exercise 1

Figure 162 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".

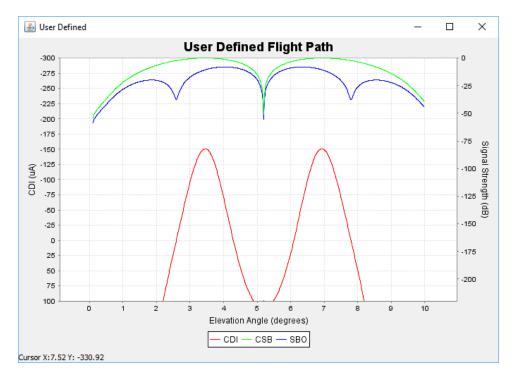


Figure 162: Exercise 1, Expected Results.

#### 24.2 Exercise 2

This example demonstrates how to use the OUNPPM to optimize the CRS-CLR ratio to obtain acceptable clearance.

#### 24.2.1 Setup Exercise 2

When the application beings, you should see something resembling figure 170.

🙆 OU Navaids Performanc	e Prediction Model,	Version: OUN	PPM.1932.2017.Jan.3	1.19.04.20.EST	.zip, UID: 48			-	ПX
Elle View Units Help									
Save Run Sim Run Ite	r. 3D World 3D N	av. Capture	JCCBI Updat	es Report	$\bigcirc$	Navaids Perform Prediction I			HIO
Localizer Model Glideslope VOR Model DME Scatterers Flight Editor Array Editor Iterators Traces User Properties									
Facility Parameters Modeling Parameters									
Array Type: WI14-10 V Most Recently Applied Airport Navaid Datasheet									
Center Frequency (MHz):	109.7	~		8 🗶					
CLR Frequency (MHz):	109.696 MHz			No Localizer	Applied Record.	Select from JCCBI Window.			
Runway Heading:	0.0 deg								
Runway Length:	10000.0 ft								
Runway Width:				Fields to Mod	del: Automatic	~			
ILS Pt. C.:	1000.0 ft			Indude R	andom DU Errors				
					ate Mutual Coupli				
Array Parameters									
Array Farameters									
Element Type:	Course Array:		learance Array:						
Main Setback:			.PD ~						
Main Offset:			0.0 ft						
Main Height:			5.57 ft						
Array Rotation:		-	0.0 deg						
Antenna Rotation:			0.0 deg						
		ance Width: 2							
		Separation:							
	_								
	Use Course Param	is as Clearance	e Params						

Figure 163: Exercise 2: Startup.

Using the problem description, set the array type, runway length, and localizer setback to the specified values. Your facility info should resemble figure 164.

🙆 OU Navaids Performan	ce Prediction Model,	Version: OU	JNPPM.1932.2017.Jan.	31.19.04.20.EST	.zip, UID: 48			-		
Eile View Units Help										
Save Run Sim Run Ite	r. 3D World 3D Na	av. Captu	Ire JCCBI Upda	tes Report	$\bigcirc$	Navaids Perfor Prediction			<b>HIO</b> NIVERSITY	
Localizer Model Glideslo	Localizer Model Glideslope VOR Model DME Scatterers Flight Editor Array Editor Iterators Traces User Properties									
Facility Parameters	Facility Parameters Modeling Parameters									
Array Type:	RECA	$\sim$	C		tly Applied Airport	t Navaid Datasheet				
Center Frequency (MHz):	109.7	$\sim$		2 🗶			_			
CLR Frequency (MHz):	109.696 MHz			No Localizer	Applied Record.	Select from JCCBI Window.				
Runway Heading:	0.0 deg									
Runway Length:	10500.0 ft						_			
Runway Width:				Fields to Mod	del: Automatic	~				
ILS Pt. C.:	1000.0 ft			Indude R	andom DU Errors					
				Approxim	ate Mutual Coupli	ing (if available)				
Array Parameters										
Array Parameters			<i>a</i> .							
Element Type:	Course Array:	٩.	Clearance Array:							
Main Setback:			1200.0 ft							
Main Offset:		<b>1</b>	0.0 ft							
Main Height:			5.57 ft							
Array Rotation:		٩.	0.0 deg							
Antenna Rotation:	0.0 deg		0.0 deg							
	Clear	ance Width:	1.3 deg							
	CLR / CRS	Separation:	-20.0 dB							
	Use Course Param	C								
	Se course Paran	is us ciedral	noc in all all is							

Figure 164: Exercise 2: Facility Info.

Because the clearance is constant for any (reasonable) range, an ILS1 (orbit) flight path is the correct approach for this problem. Go to the "Flight Editor" tab and select ILS 1 / Orbit from the "Flight Type" combo box. Your Flight Editor should resemble figure 165.

	🗟 OU Navaids Performance Prediction Model, Version: OUNPPM.1932.2017.Jan.31.19.04.20.EST.zip, UID: 63 - D X								
File View Units Help									
Save Run Sim Run It	er. 3D World 3D Nav	Capture JCCB	I Updates Report		Navaids Performance Prediction Model	<b>OHIO</b> UNIVERSITY			
Localizer Model Glides	ope VOR Model DME	Scatterers Flight	Editor Array Editor	Iterators 1	races User Properties				
Localizer / Glideslope Model	VOR Model DME Model								
Flight Configuration									
Last Saved as:									
Flight Type	: ILS 1 / Orbit	~							
	: Front Course	~							
ILS 3 / Approach ILS 2 / L	evel Run ILS 1/Orbit I	Jser Defined							
Flight Parameters									
			ľ		Ang.				
Azimuth at Start:					Azimuth				
Azimuth at Stop:					at Start				
Angular Increment:	0.5 deg			+ + + + - + - + - + - + - + - + - + - +	<b>x</b>				
Range:	24304.0 ft				Azimuth				
Altitude:	1500.0 ft				at Stop				
Velocity:	118.5 knots				. €∕				
				Range	<b>→</b>				

Figure 165: Exercise 2: Flight Path.

Because you are trying to find the maximum CRS-CLR ratio that provides acceptable coverage, start with the original value and and try incrementally higher values. We'll start with the default of -20, and try -19, -18, -17 (you are limited to 4 traces). Once the traces are added your Traces tab should resemble figure **??**.

OU Navaids Performance Prediction Model, Version: OUNPPM.1932.2017.		□ ×
Elle View Units Help Save Run Sim Run Iter. 30 World 30 Nav. Capture JCCBI U	Updates Report Report Navaids Performance Prediction Model	HIO
Localizer Model Glideslope VOR Model DME Scatterers Flight Editor	tor Array Editor Iterators Traces User Properties	
Localizer / Glideslope Model VOR Model DME Model		
Localizer / Glideslope Trace Parameters		
+ × 0		
Trace, CDI Digital, None, CRS Width: 3.427, CLS Width: 1.3, Sep: -0.0, CapA Trace, CDI Digital, None, CRS Width: 3.427, CLS Width: 1.3, Sep: -1.90, CapA Trace, CDI Digital, None, CRS Width: 3.427, CLS Width: 1.3, Sep: -18.0, CapA Trace, CDI Digital, None, CRS Width: 3.427, CLS Width: 1.3, Sep: -17.0, CapA	pAng: 0.0 pAng: 0.0	
Trace Meta Information Co	Course Parameters	
Trace Name: Trace	Course Width: 3.427 deg Mod. Balance: 0.0 uA	
Output Parameters	SBO Phase: 0.0 deg	
Parameter: CDI Digital		
Parameter: CDI Digital V Use Cls/Crs: Both V	Tailored Course Width	
	Clearance Parameters	
Modeling Parameters		
Filtering: None	Clearance Width: 1.3 deg	
Fields: Total	Mod. Balance: 0.0 uA	
Total	SBO Phase: 0.0 deg Cir/Crs Sep.: -17.0 dB	
Switches	Capture Angle: 0.0 deg	
Use ICAO Tolerences (No Zone 4 in CATII) Aways reference OmA Maintain Axes Limits Between Plots Fixed Precision	Capiture Migle: U.0 deg	

Figure 166: Exercise 2 Traces.

Figure 167 shows an example of the flight path in the virtual world.

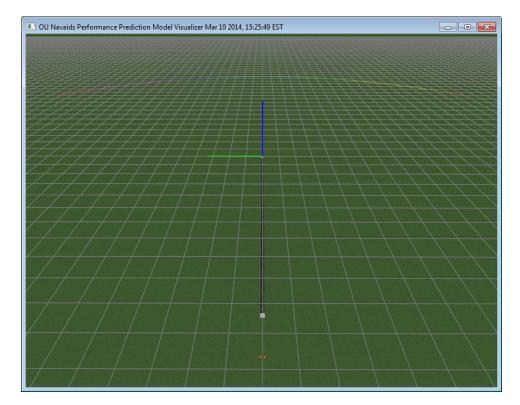


Figure 167: Exercise 2 Virtual World.

## 24.2.2 Results Exercise 2

Figure 169 shows an example of the 4 traces showing the CRS-CLR at various values.

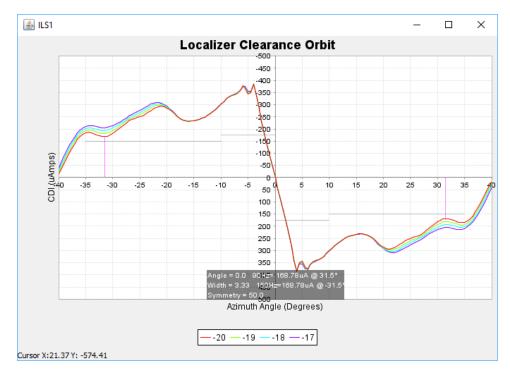


Figure 168: Exercise 2 Plot.

Figure ?? shows the results zoomed in near the  $200\mu$ A line. As you can see, the correct values lies somewhere between -17 and -18.

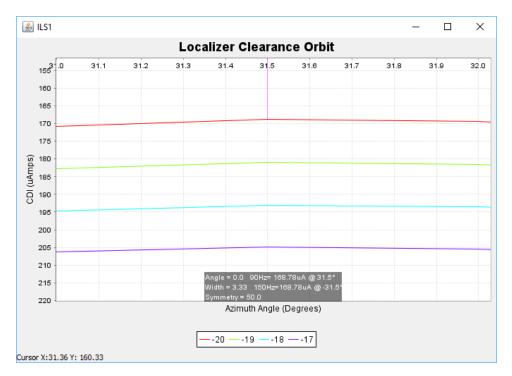


Figure 169: Exercise 2 Plot.

# 24.3 Exercise 3

This example demonstrates how to determine the effects of various antenna distributions.

### 24.3.1 Setup Exercise 3

When the application beings, you should see something resembling figure 170.

🙆 OU Navaids Performance	ce Prediction Model,	Version: OL	JNPPM.1932.2017.Jan	.31.19.04.20.ES	T.zip, UID: 48			-	□ ×
Elle View Units Help									
Save Run Sim Run Ite	r. 3D World 3D N	av. Captu	I I I I I I I I I I I I I I I I I I I	ates Report		Navaids Perform Prediction			HIO
Localizer Model Glideslo	pe VOR Model DI	1E Scatte	erers Flight Editor	Array Editor	Iterators Tra	aces User Properties			
Facility Parameters Modeling Parameters									
Array Type:	WI14-10	~	C		ntly Applied Airpor	rt Navaid Datasheet			
Center Frequency (MHz):	109.7	$\sim$		8 💥			_		
CLR Frequency (MHz):	109.696 MHz			No Localize	er Applied Record.	Select from JCCBI Window.			
Runway Heading:	0.0 deg								
Runway Length:	10000.0 ft								
Runway Width:	150.0 ft			Fields to M	odel: Automatic	~			
ILS Pt. C.:	1000.0 ft				Random DU Errors				
					mate Mutual Coup				
Array Parameters									
Classest Trans.	Course Array:	٤.	Clearance Array:						
Element Type: Main Setback:			LPD ~	1					
Main Offset:			0.0 ft						
Main Height:			5.57 ft						
Array Rotation:			0.0 deg						
Antenna Rotation:			0.0 deg						
		ance Width:							
	CLR / CRS	Separation:	-17.0 dB						
	_								
	Use Course Parar	ns as Clearar	nce Params						

Figure 170: Exercise 2: Startup.

First we use the problem description to set up our facility information. Your facility information should resemble figure 171

🛃 OU Navaids Performand	ce Prediction Model,	Version: OU	NPPM.1932.2017.Ja	n.31.19.04.20.ES	T.zip, UID: 63			_		<
Eile View Units Help										
Save Run Sim Run Ite	r. 3D World 3D N	av. Captu	re JCCBI Up	Jates Report		Navaids Perform Prediction			<b>DHIC</b>	) Y
Localizer Model Glideslo	pe VOR Model DM	IE Scatte	rers Flight Editor	Array Editor	Iterators Tra	aces User Properties				
Facility Parameters Modeling Parameters										
Array Type:	WI8	$\sim$	C	Most Rece	ntly Applied Airpor	t Navaid Datasheet				
Center Frequency (MHz):	111.9	$\sim$		8 🗶			_			
CLR Frequency (MHz):	111.896 MHz			No Localize	er Applied Record.	Select from JCCBI Window.				
Runway Heading:	0.0 deg									
Runway Length:	6001.0 ft									
Runway Width:				Fields to M	odel: Automatic	~				
ILS Pt. C.:	1000.0 ft			Indude	Random DU Errors	•				
				Approxi	mate Mutual Coupl	ling (if available)				
Array Parameters										
	Course Array:		Clearance Array:							
Element Type:		٩.	V-RING	~						
Main Setback:	1102.0 ft	٩.	1102.0 ft	1						
Main Offset:	0.0 ft	٩.	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							
	Clear	ance Width:	2.2 deg							
	CLR / CRS	Separation:	-17.0 dB							
	Use Course Param	is as Clearar	ice Params							
Current Data File: [NEW MOI	DEL NOT SAVED]									0

Figure 171: Exercise 3: Facility Info.

According to the problem description, we need to find the results of exactly 4 values. It would be perfectly acceptable to use the array editor and try each value individually, but you can accomplish this with less manual effort by using iterators. Using iterators we will try a superset of the required values. To iterate the DU Parameters, on the iterators tab, click the Iterate DU Parameters button ( $\mathcal{N}$ ), as seen in Figure 172. This will open a new frame.

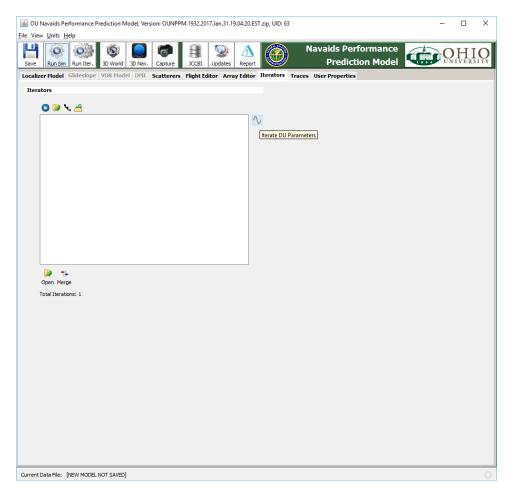


Figure 172: On the iterators tab, click the Iterate DU Parameters button.

In this window, shown in Figure 173, 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.

<u>\$</u>			-		×
Individual Antenr	nae Pair-to-Pair				
Antenna Name	Iterate Amplitude	Iterate Phase	Itera	te X Po	osition
4L					
3L					
2L					
1L					
1R					
2R					
3R					
4R					
Iterate As Grou	P 🗌				
ОК					

Figure 173: The DU iteration selection window.

If you set your iteration values to be like those shown in Figure 174 then you can test the selected elements at 0, 10, and 20 degrees. This covers all options in this example.

<u></u>			- 🗆 🗙
	Min	Max	Inc
Phase (deg):	0.0 deg	20.0 deg	10.0 deg
$\bigcirc$			

Figure 174: Values for the DU group iteration.

Select at least the elements needed for this example, as shown in Figure 175.

<u></u>			-		×
Individual Antenna	e Pair-to-Pair				
Antenna Name	Iterate Amplitude	Iterate Phase	Iterat	te X P	osition
4L					
3L		✓			
2L					
1L		✓			
1R					
2R		✓			
3R		✓			
4R					
Iterate As Group		✓			
ОК					

Figure 175: Exercise 3 elements.

Figure 176 shows the iterators tab after adding the DU iterators. Notice this will create 12 iterators total.

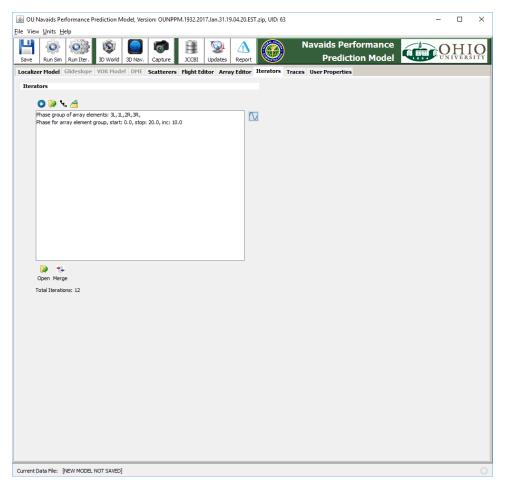


Figure 176: 12 total iterations.

Press the "Run Iteratations" button on the main toolbar to run the iterations. After running iterations a table of iterations will appear, as seen in Figure 177.

🛓 Iteration File	viewer							
CAT I v All Areas v								
Filename	Pattern	Ang(y)	Z2	Z3	Z4	Z5	Array Element Phase	Array Element Gr.
ex3_1.dat	ILS 3 / Approach	0	0.000% @ 4.000	0.000% @ 0.576			0.0	3L
ex3_2.dat	ILS 3 / Approach	13.15	0.021% @ 2.387	0.014% @ 0.173			10.0	3L
ex3_3.dat	ILS 3 / Approach	25.99	0.075% @ 2.576	0.042% @ 0.165			20.0	3L
ex3_4.dat	ILS 3 / Approach	0	0.000% @ 4.000	0.000% @ 0.576			0.0	1L
ex3_5.dat	ILS 3 / Approach	18.89	0.005% @ 1.943	0.000% @ 0.576			10.0	1L
ex3_6.dat	ILS 3 / Approach	37.99	0.007% @ 1.161	0.005% @ 0.256			20.0	1L
ex3_7.dat	ILS 3 / Approach	0	0.000% @ 4.000	0.000% @ 0.576			0.0	2R
ex3_8.dat	ILS 3 / Approach	-16.75	0.003% @ 0.576	0.003% @ 0.544			10.0	2R
ex3_9.dat	ILS 3 / Approach	-33.33	0.016% @ 2.634	0.007% @ 0.297			20.0	2R
ex3_10.dat	ILS 3 / Approach	0	0.000% @ 4.000	0.000% @ 0.576			0.0	3R
ex3_11.dat	ILS 3 / Approach	-13.15	0.021% @ 2.387	0.014% @ 0.173			10.0	3R
ex3_12.dat	ILS 3 / Approach	-25.99	0.075% @ 2.576	0.042% @ 0.165			20.0	3R

Figure 177: Table of iteration values.

### 24.3.2 Results Exercise 3

If you click "Select Iterables" on the iteration file viewer, and the plot the two paramters you will generate a plot with phases on one axis and the element on the other. The DU adjustments will not affect structure, but will affect angle. If you select "angle" on the plot you should see the results in Figure 178.

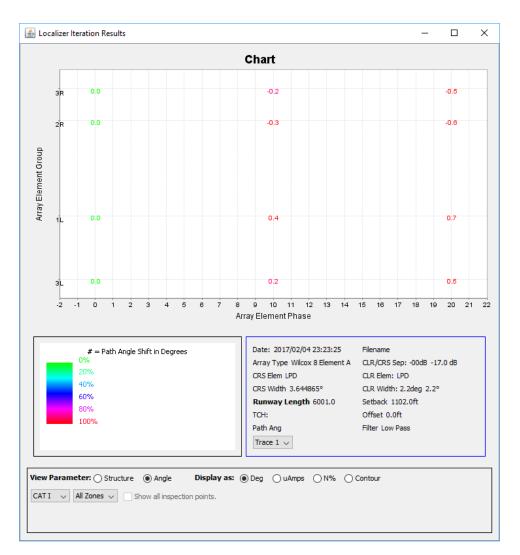


Figure 178: Exercise 3 Results.

## 24.4 Exercise 4

This example demonstrates how to use the vertical pull from image scatterer creation tool in a real scenario.

### 24.4.1 Setup Exercise 4

When the application beings, you should see something resembling figure 179.

🛃 OU Navaids Performand	📓 OU Navaids Performance Prediction Model, Version: OUNPPM.1932.2017.Jan.31.19.04.20.EST.zip, UID: 48 – 🗆 🗙								
Ele View Units Help									
Save Run Sim Run Ite	r. 3D World 3D Nav. Cap	ture JCCBI Updat	es Report	Navaids Performance Prediction Model	OHIO UNIVERSITY				
Localizer Model Glideslope VOR Model DHE Scatterers Flight Editor Array Editor Iterators Traces User Properties									
Facility Parameters Modeling Parameters									
Array Type:	WI14-10 ~	C	Most Recently Applied Airpor	t Navaid Datasheet					
Center Frequency (MHz):	109.7 🗸		2 🗙						
CLR Frequency (MHz):	109.696 MHz		No Localizer Applied Record.	Select from JCCBI Window.					
Runway Heading:									
Runway Length:									
Runway Width:			Fields to Model: Automatic	~					
ILS Pt. C.:	1000.0 ft		Include Random DU Errors						
			Approximate Mutual Coupl	ing (if available)					
Array Parameters									
, and the second second	Course Array:	Clearance Array:							
Element Type:		LPD V							
Main Setback:		1000.0 ft							
Main Offset:		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 Widt	a: 2.2 deg							
	CLR / CRS Separation	17.0 dB							
	Use Course Params as Clear	ance Params							
	Sectorial rename as Clear	ance i anama							

Figure 179: Exercise 4: Startup.

Using the problem description set up the facility information to resemble figure 180.

	Prediction Model, Version	OUNPPM.svn1746.2014.Mar.13.13.50.33.EDT	.zip, UID: 1
<u>File View Units H</u> elp			
Run Simulation Show 3D World	I Show 3D Navigator Run It	n 📢 📑 😡 🖕 ations Flight Path JCCBI Updates Authentica	tion Info Report Issue
Localizer Model Glideslope Mo	odel VOR Model DME Mod	Scatterers Flight Parameters Array Editor	Iterators Traces
Facility Info			
Array Type:	WI8	Include Random DU Errors	
Runway Length:	7218.0 ft	Most Recently Applied Airport I	Navaid Datasheet
Runway Width:	150.0 ft		let for 1000
Runway Heading:	0.0 deg	No Localizer Applied Record. So Window.	Sect from JCCBI
ILS Pt. C.:	1000.0 ft		
Center Frequency (MHz):	108.55		
Clearance Frequency (MHz):	108.546 MHz	Use Course Params as Clear	ance Params
	Course Array Params:	learance Array Params:	
Element Type:		PD v	
Ant Setback:		1000.0 ft	
Main Offset:	0.0 ft	).0 ft	
Main Height:	5.57 ft	5.57 ft	
Array Rotation:	0.0 deg	).0 deg	
Antenna Rotation:	0.0 deg	).0 deg	
	Clearance Width:	L.3 deg	
	CLR/CRS Separation:	20.0 dB	

Figure 180: Exercise 4 Facility Info.

In your presentation materials on your training flash drive you should have a picture of the small boat. If not you can download the image directly from figure 181.

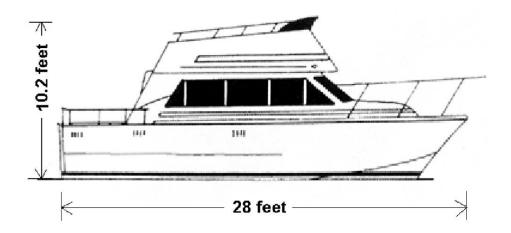


Figure 181: Exercise 4 Small Boat.

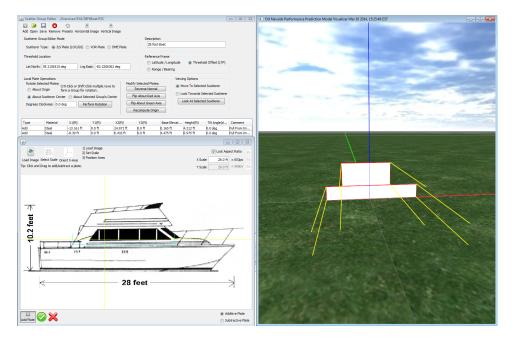


Figure 182: In the Scatterer Group Editor, click "XZ Image" to Pull from Image. 2) Load the 28 ft boat image. 3) Set the Scale. 4) Position the origin at the BOTTOM CENTER of the boat. The origin denotes the point about which the scatterer is locally rotated when manipulated in the editor. 5) Click the "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.

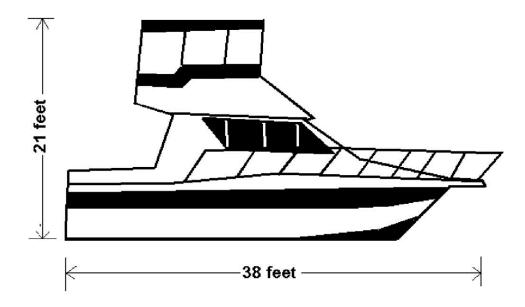


Figure 183: Exercise 4 Large Boat.

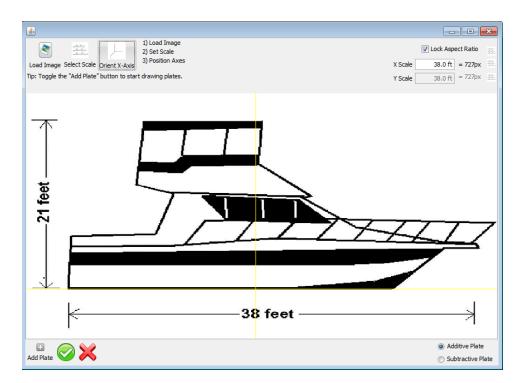


Figure 184: Setting origin of Large Boat to the boat's Bottom Center. This is the point of rotation for manipulations within the editor.

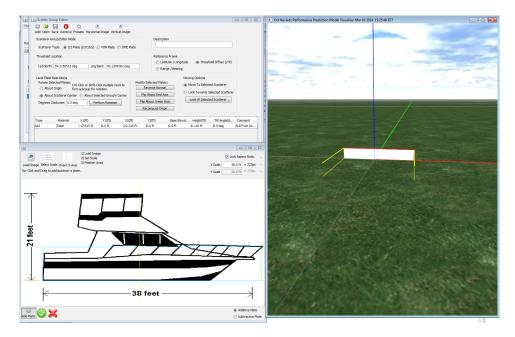


Figure 185: Creating Bottom Plate of Large Boat.

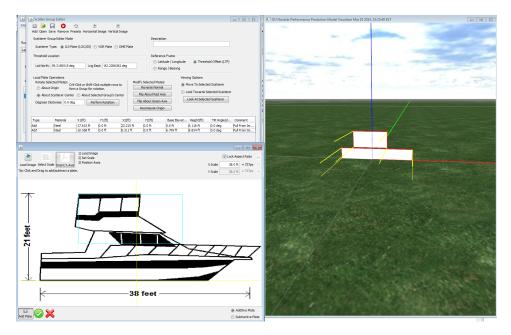


Figure 186: Creating Top Plate of Large Boat.

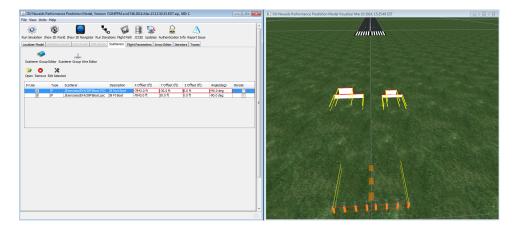


Figure 187: From the localizer's viewpoint, the large boat is on the left and the small boat is on the right. Notice the X Offset, Y Offset, and Angle specified within the *Scatterers* Tab.

OUNPPM			
Solution EX 4	X		
	Threshold (0,0)		
	4-1	Not to scale	
	7218++		
	1		
1			
Maximal	w ( 2220.5 0)		
Conel Boundry	START = (-7730.5,0)	225ft	
	15051		
setback 77	Stt Lord Per		
X = Course Width a:	3.64° (con change in traces to	6)	
Compute Iterator Field:		·	
ton x = 2 where (3755t) ton 3.64° = $10 = 23$	x=3.64° and L=150ft	+225ft:375ft	
			ATAPTIN IN
	-least [-255t, 25ft] in	3	STARTS iteration
and 225 ft in the	X direction		TARTY: O (conter line)
			505++(225++) = 262.5
We will position the	e boats at the center o-	f this area and	505++(2253+) = 262.5 Ruinty 2 Setback 72185++775ft-262
iterate in the y	-25gt, 25] by steps of	· 10ft (5 steps)	7730.55tin
iterate in the X [	-112.5, 112.5] by steps of	25ft (9 steps) 45 samples.	7730.5 St in negative X
		12 Jampies.	(-7730.5,0)

Figure 188: A pictoral 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.

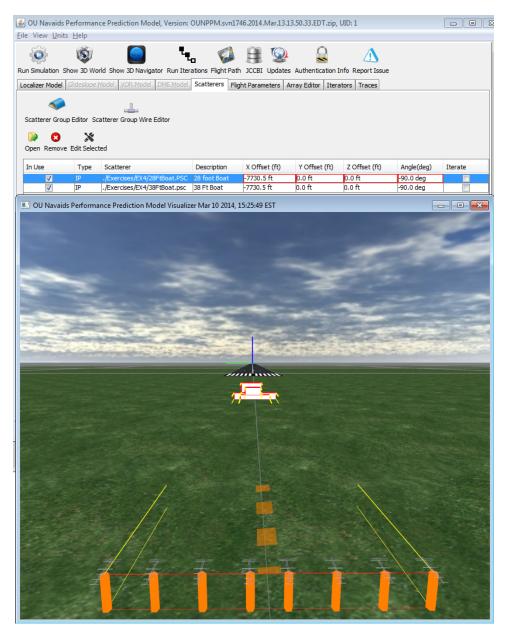


Figure 189: The boats have been positioned at the center of the iterator field derived in Fig.188.

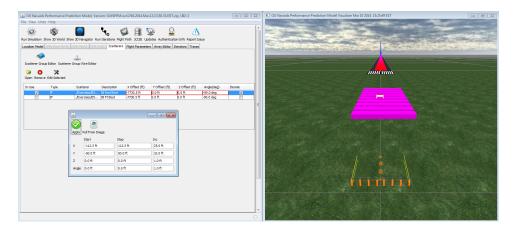


Figure 190: Small Boat: The iteration parameters have been set for the small boat. Using the diagram above, the Y iterator values were selected to be double the range computed in the diagram above (Fig.188. Click *Run Iterations* to simulate the model.

1         1	Image: Note of the state of the st	Column	-7,000 -7,025 -7,050 -7,055 -7,055 -7,755 -7,755 -7,755 -7,775	0.076 0.089 0.099 0.107 0.115 0.117	0.040 0.051 0.051 0.051 0.075 0.009	0.018 0.019 0.022	0.009 0 0.005 0 0.0 0	002 00 018 00 016 00 011 00	36 0.062 36 0.066	0.054 0.067 0.06 0.062	0.030	0.011	-0.016 -0.029
Image: Index manual part of the intervent p	Image: Contraction of Difference of Diffe	Image: Decision of the second of th	-7.825 -7.850 -7.876 -7.700 -7.725 -7.750 -7.776	0.090 0.000 0.107 0.115 0.117	0.051 0.061 0.075 0.009	0.018 0.019 0.022	0.009 0 0.005 0 0.0 0	002 00 018 00 016 00 011 00	36 0.062 36 0.066	0.054 0.067 0.06 0.062	0.030	0.002	0.023
Inter-         Inter-<	Definition         Instrumentary         Instrumenta	Difference         Processor         <	-7,850 -7,876 -7,700 -7,725 -7,750 -7,776	0.090 0.000 0.107 0.115 0.117	0.051 0.061 0.075 0.009	0.018 0.019 0.022	0.009 0 0.005 0 0.0 0	.018 0.0 .016 0.0 .011 0.0	36 0.062 36 0.066	0.054 0.057 0.06 0.062	0.030	0.002	0.023
Protect         Protect <t< td=""><td>Image:         Image:         Image:&lt;</td><td>Person         Person         Person&lt;</td><td>-7,876 -7,700 -7,725 -7,750 -7,776</td><td>0.098 0.107 0.115 0.117</td><td>0.001 0.075 0.093</td><td>0.019</td><td>0.005 0 0.0 0</td><td>016 0.0 011 0.0</td><td>90 0.099</td><td>0.067</td><td>0.035</td><td></td><td></td></t<>	Image:         Image:<	Person         Person<	-7,876 -7,700 -7,725 -7,750 -7,776	0.098 0.107 0.115 0.117	0.001 0.075 0.093	0.019	0.005 0 0.0 0	016 0.0 011 0.0	90 0.099	0.067	0.035		
Interne         Main	Neme         No         N	Please         Plane         Plane <t< td=""><td>-7,876 -7,700 -7,725 -7,750 -7,776</td><td>0.107 0.116 0.117</td><td>0.075</td><td>0.022</td><td></td><td>a11 aa</td><td></td><td>0.09</td><td></td><td>0.011</td><td>0.03</td></t<>	-7,876 -7,700 -7,725 -7,750 -7,776	0.107 0.116 0.117	0.075	0.022		a11 aa		0.09		0.011	0.03
0.0000101114     0.000010114     0.000010000000000000000000000000000000	0.00000000000000000000000000000000000	0.00000000000000000000000000000000000	-7,700 -7,728 -7,750 -7,776	0.107 0.116 0.117	0.075	0.022		a11 aa		0.062		-0.011	-0.03
0.00000000000000000000000000000000000	Starting Light 2013 (2013)	0.0000 (12) -0.0000 (12) -0.0000 (12) -0.0000 (12) -0.	-7,725 -7,750 -7,776	0.116	0.093				97 0.08	0.062			
0.0000       0.0000	0.00000000000000000000000000000000000	2009/97/42.44 33.7.499945 102.21974 2010 11114 0.000 21145 0.000 21455 0.000 2	-7,725 -7,750 -7,776	0.117		0.029	0.004 0	.007 0.0			0.029	-0.026	-0.034
0.00001_01_14.0       0.00001_01_14.0       0.00001_01_14.0       0.0000_01_14.0       0.0000_0001_00.0       0.000_0000_0000_0000_0000_0000_0000_00	0.0000       0.0000	02099/0714-08 03.7.0eeeeb 0.2.1.0978 0193 0496 030 16469 0410 1478 0478 0410 02780 0496 030 7800 0 02099/0714-08 03.7.0eeeb 030.0eeb 030.0eeb 030 0489 049 041 0410 0489 049 041 0278 02009/0714-08 030 0490 0490 0489 0490 0489 0490 0489 0490 0489 0490 0489 0490 0490	-7,750	0.117		0.029	-0.004 0						
Dem U - La -	Doment View 100 (100 (100 (100 (100 (100 (100 (100	DUPPE_124_06 123_Approx.0 1201_06FH 1139_204H 6200 1487H 6444 044H 1487H 64.44H 10 7400 7400 7400 740 74 74 74 74 74 74 74 74 74 74 74 74 74	-7,776		0.117				38 0.005	0.064	0.018	-0.044	
VARPEL (54.4) 43.3 Approx.h VARPEL (54.4)	Starth (1,2,4,4,4,1,3) Agreend) Starth (2,3,4,4,4,4,1,3) Agreend) Starth (2,3,4,4,4,4,1,3) Agreend) Starth (2,3,4,4,4,4,1,4,4,4,4,4,4,4,4,4,4,4,4,4,4	D2009 (2144) 333 / Aprendo 342 / Aprendo 342 / Aprelo 243 / Aprelo 24	-7,776										
COMPUT_LIN_LIN_US_1         X3.7 Approx/h         -110 - 60% - 60% - 100% - 60%         X3.7 6 - 64%         X4.8 23         X3.7 6 - 64%         X3.7 6 - 64%	0.00000000000000000000000000000000000	CXPPPE_LT_L_0000         X123         Apress 0.4         X124         X124				0.04	-0.000		A 0.073	0.005	-0.002	-0.064	
COMPUT_V1_LIN_US_1         X3 / Approx/h         -110 - 60m + 0.07 + 0.07 + 0.00 / 20 / 100 + 0.00 / 100 + 0.00 / 100 + 0.00 / 100 + 0.00 / 100 + 0.00 / 100 + 0.00 / 100 + 0.00 / 100 + 0.00 / 100 + 0.00 / 100 + 0.00 / 100 + 0.00 / 100 + 0.00 / 100 / 100 / 00 / 100 / 00 / 100 / 00 / 100 / 00 /	0.00000000000000000000000000000000000	CXPPPE_LT_L_0000         X123         Apress 0.4         X124         X124		0,109	0.145	0.00	0.012 4	007 0.0	42 0.082	0.061	-0.029	-0.083	-0.002
0.0000         0.00000         0.0000         0.0000	Company Sci. Link 333 Approxima Sci. Sci. Sci. 9, S	0.0009(05)(11.06) 153.1,269(00) 551.2,3716 0.100 7.2516 0.000 18.076 0.049 7.2516 0.000 7.9500 0.0000 7.9500 0.00000											
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Colorer_L_L_L_L_L_L_L_L_L_L_L_L_L_L_L_L_L_L_	0.00000000000000000000000000000000000	0.04999, 0.1.4.4.5.1.5.1.4.5.9.5.1.4.5.9.5.1.4.5.1.4.5.5.1.4.5.5.1.4.5.5.1.4.5.5.5.5											
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0.0499/ p4/34at 153 /aprovah 10.45/279/ p4.159 / aprovah 10.45/279/ p4.159 / aprovah 10.45/279/ p4.159 / aprovah 10.15/279/ p4.159 / aprovah 1	0.000% JSA 15.3 / JANUAR 15.3									cox 8 Eleme			
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	CATLI V Al Zones V Show all inspection points.												

## 24.4.2 Results Exercise 4 Small Boat

Figure 191: Small Boat: Plot results Table appears. Click *Select Iterables* to view the corresponding plot.

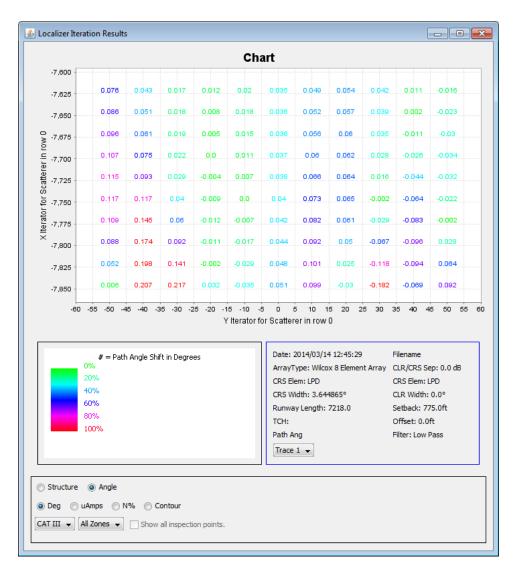


Figure 192: Small Boat: Cat III Angle plot results shown in Degrees. Very little is out of tolerance; if the size of the plates approximating the small boat were made a little smaller, then these areas may be within tolerance. Cat I is within tolerance.

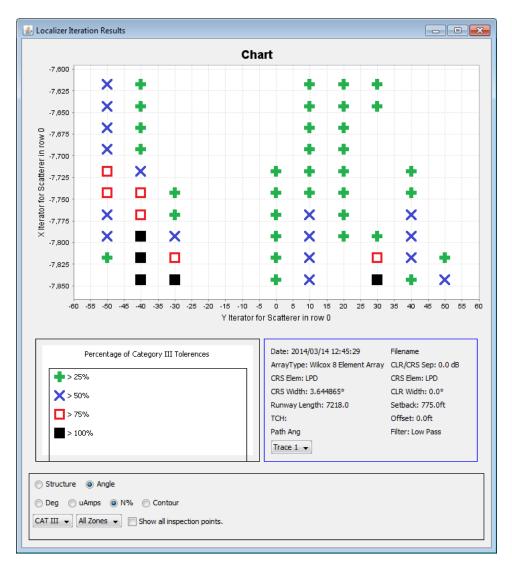


Figure 193: Small Boat: Cat III Angle plot results shown as a percent of tolerance. Very little is out of tolerance; if the size of the plates approximating the small boat were made a little smaller, then these areas may be within tolerance.

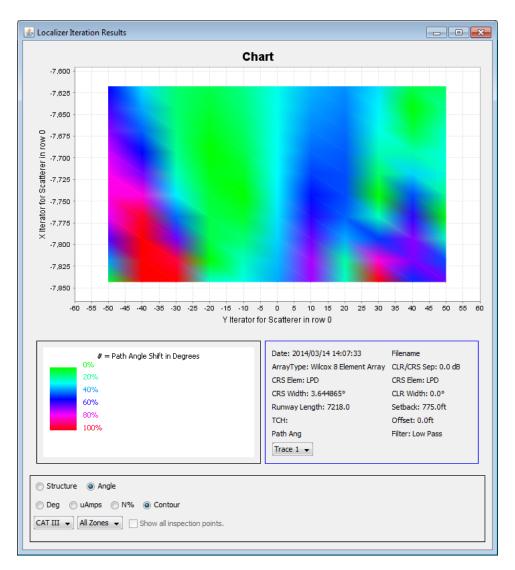


Figure 194: Small Boat: Cat III Angle plot results shown as a contour map of percent of tolerance. Very little is out of tolerance; if the size of the plates approximating the small boat were made a little smaller, then these areas may be within tolerance.

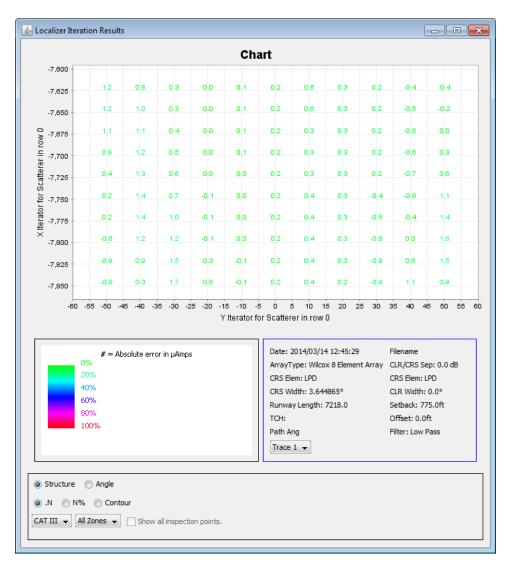


Figure 195: Cat III Structure plot shows very little error with nothing out of tolerance; the angle plot shows more error.

## 24.4.3 Results Exercise 4 Large Boat

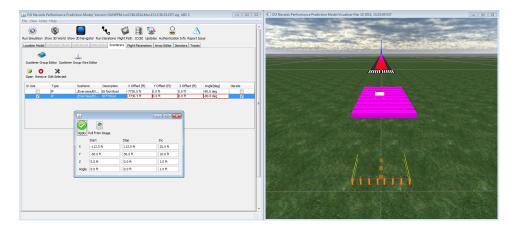


Figure 196: Large Boat: Iterator settings to model the large boat's effect on the localizer. Using the diagram show in Fig.188, the Y iterator values were selected to be double the range computed. Click *Run Iterations* to simulate the model.

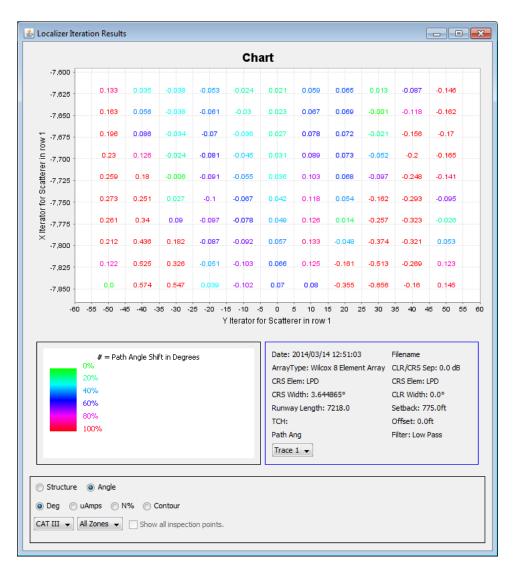


Figure 197: Large Boat: Cat III Angle plot results shown in Degrees. Areas shown in red are out of tolerance. The Angle tolerances of Categories I, II, and III are all out of tolerance, in contrast to the results shown with the small boat.

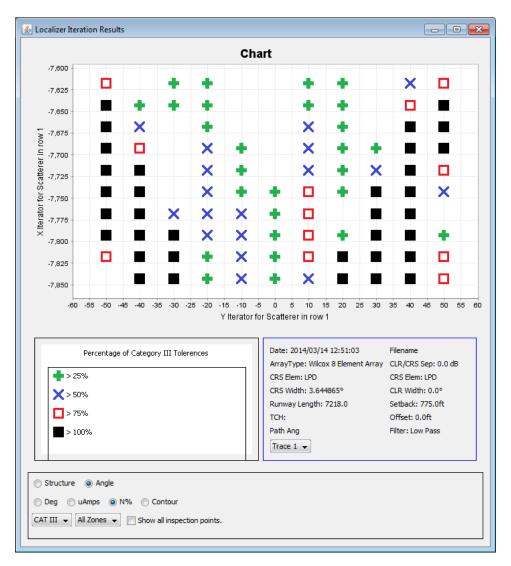


Figure 198: Large Boat: Cat III Angle plot results shown as a percentage of tolerance. Areas shown in black are out of tolerance.

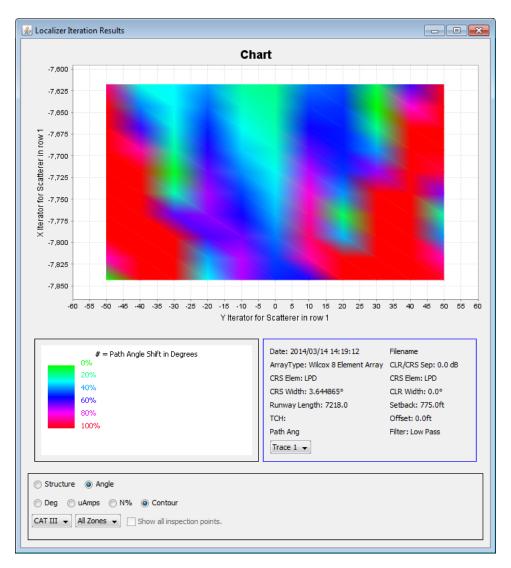


Figure 199: Large Boat: Cat III Angle plot results shown as a contour map of percent of tolerance. Areas shown in red are out of tolerance.

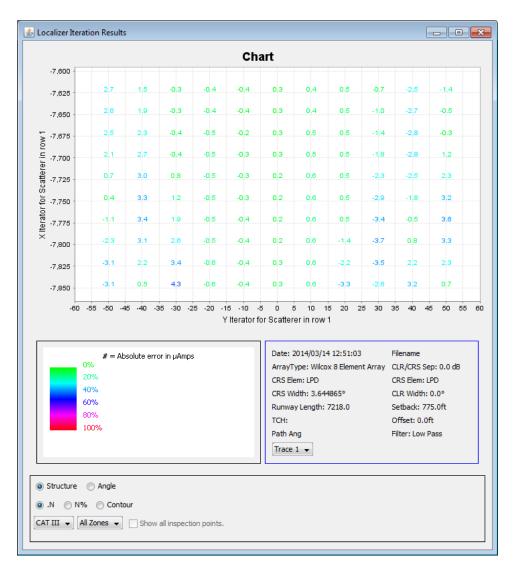


Figure 200: Large Boat: Cat III Structure plot shown in degrees. Notice the structure is well within tolerance whereas the angle is not.

## 24.5 Exercise 5

This example shows how to use the scatterer editor to model buildings by hand and iterate their locations.

### 24.5.1 Exercise 5 Setup

When the application beings, you should see something resembling figure 201.

🙆 OU Navaids Performant	e Prediction Model, Version:	OUNPPM.1932.2017.Jan.3	1.19.04.20.EST.zip, UID: 48		– 🗆 X
<u>F</u> ile View <u>U</u> nits <u>H</u> elp					
Save Run Sim Run Ite	r. 3D World 3D Nav. Ca	pture JCCBI Updat	es Report	Navaids Performance Prediction Model	OHIO UNIVERSITY
Localizer Model Glideslo	pe VOR Model DME Sca	tterers Flight Editor A	array Editor Iterators Tra	aces User Properties	
Facility Parameters		Modeli	ng Parameters		
Array Type:	WI14-10 ~	C	Most Recently Applied Airpor	t Navaid Datasheet	
Center Frequency (MHz):	109.7 ~		2 ×		
CLR Frequency (MHz):	109.696 MHz		No Localizer Applied Record.	Select from JCCBI Window.	
Runway Heading:	0.0 deg				
Runway Length:					
Runway Width:			Fields to Model: Automatic	~	
ILS Pt. C.:	1000.0 ft		Include Random DU Errors	1	
			Approximate Mutual Coupl	ing (if available)	
Array Parameters					
Array Farameters					
Element Type:	Course Array:	Clearance Array:			
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 Wid	th: 2.2 deg			
	CLR / CRS Separati	on: -17.0 dB			
	_				
	Use Course Params as Clea	arance Params			

Figure 201: Exercise 5: Startup.

Using the problem description set up the facility information to resemble figure 202.

<u>\$</u>	OU Navaids Perf	ormance	Prediction Model,	l, Version: OUNPPM.svn1892x1893.2015.Jul.12.15.22.04.EDT.zip, UID: 50 🛛 🚽 🗖 💌
<u>F</u> ile View <u>U</u> nits <u>H</u> elp				
Save Run Sim Run Ite				Report OF Interators Traces
-	pe voichouer pr	in   Statte		
Facility Parameters				ing Parameters
Array Type:		~	C	Most Recently Applied Airport Navaid Datasheet
Center Frequency (MHz):		~		No Localizer Applied Record. Select from JCCBI Window.
CLR Frequency (MHz):				No cocare applied record. Select from Social Window.
Runway Heading:				
Runway Length: Runway Width:				
	1000.0 ft			Fields to Model: Automatic 🗸
115 Pt. C.:	1000.011			Indude Random DU Errors
Array Parameters				
	Course Array:		Clearance Array:	
Element Type:			LPD v	
Main Setback:			1000.0 ft	
Main Offset:	0.0 ft	<b>1</b> .	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	
	Clear	ance Width:	2.2 deg	
	CLR / CRS	Separation:	-17.0 dB	
		-		
	Use Course Param	ns as Clearai	nce Params	
				0

Figure 202: Exercise 5 Facility Info.

On the "Scatterers" tab, use the

<u></u>			Scat	ter Group E	ditor ./para/	/ex5.psc		- 🗆 🗙	
<b>D</b> pen	H Save	Presets	Noriz. Image	Nert. Image	3D Navigator	Capture 3D		Edit Plate Scatter	er
<b>+</b> ≭ ∰					Plate Type	:   ILS (LOC)	GS) OVOR (		)
Type Add	Material Steel	X1(ft) -250.0 ft	Y1(ft) 0.0 ft	X2(ft) 250.0 ft	Y2(ft) 0.0 ft	Base Elevat 0.0 ft	Height(ft) 120.0 ft	Tilt Angle(d Comment 0.0 deg	
Plate Gene	ral Paramete	rs			Crtl-C		multiple rows to	o form a Group for transformation	n.
				_	Potate S	elected Plates			
Desc	ription:				Kotate 5	About 0			
Reference	Frame Param	eters				-	Gatterer Center		
Defer			. (			O About S	elected Group's	Center	
Refere	-	Threshold Offs Latitude / Long				Angle (De	grees ccw): 0.0	deg Apply	
			: 39.2156515 d	eg	Translate	e Selected Plat	tes:		
		Lng East	-82.2206362	deg		X / East: 0	.0 ft		
	C	) Range / Bearin	g			Y / North: 0	.0 ft		
						Z / Elev: 0	.0 ft	Apply Translation	
_					Modify S	elected Plates			
Viewing Op	tions					Reverse N	lormal	Flip About Red Axis	
	-	Selected Scatte							
		wards Selected S				Recompute	e Origin	Flip About Green Axis	
	Ap	ply View Change							

Figure 203: Exercise 5 Scatterer.

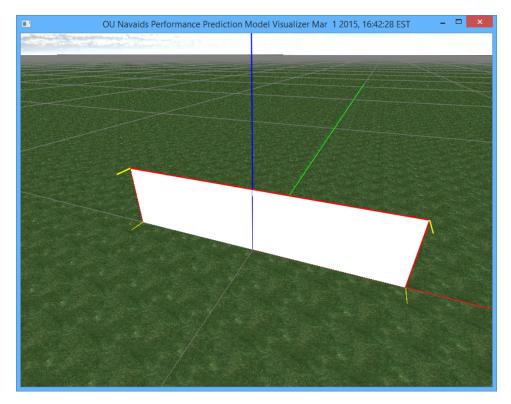


Figure 204: Exercise 5 scatterer in the virtual world.

٩			- 🗆 🗙
	2		
Apply	Pull From Image		
	Start	Stop	Inc
х	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 205: Exercise 5 iteration values.

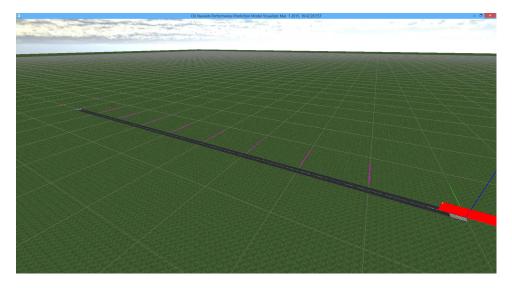


Figure 206: Exercise 5 iteration locations in the virtual world.

OU Navaids Performance Prediction Model, Version: OUNPPM.svn1892x1893.2015Jul.12.15.22.04.EDT.zip, UID: 50	×
File View Units Help	
Save         Run Sim         Save         Save         Capture         Scatteres         Flight Editor         Array Editor         Teces         Navaids Performance         Prediction Model         Control of the save         State         Save         Save	HIO
Facility Parameters Modeling Parameters	
Array Type: WI20-10 V C Most Recently Applied Airport Navaid Datasheet	
Center Prequency (vinz): 110.1	
CLR Frequency (MHz): 110.096 MHz No Localizer Applied Record. Select from JCCBI Window.	
Runway Heading: 0.0 deg	
Runway Length: 9000.0 ft	
Runway Width: 150.0 ft Fields to Model: Automatic V	
ILS Pt. C.: 1000.0 ft	
Array Parameters	
Course Array: Clearance Array:	
Element Type: LPD v Re LPD v	
Main Setbad: 1000.0 ft 1000.0 ft 1000.0 ft	
Main Offset: 0.0 ft 0.0 ft	
Main Height: 5.57 ft 5. 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: -20.0 dB	
✓ Use Course Params as Clearance Params	

Figure 207: Exercise 5 Facility Info with better array.

#### 24.5.2 Exercise 5 Results

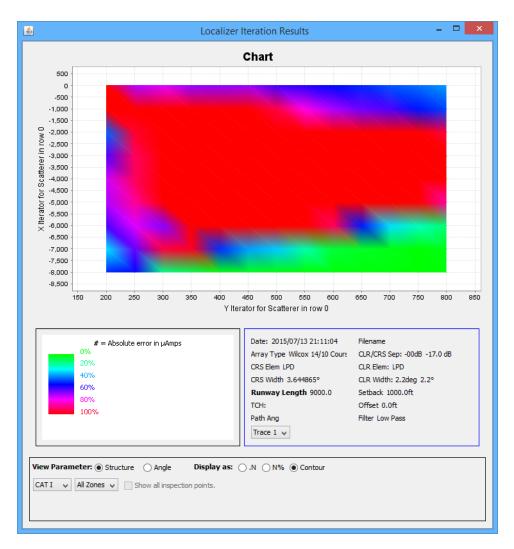


Figure 208: Exercise 5 Solution with WI 14-10.

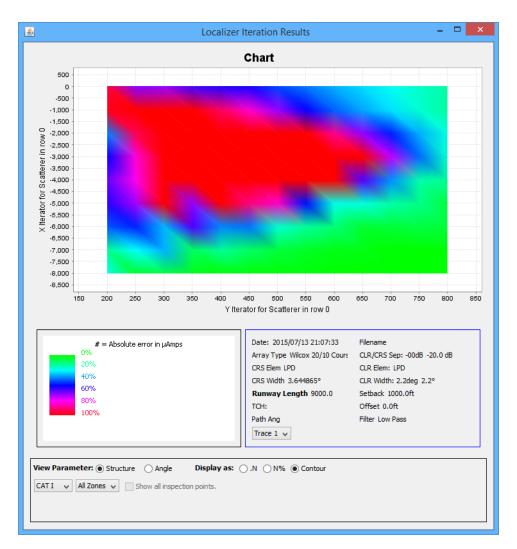


Figure 209: Exercise 5 Solution with WI 20-10.

## 24.6 Exercise 6

This example uses the scatterer editor in combination with a glideslope.

### 24.6.1 Exercise 6 Setup

When the application beings, you should see something resembling figure 210.

🙆 OU Navaids Performance	e Prediction Model,	Version: OUN	PPM.1932.2017.Jan.3	1.19.04.20.EST.	zip, UID: 48			_	п×	
Eile View Units Help										
Save Run Sim Run Ite	r. 3D World 3D N	av. Capture	JCCBI Updat	es Report	0	Navaids Perform Prediction I			HIO	
Localizer Model Glideslo	pe VOR Model DM	IE Scattere	ers Flight Editor A	rray Editor I	Iterators Tra	ces User Properties				
Facility Parameters			Modeli	ng Parameter	rs					
Array Type:	WI14-10	~ (	2		ly Applied Airport	t Navaid Datasheet				
Center Frequency (MHz):	109.7	~		8 💥						
CLR Frequency (MHz):	109.696 MHz			No Localizer /	Applied Record. S	Select from JCCBI Window.				
Runway Heading:	0.0 deg									
Runway Length:	10000.0 ft									
Runway Width:				Fields to Mode	el: Automatic	~				
ILS Pt. C.:	1000.0 ft			Indude Ra	andom DU Errors					
					te Mutual Coupli					
Array Parameters										
Array Farameters										
Element Type:	Course Array:		learance Array:							
Main Setback:			.PD ~							
Main Offset:			0.0 ft							
Main Height:			5.57 ft							
Array Rotation:		-	0.0 deg							
Antenna Rotation:			0.0 deg							
		ance Width: 2								
		Separation:								
	_									
	Use Course Param	is as Clearance	e Params							

Figure 210: Exercise 6: Startup.

This is a glideslope example, so select File  $\rightarrow$  New Model  $\rightarrow$  Glideslope, as shown in figure 211, to change the model to a glideslope simulation.

OU Navaids Performance	e Prediction Model, Ver	rsion: OUI	NPPM.1932.2017.Jan	.31.19.04.20.EST	zip, UID: 48			_	
View Units Help									
New Model	Localizer	1				Navaids P	erformance		ы
Switch ILS	Glideslope	Captur	re JCCBI Upd	ates Report		Pred	ction Model		NIVERSI
Save Model	VOR		rers Flight Editor		Itonatons Tra		_		
Open Model	DME	Statter				ices oser Propert	ies		
Load Results	-		Mode	ling Paramete					
Exit Ctrl+Q	WI14-10	~	C		ly Applied Airpor	t Navaid Datasheet			
Center Frequency (MHz):	109.7	$\sim$		2 🗶					
CLR Frequency (MHz):	109.696 MHz			No Localizer	Applied Record.	Select from JCCBI Wi	ndow.		
Runway Heading:	0.0 deg								
Runway Length:	10000.0 ft								
Runway Width:	150.0 ft			Fields to Mod	el: Automatic	~			
ILS Pt. C.:	1000.0 ft								
					andom DU Errors				
					ate Mutual Coupl	ing (if available)			
rray Parameters									
	Course Array:		Clearance Array:						
Element Type:	LPD v	۰.	LPD v	1					
Main Setback:	1000.0 ft	۰.	1000.0 ft	1					
Main Offset:	0.0 ft		0.0 ft						
Main Height:	5.57 ft	۰.	5.57 ft						
Array Rotation:		۰.	0.0 deg						
Antenna Rotation:			0.0 deg						
		ce Width:							
	CLR / CRS Se								
		paradon	-17.0 00						
	Use Course Params a	as Clearan	nce Params						

Figure 211: Exercise 6: Switching to Glideslope.

Your interface should now resemble figure 212.

🕌 OU Navaids Performance	Prediction Model, Version: C	UNPPM.1932.201	7.Jan.31.19.04.20.ES	T.zip, UID: 48		- 🗆 X
<u>File View Units H</u> elp						
Save Run Sim Run Iter.	3D World 3D Nav. Cap	JCCBI	Updates Report		Navaids Performance Prediction Mode	
Localizer Model Glideslope	VOR Model DME Scatt	erers Flight Edi	itor Array Editor	Iterators Tra	ces User Properties	
Facility Parameters			Modeling Param	eters		
Array Type:	CAPT_EFF ~		Most Rec	cently Applied Airpo	rt Navaid Datasheet	
Course Frequency (MHz):	333.2 🗸		2 💥			
CLR Frequency (MHz);	333.196 MHz		Window Fields to I		kecord. Select from JCCBI	
Array Parameters			Array Auto-Adj	ust		
Element Type:	FA-8976 ~	]	Glide Path /	Angle: 3.0 deg		
Main Setback:	1000.0 ft		Antenna Height I	Ratio: 2.0		
Main Offset:	400.0 ft					
Array Rotation:	0.0 deg		As-Is Ca	lculate heights base	ed on current glide-path angle	
Clearance Width:	0.7 deg		Adjust Ad	just setback to ach	ieve 55.0 ft TCH at desired angle	
CLR/CRS Separation:	1.0 dB		Automatical	y Update Glideslope	Positions on Offset Change	
Current Data File: [NEW MODE	L NOT SAVED]					

Figure 212: Exercise 6: Default Facility Info.

Using the problem description offset and setback.

🙆 OU Navaids Pe	erformance Prediction Model, Version: OUNPPM.svn1894.2015Jul.14.14.54.35.EDT.zip, UID: 67	- 🗆 🗙
File View Units Help		
Save Run Sim Run Iter. 30 World 30 Nav		OHIO
Localizer Model Glideslope VOR Model DME	E Scatterers Flight Editor Array Editor Iterators Traces	
Facility Parameters	Modeling Parameters	
Array Type: CAPT_EFF	Most Recently Applied Airport Navaid Datasheet	
Course Frequency (MHz): 333.2	× 8 ×	
CLR Frequency (MHz): 333,195 MHz	No Gildeslope Applied Record. Select from JCCBI Window. Fields to Model: Automatic v Indude Random DJ Errors	
Array Parameters	Array Auto-Adjust	
Element Type: FA-8976	V Glide Path Angle: 3.0 deg	
Main Setback: 1040.0 ft	Antenna Height Ratio: 2.0	
Main Offset: 463.0 ft		
Array Rotation: 0.0 deg	As-Is Calculate heights based on current glide-path angle	
Clearance Width: 0.7 deg	Adjust Adjust setback to achieve 55' TCH at desired angle	
CLR/CRS Separation: 1.0 dB	☑ Automatically Lipidate Glideslope Positions on Offset Change	
Current Data File: C:\OUNPPM\trunk\WAVAID\data\e>	zxamples\ex6.dat	0

Figure 213: Exercise 6: Facility Info.

Using the table in the problem description, create the 5 scatterer plates using the scatterer editor. First go the "Scatterers" tab, and click the "Plate Group Editor" button to open the Scatterer Group Editor. Use the Add Plate Button to add 5 plates and enter the values from the table in the problem description to that it resembles figure 216, then save your scatterer.

실 Scatter G	roup Editor							_		×	
<b>Open</b>	Save	Presets	Noriz. Image	Vert. Image	3D Navigator	Capture 3D		Edit	Plate Sca	tterer	
🕂 🗱 🎆	I				PI	ate Type: 🧿 ILS	(LOC/GS) OVC	or Ome/P (ILS)		VOR)	
Туре	Material	X1(ft)	Y1(ft)	X2(ft)	Y2(ft)	Base Eleva	ti Height(ft)	Tilt Angle(deg)	Comment		
Add	Steel	28.06 ft	866.81 ft	177.1 ft	666.7 ft	0.0 ft	18.0 ft	0.0 deg			
Add	Steel	2.61 ft	962.0 ft	119.34 ft	963.0 ft	0.0 ft	26.0 ft	0.0 deg		_	
Add Add	Steel	-526.9 ft -340.69 ft	879.31 ft 879.31 ft	-340.64 ft 28.06 ft	879.31 ft 854.31 ft	0.0 ft 0.0 ft	11.0 ft 11.0 ft	0.0 deg 0.0 deg			
Add	Steel	28.06 ft	854.31 ft	253.06 ft	860.56 ft	0.0 ft	11.0 ft	0.0 deg		-	
Permiability (µ	i) 2000.0	Permitivity (ε)	1.0 C	onductivity (Σ)	2000000.0 Plate Transfo		ft-Click multiple ro	ws to form a Group fo	or transform	ation.	
There delie					There maniste	inditions					
Desc	ription:				Rotate S	elected Plates:					
						🔿 About Ori	gin				
Reference	Frame Paran	neters				O About Sca	atterer Center				
herenenee		icters				O About Sel	ected Group's Cer	nter			
Refere	nce Frame: 🔇	Threshold Offset	(LTP)			Angle (Degr	ees ccw): 0.0 deg	Apply			
	C	) Latitude / Longiti	ude			Angle (Degri	ces ceny. 0.0 deg				
		Lat North:	39.2156515 de	g	Translate	e Selected Plate	5:				
		Lng East:	-82.2206362 d	eg	X / East: 0.0 ft						
	(	Range / Bearing				Y / North: 0.0	ft				
						Z / Elev: 0.0	nt (	Apply Translation			
Viewing Op	tions				Modify S	elected Plates:					
						Reverse No	rmal Fli	p About Red Axis			
	🔿 Move To	Selected Scattere	r								
	O Look To	wards Selected Sca	tterer			Recompute C	Drigin Fli	p About Green			
	Ap	ply View Change									

Figure 214: Exercise 6: Scatterers.

Add your new scatterer group to the world using the table on the "Scatterers" tab, and your virtual world should resemble figure **??**.

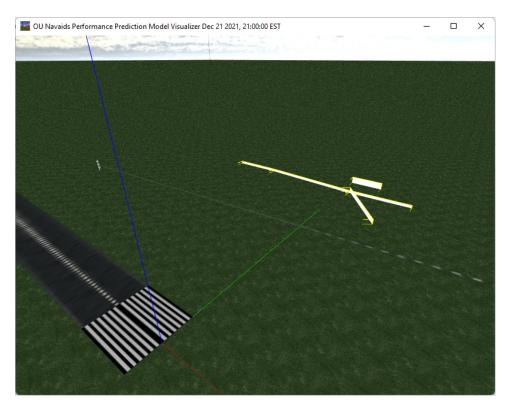
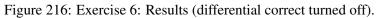


Figure 215: Exercise 6: Virtual World.

#### 24.6.2 Exercise 6 Results

When you run your simulation, the results should resemble figure ??.





### 24.7 Exercise 7

This example demonstrates how to use the horizontal pull from image scatterer creation tool in a real scenario.

#### 24.7.1 Exercise 7 Setup

When the application beings, you should see something resembling figure 217.

OU Navaids Performanc	e Prediction Mode	l, Version: OL	JNPPM.1932.201	17.Jan.31.19	.04.20.EST.zip, UID: 48			-	
e View Units Help			9	<b>@</b>		Navaids Perform Prediction I			
Save Run Sim Run Iter ocalizer Model Glideslo		Nav. Captu		Updates	Report		nouei		
Facility Parameters					arameters				
Array Type:	WI14-10	~	C		lost Recently Applied Airp	ort Navaid Datasheet			
Center Frequency (MHz):	109.7	~		1	8 💥				
CLR Frequency (MHz):	109.696 MHz			N	o Localizer Applied Recon	d. Select from JCCBI Window.	]		
Runway Heading:	0.0 deg								
Runway Length:									
Runway Width:				Fie	elds to Model: Automatic	~			
ILS Pt. C.:	1000.0 ft				Include Random DU Erro	vrs			
					Approximate Mutual Cou	upling (if available)			
Array Parameters									
	Course Array:		Clearance Arr	ay:					
Element Type:	LPD ·	~	LPD	~					
Main Setback:	1000.0 ft	٩.	1000.0 ft						
Main Offset:	0.0 ft	۰.	0.0 ft						
Main Height:		۰.	5.57 ft						
Array Rotation:	-	۰.	0.0 deg						
Antenna Rotation:		<b>1</b> .	0.0 deg						
		arance Width: IS Separation:							
		co oeparation.	-17.0 00						
	Use Course Para	ams as Clearar	nce Params						

Figure 217: Exercise 7: Startup.

Using the problem description adjust the facility info to resemble figure 218.

<u></u>	OU Navaids P	Performar	nce Prediction Mod	del, Version: OUNPPM.svn1894.2015Jul.14.14.54.35.EDT.zip, UID: 67 🛛 🚽 🗖 💌
<u>File View Units H</u> elp				
Save Run Sim Run Ite				
Localizer Model Glideslo	pe VOR Model DM	1E Scatte	rers Flight Editor A	rray Editor Iterators Traces
Facility Parameters			Modelin	ng Parameters
Array Type:	WIN8	~	C	Most Recently Applied Airport Navaid Datasheet
Center Frequency (MHz):	109.7	~		2 🗙
CLR Frequency (MHz):	109.696 MHz			No Localizer Applied Record. Select from JCCBI Window.
Runway Heading:	0.0 deg			
Runway Length:	11200.0 ft			
Runway Width:	150.0 ft			Fields to Model: Automatic 🗸
ILS Pt. C.:	1000.0 ft			Include Random DU Errors
Array Parameters				
	Course Array:		Clearance Array:	
Element Type:			LPD v	
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	
		ance Width:		
	CLR / CRS	Separation:	-17.0 dB	
	Use Course Param	ns as Clearar	nce Params	
Current Data Silay, Color MDD				
Current Data File: C:\OUNPP	m (trunk (vAVAID (data)	examples\e>	(/.dat	0

Figure 218: Exercise 7: Facility Info.

Under the "Scatterers" tab load the "Plate Group Editor" and select the "Horiz. Image", and you should see an interface resembling figure **??**.

Load the "EX\_7.jpg" file directly from your presentation materials, and your interface should resemble figure 219.

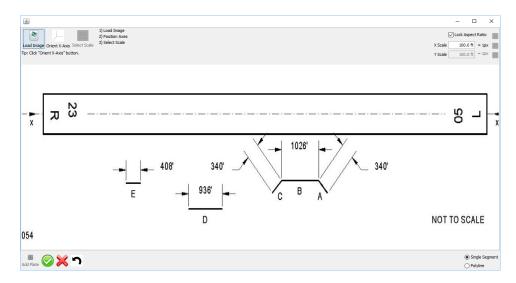


Figure 219: Exercise 7: Image Loaded.

If you no longer have access to your original file, you can get the image by resaving figure **??**.

Next we need to orient our axes. Since the problem description this is an approach on 23R, the positive x-axis (red) should extent to the right from right end of the runway. Once positioned your interface should resemble figure **??**.

Next we need to set our scale. We need to pick a reference object we know the length of, I chose building B, but you could just as easily have chosen the runway whose length is given in the problem description. You will see in the upper right corner that this is 98 pixels long which will represent 1026 feet. This is demonstrated in figure 220.

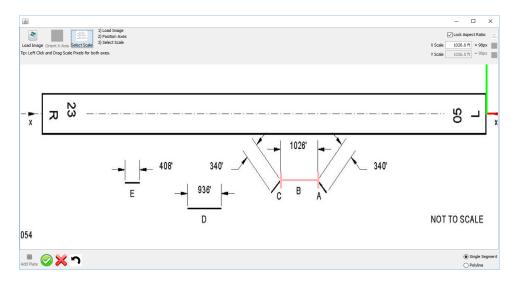


Figure 220: Exercise 7: Set Scale.

Now we need to add each of our plates, click the "Add Plate" button and drag from right to left on each plate. Optionally, try the polyline option so that the last 3 plates are meet coincidentally. Your result should look something like figure **??**.

Once you manipulate the heights of the plates to match those in the problem description, you can safely exit the pull from image interface and should see 5 scatterers in your scatterer table, similar to those in figure 221. Save this scatterer group and add it to your scatterer group table on the scatterer tab of the main window.

<u>\$</u>			Scat	ter Group Ed	ditor ./para,	/ex7.psc			- 🗆 🗙		
Open Open	Save	Presets	Noriz. Image	Vert. Image	3D Navigator	Capture 3D		E	lit Plate Scatterer		
+*8							S) OVOR		) Ome/N (Vor)		
Туре	Material	X1(ft)	Y1(ft)	X2(ft)	Y2(ft)	Base Elevat	Height(ft)	Tilt Angle(d	Comment		
Add	Steel	-3914.59 ft	-1957.3 ft	-4144.32 ft	-1663.24 ft	0.0 ft	72.0 ft	0.0 deg	Pull From Im		
Add	Steel	-4144.32 ft	-1663.24 ft	-5063.24 ft	-1663.24 ft	0.0 ft	72.0 ft	0.0 deg	Pull From Im		
Add	Steel	-5063.24 ft	-1663.24 ft	-5265.41 ft	-1938.92 ft	0.0 ft	72.0 ft	0.0 deg	Pull From Im		
Add	Steel	-6487.57 ft	-2361.62 ft	-7332.97 ft	-2352.43 ft	0.0 ft	80.0 ft	0.0 deg	Pull From Im		
Add	Steel	-8500.0 ft	-1727.57 ft	-8858.38 ft	-1718.38 ft	0.0 ft	75.0 ft	0.0 deg	Pull From Im		
Crtl-Click or Shift-Click multiple rows to form a Group for transformation. Plate General Parameters Plate Transformations											
Plate General Parameters Plate Transformations											
Description: Rotate Selected Plates:											
						About C	rigin				
Reference	Frame Param	eters				O About S	catterer Cente	er			
						O About S	elected Group	s Center			
Refere	nce Frame: 🔘	Threshold Offse	et (LTP)								
	0	Latitude / Longi	tude			Angle (Deg	rees ccw): 0.	0 deg	Apply		
		Lat North:	39.2156515 de	2g	Translat	e Selected Plat	es:				
		Lng East:	-82.2206362 d	eg		X / East: 0	.0 ft				
	0	Range / Bearing	3			Y / North: 0	.0 ft				
						Z / Elev: 0	.0 ft	Apply T	anslation		
Viewing Op	otions				Modify S	elected Plates:					
						Reverse N	ormal	Flip About I	Red Axis		
	Move To	Selected Scatter	er								
	O Look Tow	ards Selected So	atterer			Recompute	Origin	Flip About G	reen Axis		
	App	ly View Change									

Figure 221: Exercise 7: Final Scatterers.

When the scatter group has been added to the main table, your virtual world should look like figure **??**, and it is safe to run your simulation.

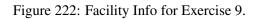
#### 24.7.2 Exercise 7 Results

Figure **??** shows the results for this simulation. As you can see it would not pass inspection.

## 24.8 Exercise 8

- 24.8.1 Exercise 8 Setup
- 24.8.2 Exercise 8 Results
- 24.9 Exercise 9
- 24.9.1 Setup Exercise 9

<u>4</u>	OU Navaids Performance Prediction Model, Version: OUNPPM.svn1894.2015.Jul.14.14.54.35.EDT.zip, UID: 67 – 🗖 💌
<u>File View Units H</u> elp	
Save Run Sim Run Iter.	Image: Source of the
Facility Parameters	Modeling Parameters
VOR Type:	
Frequency (MHz):	
Position North:	.0 ft No VOR Applied Record. Select from JCCBI Window.
Position East:	.0 ft
Ground Elevation:	.0 ft
Antenna Height:	
Counterpoise Height:	
Counterpoise Radius:	6.0 ft
Current Data File: [NEW MODE	L NOT SAVED]



OU Navaids Performance P	rediction Model, Version: OUNPPM.svn1894.2015Jul.14.14.54.35.EDT.zip, UID: 67 🦳 – 🗖 💌
<u>File View Units H</u> elp	
Save Run Sim Run Iter. 30 World 30 Nav.	Image: Second Updates         Analytic Control         Mavaids Performance         Image: Control Control         Contro <th< th=""></th<>
Localizer Model Glideslope VOR Model DME Scatterers	Flight Editor Array Editor Iterators Traces
Localizer / Glideslope Model VOR Model DME Model	
VOR Flight Profiles	
· 🛛 💥 🖸	
Orbital Radial: [0.0 deg, 360.0 deg] Rng; [40.0 nmi, 40.0 nmi]	Alt: [1000.0 ft; 1000.0 ft] Step Sze: 1.0 deg
Flight Pattern for Selected Profile: Orbital	
Orbital	RNAV
Start Radial: 0.0 deg Stop Radial: 360.0 deg	Start Radial: 0.0 deg Stop Radial: 360.0 deg
Start Range: 40.0 nmi Stop Range: 40.0 nmi	Start Range: 40.0 nmi Stop Range: 40.0 nmi
Start Alt: 1000.0 ft Stop Alt: 1000.0 ft	Start Alt: 1000.0 ft Stop Alt: 1000.0 ft
Step Size: 1.0 deg	Step Size: 1.0 nmi
Radial	Fixed Point
Start Range:         40.0 nmi         Stop Range:         40.0 nmi           Start Alt:         1000.0 ft         Stop Alt:         1000.0 ft	Radial: 0.0 deg
Start Alt:         1000.0 ft         Stop Alt:         1000.0 ft           Radial:         0.0 deg         Step Size:         1.0 nmi	Range: 40.0 nmi
Reduct 0.0 deg	Alt: 1000.0 ft
Units	
Range: nmi v Alt: ft v Step	o Size: nmi ↓
Current Data File: [NEW MODEL NOT SAVED]	

Figure 223: The flight for Exercise 9.

<u>*</u>				Scat	ter Group E	ditor ./pa	ra/ex9.psc			-	×	
<b>D</b> pen	Save	Presets		S) . Image	Vert. Image	3D Navigato	r Capture 3			Edit Pl	ate Scatterer	
<b>+</b> ≭ ⊞	è					Plate T	ype: 🔿 ILS (	.oc/gs) 💿		ME/P (ILS) 🔘	DME/N (VOR)	
Type Add	Material Steel	N1(ft) -1034.132 ft	E1(ft) 4197.79 ft	N2(ft)	E2(ft) 21 ft 4194.651	Gnd Plate	Gnd Elev 0.0 ft	Base Hei 0.0 ft	Height(ft) 104.8 ft	Tilt Angl 0.0 deg	Comment	
Add	Steel	-1046.864 ft	5216.027 ft	-1039.7	43 ft 4196.052	ft 🗸	0.0 ft	0.0 ft	104.8 ft	0.0 deg		
Plate Gen	eral Parame	ters					tl-Click or Shift sformations	-Click multiple	rows to for	m a Group for t	ransformation.	
Desc	cription:					Rotat	e Selected Pl					
							0	out Origin	Cantas			
Reference	e Frame Par	ameters					0	out Scatterer out Selected		ter		
Refere	ence Frame:	Threshold	Offset (LTP	)			0				alu	
			/Longitude			Angle (Degrees ccw): 0.0 deg Apply						
			North: 39.2		-	Translate Selected Plates:						
			East: -82.2	206362 0	eg	X / East: 0.0 ft						
		O Range / E	Bearing				Y / Nort	h: 0.0 ft				
							Z / Ele	v: 0.0 ft		Apply Transla	tion	
Viewing O	ptions					Modify	/ Selected Pl	ates:				
							Reve	rse Normal	F	ip About Red A	xis	
	0	To Selected S					-					
		Towards Selec Apply View Ch		r			Recor	npute Origin	Fit	About Green	AXIS	
		Apply view cit	lange									

Figure 224: The scatterer (2 plates), for Exercise 9.

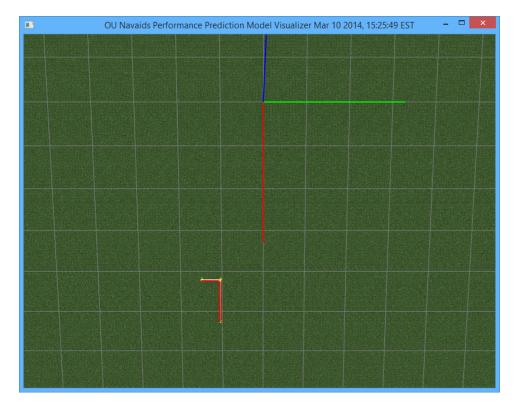


Figure 225: The scatterer (2 plates), for Exercise 9 in the virtual world.

#### 24.9.2 Results Exercise 9

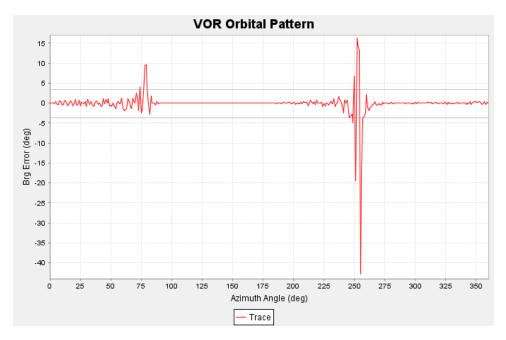


Figure 226: Results for Exercise 9 with both scatterer plates in place.

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

## 24.10 Exercise 10

#### 24.10.1 Setup Exercise 10

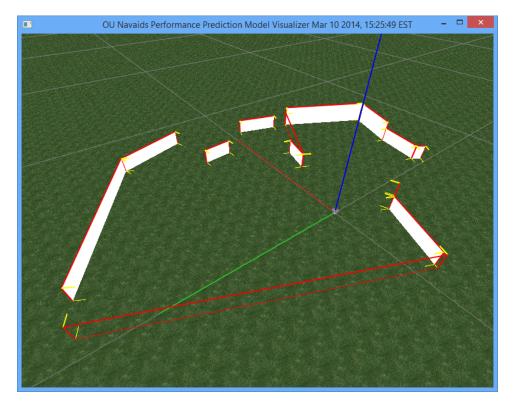


Figure 227: The plates for exercise 10 viewed from the northwest.

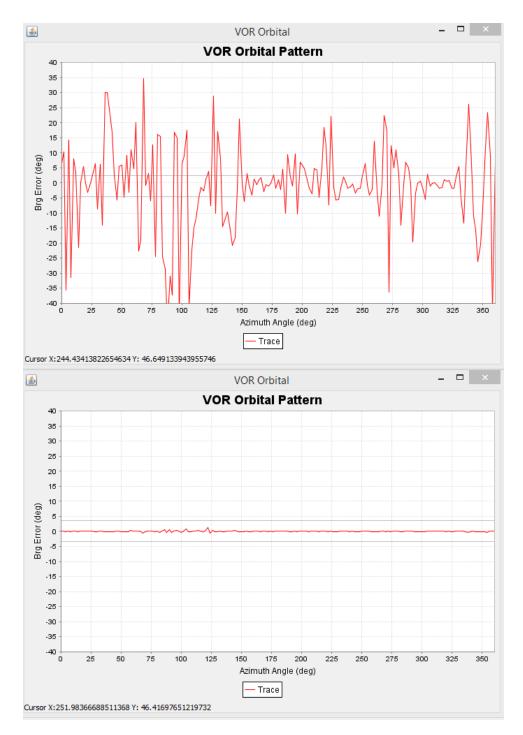


Figure 228: Results for Exercise 10 with all scatterer plates in place. Top is conventional VOR, bottom is doppler.

# 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**

#### 25 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:

#### 26 Distance Units

#### 26.1 Feet

#### 26.1.1 Feet

1 Foot to 1 Foot

#### 26.1.2 Meters

1 Foot to .3048 Meters

#### 26.1.3 Nautical Miles

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

#### 26.1.4 Wavelengths

26.2 Meters

## Part XI

# **Appendix B: Files**

### 27 File Extentions

- .dat The data file containing the state of a simulation.
- .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

### 28 File Contents

#### 28.1 Input Files

- 28.1.1 Localizer
- 28.1.1.1 LDU
- 28.1.2 Glideslope
- 28.1.2.1 GDU
- **28.2** Intermediate Files
- 28.2.1 Localizer and Glideslope
- 28.2.1.1 DAT
- 28.3 Output Files
- 28.3.1 PTS

## Part XII

# **Appendix C: Troubleshooting**

#### 29 FAQ

Q: Updates won't download.

A: Ensure that you are connected to the internet. Ensure that you can browse to the website containing the update repository. If these both work, check to make sure your Java security is not set to "highest", these prevents in-app downloads.

Q: The program ran, but the plot is all white.

A: If you are running a User Defined flightpath, ensure that the domain parameter is not constant between itinerary points.

#### 30 Issue Reporter

- 31 Log Files
- 31.1 Java Log File
- 31.2 Visualization Log File
- 31.3 VOR Output File

## Part XIII

# **Appendix D: Known Issues**