Research Project Number 0-4463
Product 0-4463-P3
Program Instruction Manual

Project Title: Using Profile Measurements to Locate and Measure Grind and Fill Areas to Improve Pavement Ride

Performed in cooperation with the Texas Department of Transportation and the Federal Highway Administration

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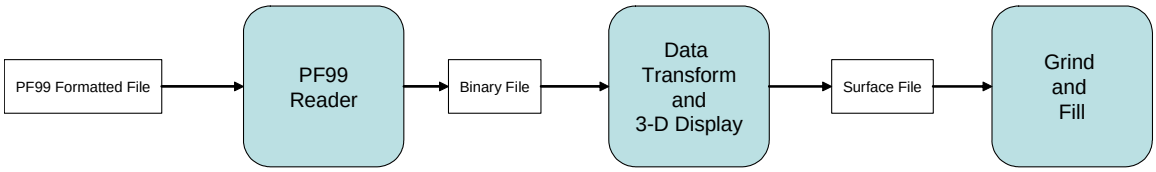
INTRODUCTION

INSTRUCTION MANUAL FOR USING THE 3-D SURFACE PROFILE AND GRIND AND FILL SOFTWARE

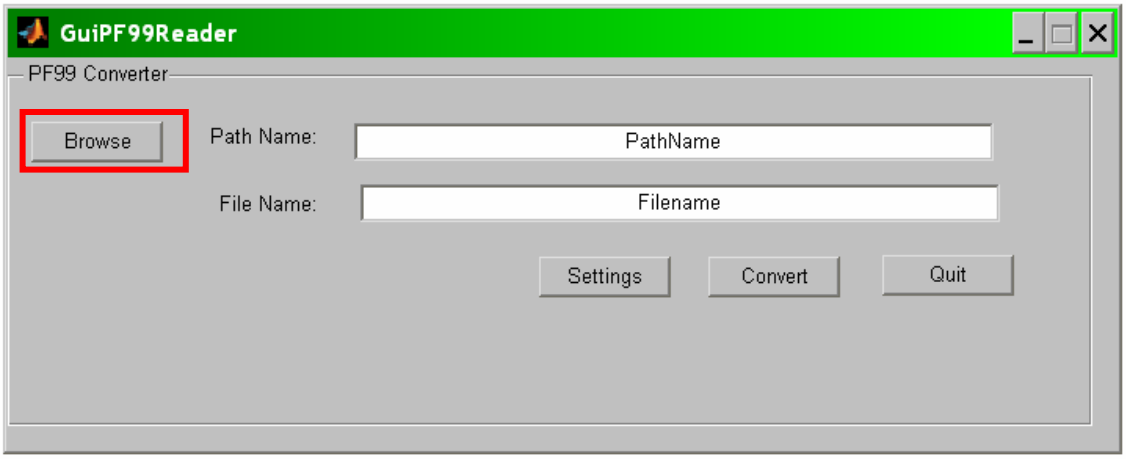
The 3-D Surface Profile and Grind and Fill Software consists of three standalone programs. The first is the PF9 VNET data file reader. This program will read the PF9 data file generated from a TMV generated project or network level data collection. From this file, the inertial reference profile, gyroscope sensor, scanning laser transverse profile, or rut displacement data is broken out and separate files generated that are suitable for the 3-D graphics and grind and fill programs. The second program, Data Transform program takes the *.bin file from the PF99 Reader and transforms it into data files that can be used with the Grind and Fill program. It additionally provides a 3-D surface profile display which reads selected sensor data and provides a 3-D display of this data. The user may select various display options such as viewing angle or rotation. The user may also select or deselect specific sensors and reprocess the display. The third program provides cut and fill quantities and the resulting images after passing a plane over, under, or through the 3-D surface profile image. The user specifies the plane's longitudinal starting point, angle of entry, and height. For each selection, the resulting volume computations are provided for the fill or cut quantities. Additionally the program will plot the resulting 3-D surface profile for the cut or fill areas. This package will allow the user to model and view various overlay, cut or fill strategies. The relationships between the three programs are illustrated in the figure below.



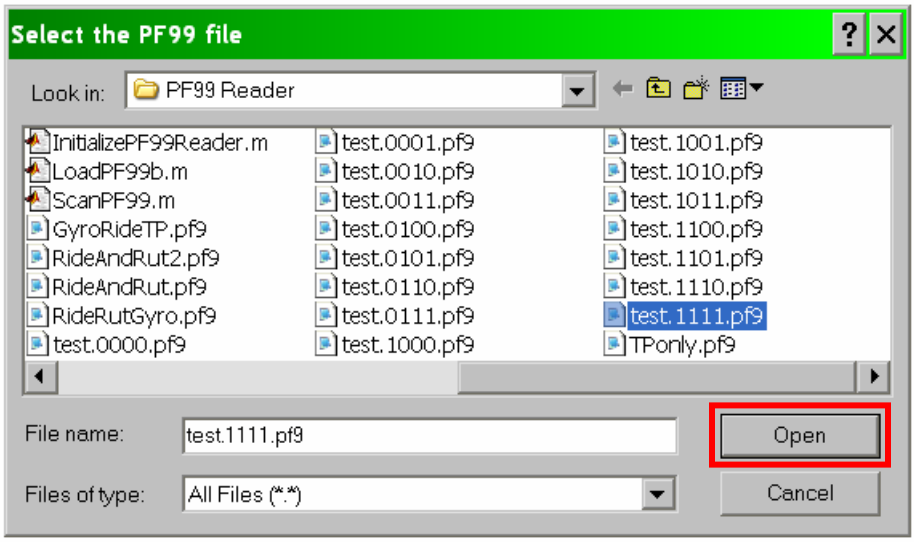
Flow of Data between the three programs

THE PF99 READER

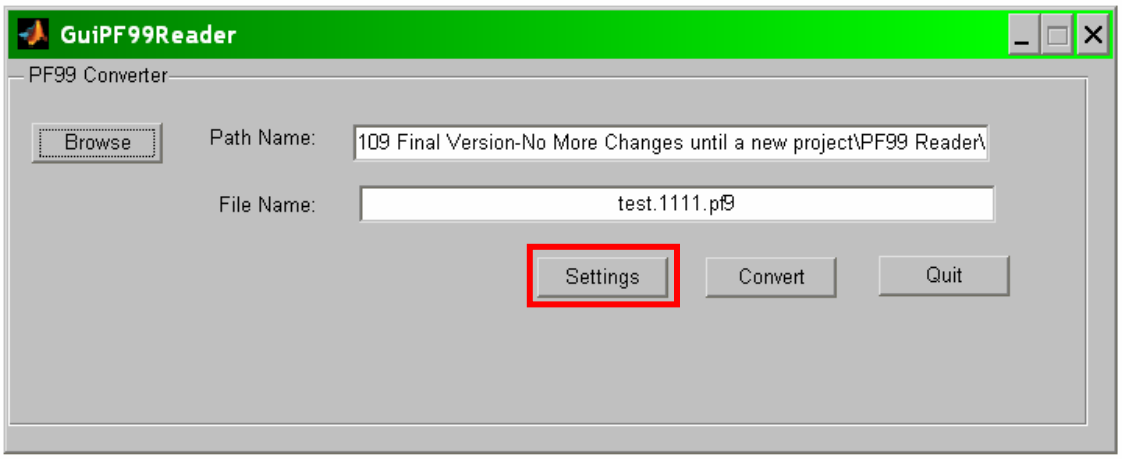
The PF99 Reader program will read a PF99 Format data file and extract a section of the various sensor data to be processed.



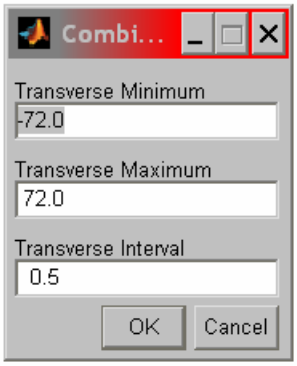
The first step in running the 4463 programs is to run PF99 Reader. When the program first executes, the dialog box above appears. The next step is then to click **Browse**.



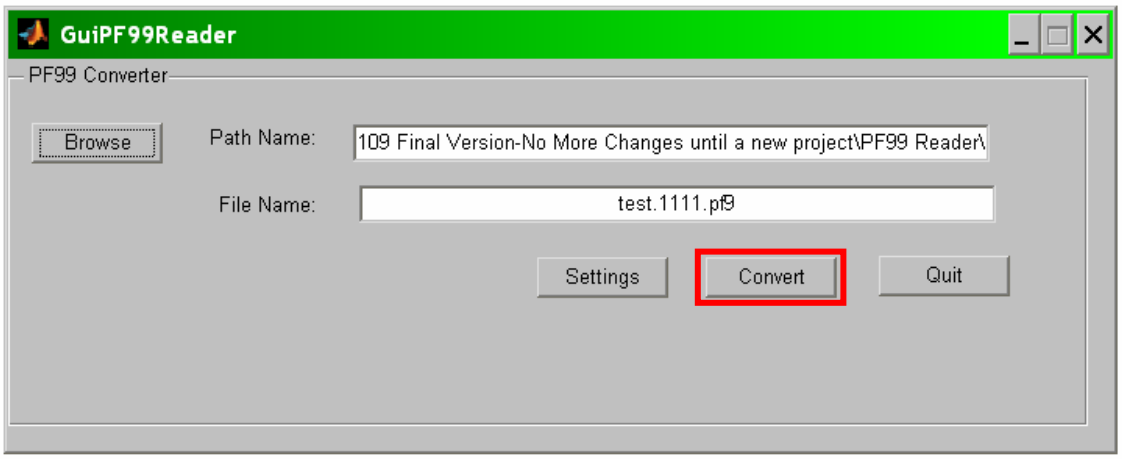
When Browse is selected, a file dialog box pops up. Select the file that is to be processed, and click **Open**. The file will now be selected.



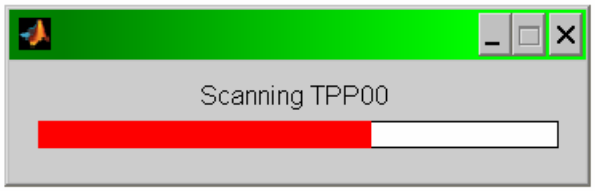
Now, the file has been selected, the settings need to be checked. Click **Settings**.

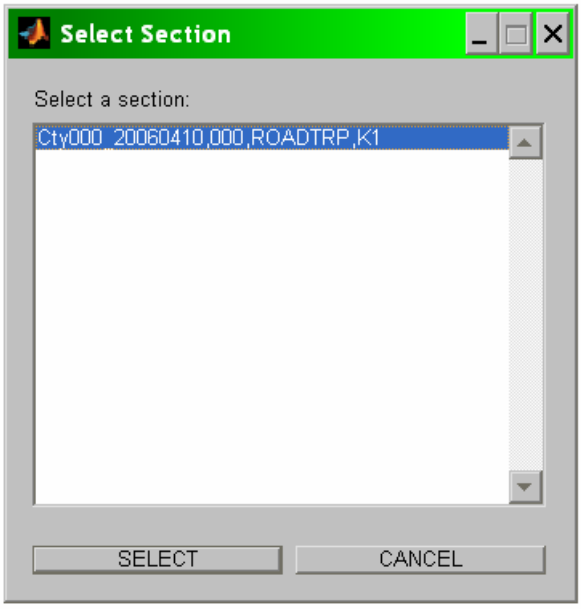


The Select button opens the Combination Settings dialog, which contains the sweep for the Transverse Profile. The data will have to be sorted and interpolated to be a fixed interval between readings.

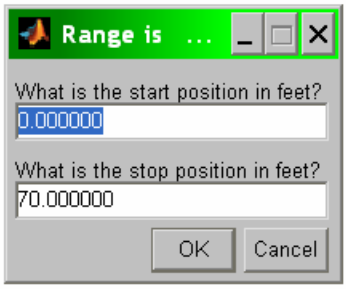


Next, the **Convert** button should be clicked. The PF99 reader will begin scanning the file to see what sections are stored within the PF99 Files.

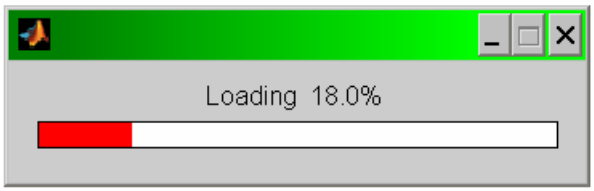




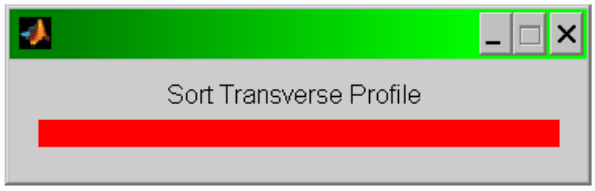
One or more sections within the PF9 File will be displayed, and the user can then select the section to be processed. Once selected, the distance stored in the section will be prompted to the user.



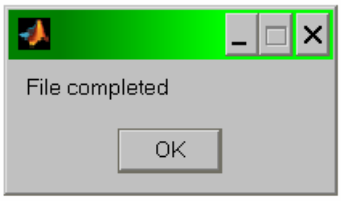
The user will enter the start position and the stop position to be processed.



Now that the data set and the location of the data are known, the data for that section will be loaded into the program memory for processing.



Once loaded, the data will go though several processing steps, converting the data into the target file.

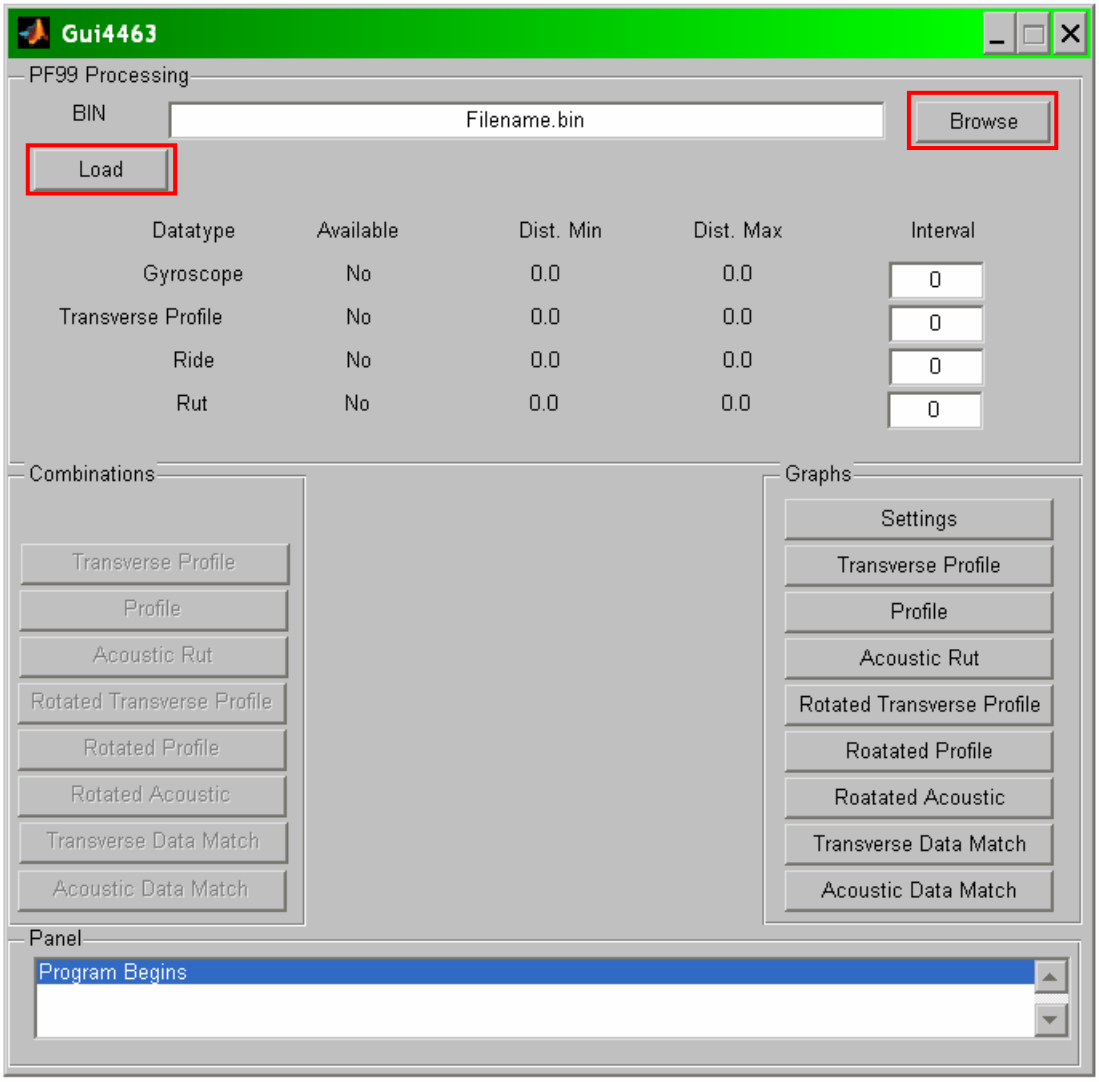


Once complete, the program will add '.bin' to the end of the original file, and the program is finished.

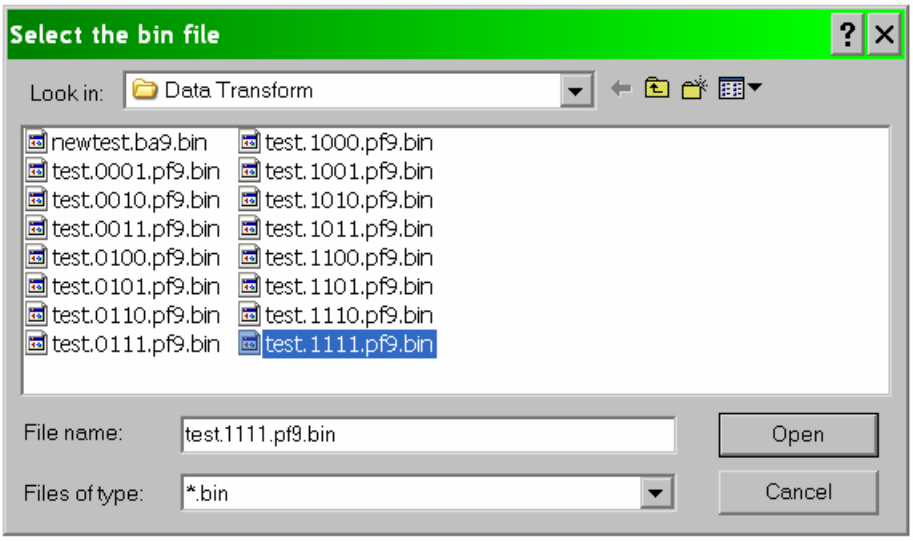
DATA TRANSFORM AND 3-D DISPLAY

The Data Transform program, is used to read data files generated by the will take a file generated by the PF99 Reader program and turn it into a set of surface files which can then be displayed.

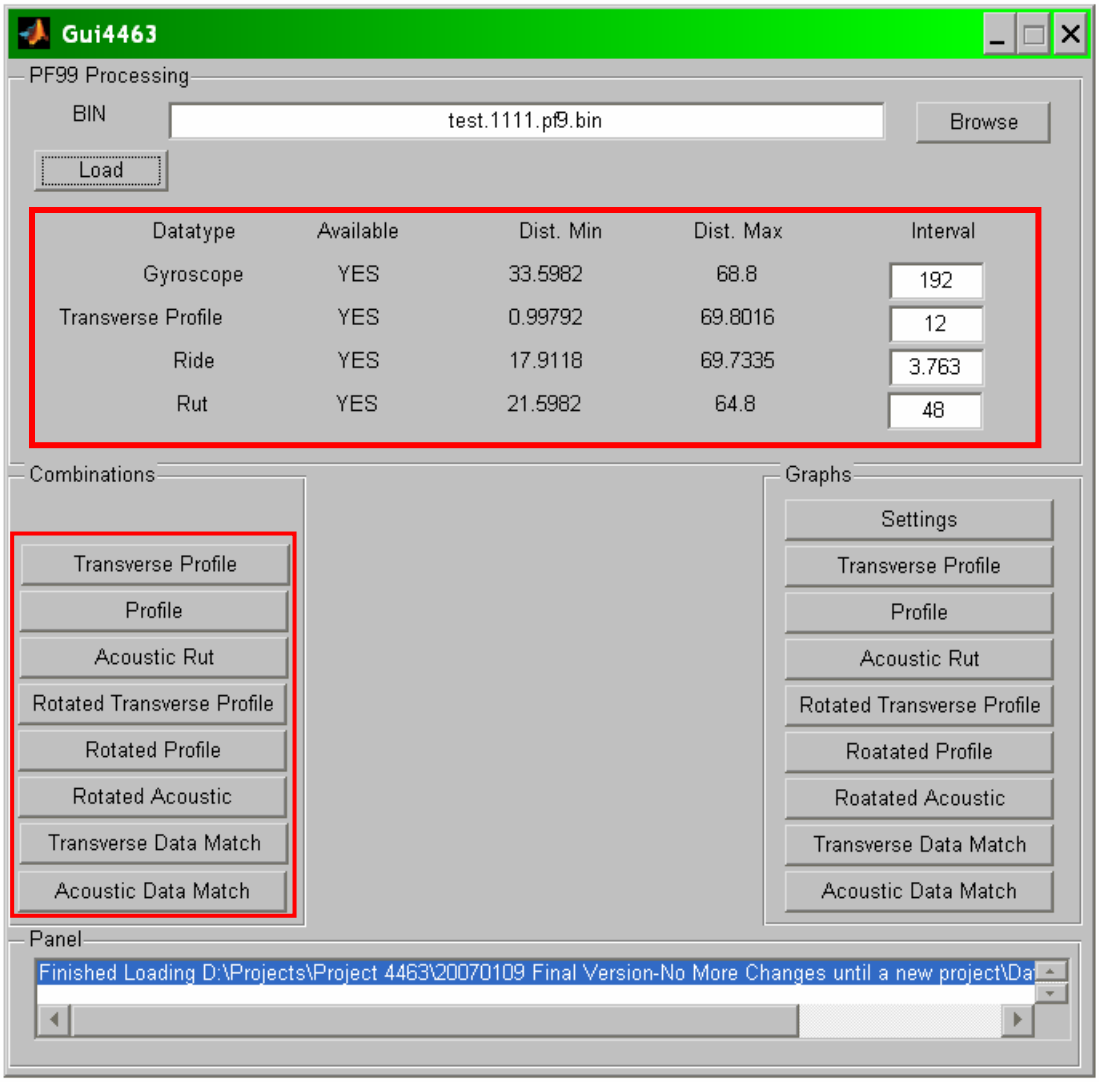
Transforming the Data



The Data Transform program takes the *.bin file from the PF99 Reader and transforms it into data files that can be used with the Grind and Fill program. The first step is to select a file by clicking the Browse button on the dialog box.



Then, select a *.bin file that was created by the PF99Rreader. Once this has been done, select the Load button to finish getting the data. The status window will update with the data available, the minimum distance, the maximum distance, and the distance interval. The distance interval may also be altered in this box if it is not read from the data file.



When the data is loaded, the summary of what data is available will appear on the top half of the dialog box. Given that certain data is available, the **Combination** box on the lower left side will activate various buttons as displayed in the table below. Each button will activate only if all the data needed is available.

Combinations available from loaded data

	Transverse Profile Button	Profile Button	Acoustic Rut Button	Rotated Transverse Profile Button	Rotated Profile Button	Rotated Acoustic Rut Button	Transverse Data Match Button	Acoustic Data match Button
Transverse Profile Data	X			X			X	
Profile Data		X			X		X	X
Acoustic Rut Data			X			X		X
Gyroscope Data				X	X	X	X	X

Each of these combinations produces an additional file, which has yet another extension added to describe the contents of the file. If the data type is in the file, the appropriate letter is assigned; otherwise, the character '0' is put in as a placeholder.

	Gyroscope	Transverse Profile	Profile	Acoustic Rut
Filename.bin.	G	T	P	R

Defining the extension of the transformed files

- If Scanning Laser data is present, the **Transverse Profile** combination button will activate. This option will read the information from the status box and the stored data to create a *.0T00 file. The *.0T00 file can be used to graph the surface in three dimensions.

- If Profile data is present, the **Profile** combination button will activate. This option will read the information from the status box and the stored data to create a *.00P0 file. The *.00P0 file can be used to graph the profile in three dimensions.

- If Acoustic Rut data is present, the **Acoustic Rut** combination button will activate. This option will read the information from the status box and the stored data to create a *.000R file. The *.000R file can be used to graph the acoustic rut in three dimensions

- If Gyroscope data and Transverse Profile data are available, the **Rotated Transverse Profile** combination button will activate. This option will read the information from the status box and the stored data to create at *.GT00 file. The *.GT00 file can be used to graph the rotated transverse profile in three dimensions.

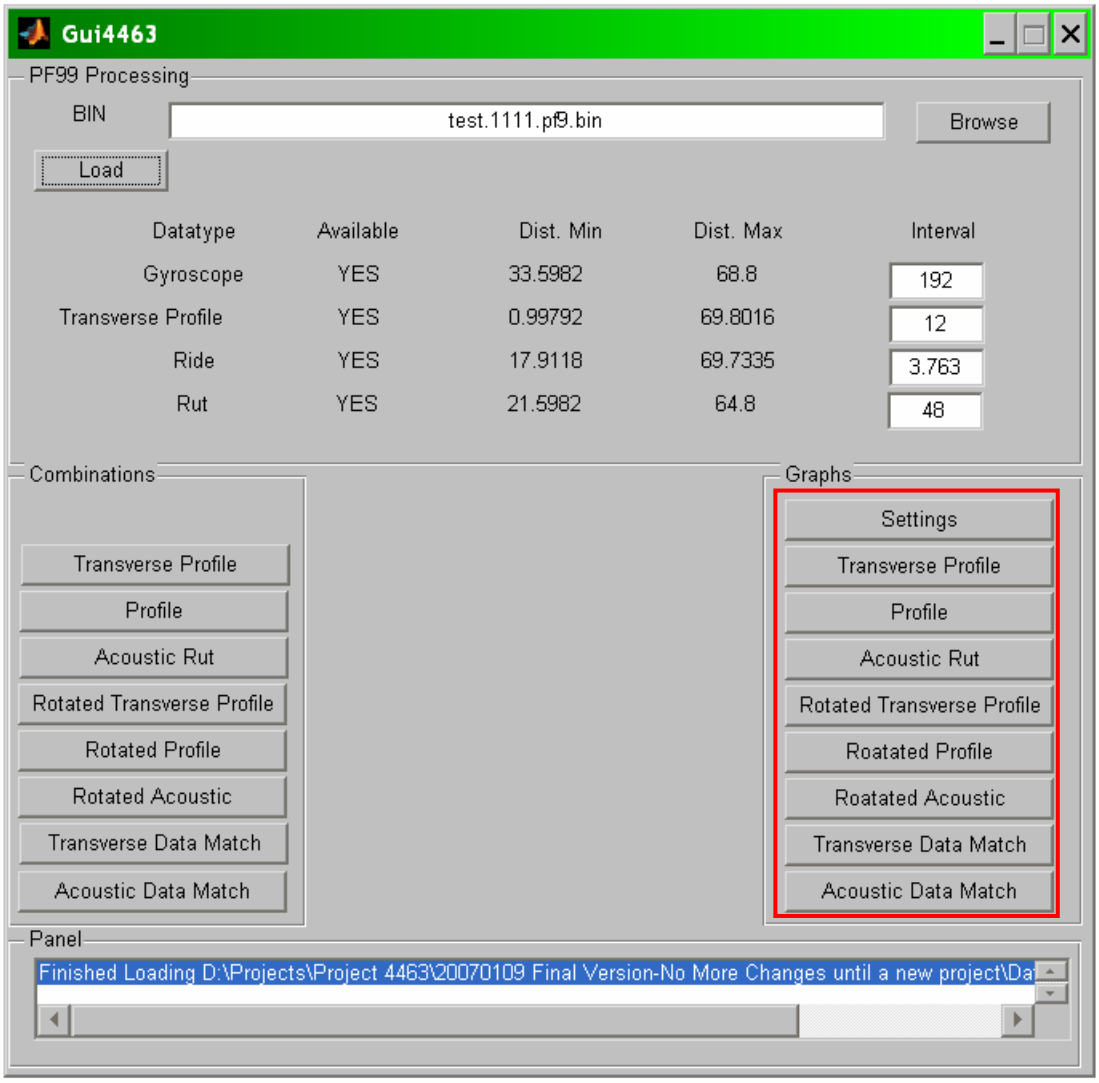
- If Gyroscope data and Profile data are available, the **Rotated Profile** combination button will activate. This option will read the information from the status box and the stored data to create a *.G0P0 File. The *.G0P0 file can be used to graph the rotated profile in three dimensions.

- If Gyroscope data and Acoustic Rut data are available, the **Rotated Acoustic** button will activate. This option will read the information from the status box and the stored data to created a *.G00R file. The *.G00R file can be used to graph the rotated acoustic rut in three dimensions

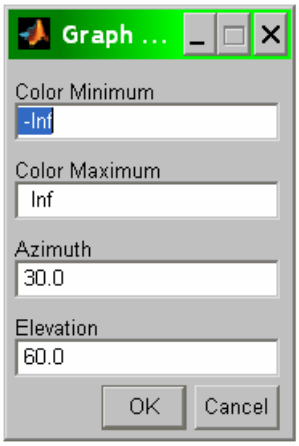
- If Gyroscope data and Transverse Profile data and Profile Data are all available, then the **Transverse Data Match** combination button will activate. This option will create a *.GTP0 File. The GTP0 File can be used to graph the combination of the profile and the transverse laser rotated to the same angle. This Transverse Data Match file is also one of the valid inputs for the Grind and Fill program.

- If Gyroscope data and Acoustic Rut data and Profile data are all available, then the **Acoustic Data Match** combination button will activate. This option will crate a *.G0PR file. The *.G0PR file can be used to graph the combination of the profile and the acoustic rut rotated to the same angle. This Acoustic Data Match file is also one of the valid inputs for the Grind and Fill program.

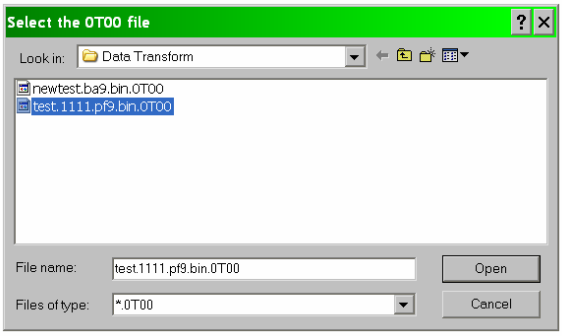
Displaying the Data

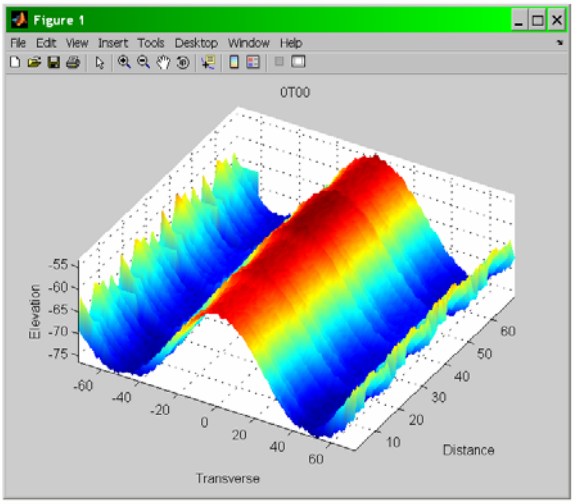


The other section of the Data Transform program is the graphical control box. These buttons control the display of graphs of data generated by the combination boxes. These are always active, and can display previously generated files.

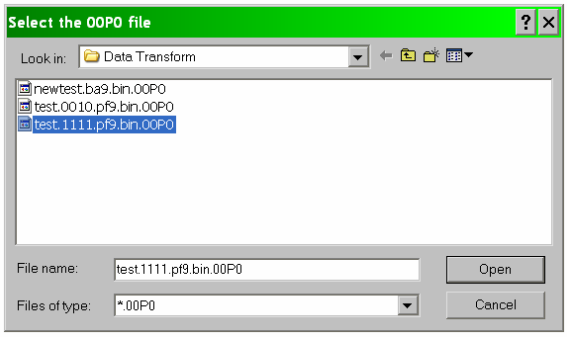


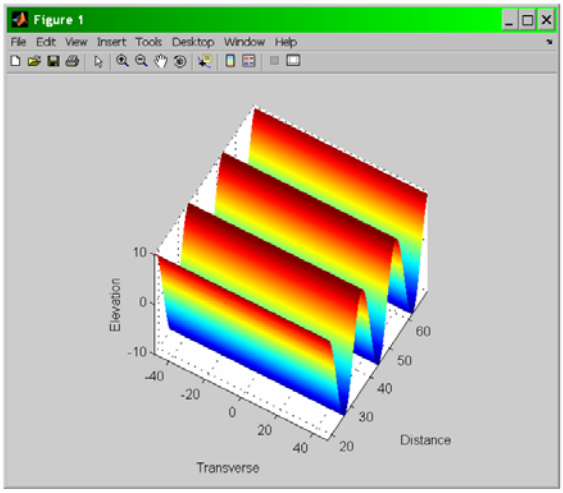
The first button is the **Settings** button, which opens a Graph Options dialog box for use with the Matlab display engine. The colors visible on the graph go from some minimum in the elevation plane to some maximum in the elevation plane. The defaults are '-inf' for negative infinity and 'inf' for positive infinity. The next two co-ordinates are the rotation of the plane of the graph, and the height of the view above the graph.



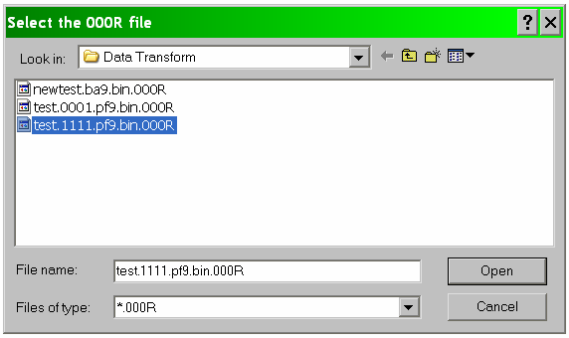


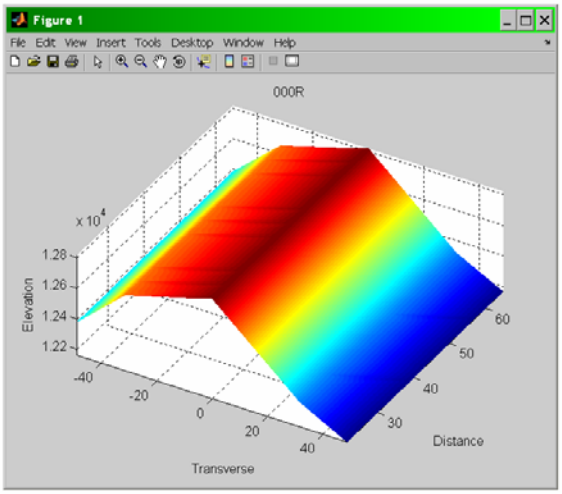
To see the Transverse Profile, click that button and select a *.0T00 file. The system will then display a graph showing the surface at the azimuth and elevation specified.



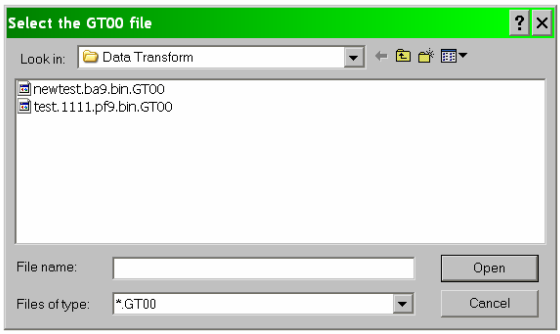


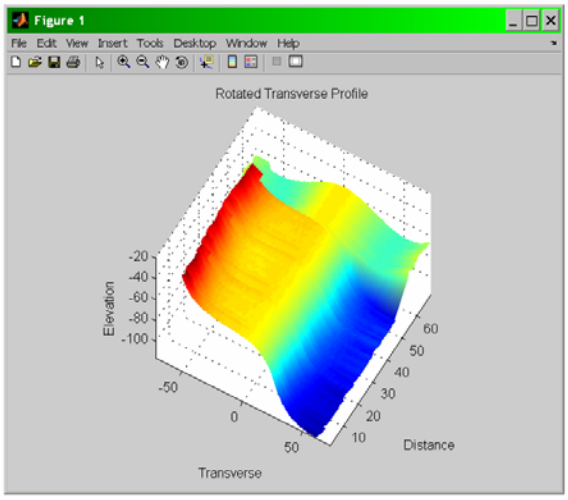
To see the Profile, click that button and select a *.00P0 file. The system will then display a graph showing the surface.



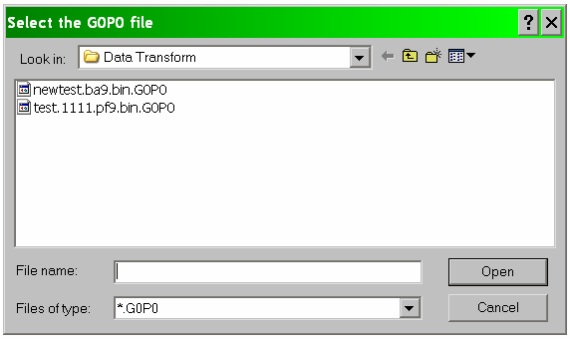


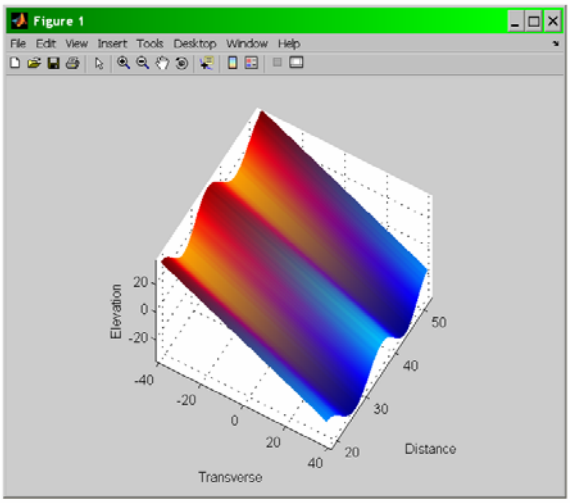
To see the Acoustic Rut Profile, click that button and select a *.000R file. The system will then display a graph showing the surface.



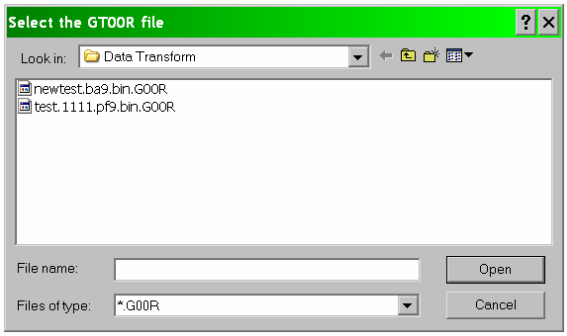


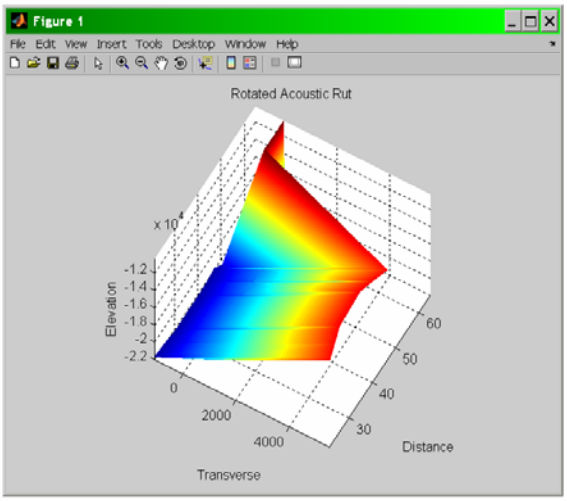
To see the Rotated Transverse Profile, click that button and select a *.GT00 file. The system will then display a graph showing the surface.



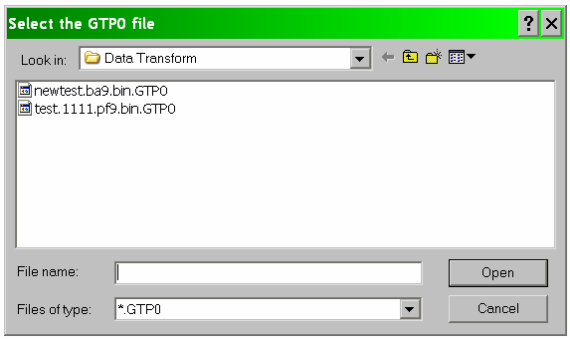


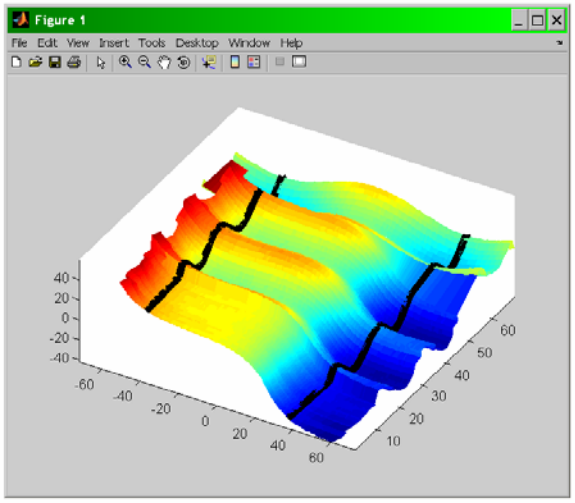
To see the Rotated Profile, click that button and select a *.G0P0 file. The system will then display a graph showing the surface.



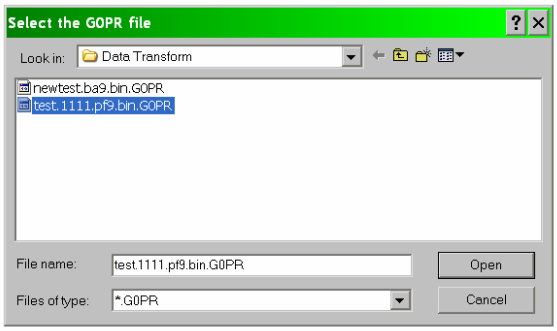


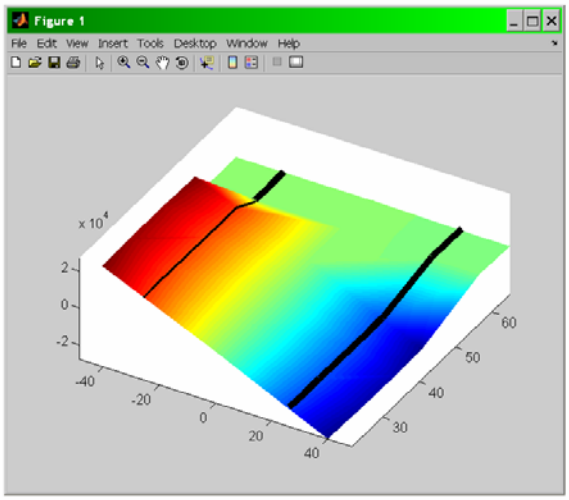
To see the Rotated Acoustic Rut, click that button and select a *.G00R file. The system will then display a graph showing the surface.





To see the Transverse Profile Data Match, click that button and select a *.GTP0 file. The system will then display a graph showing the surface.



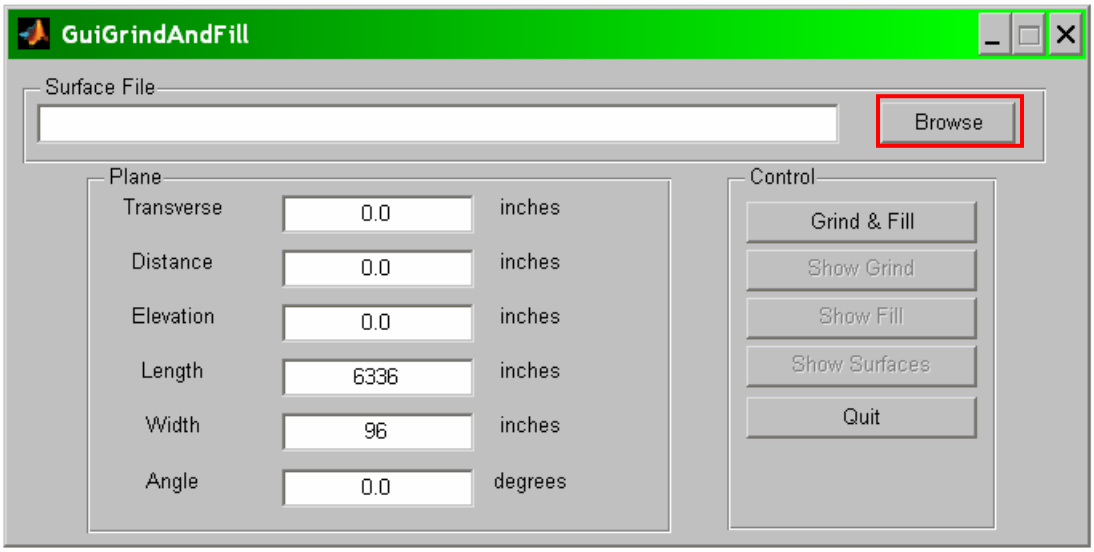


To see the Acoustic Rut Data Match, click that button and select a *.GTP0 file. The system will then display a graph showing the surface.

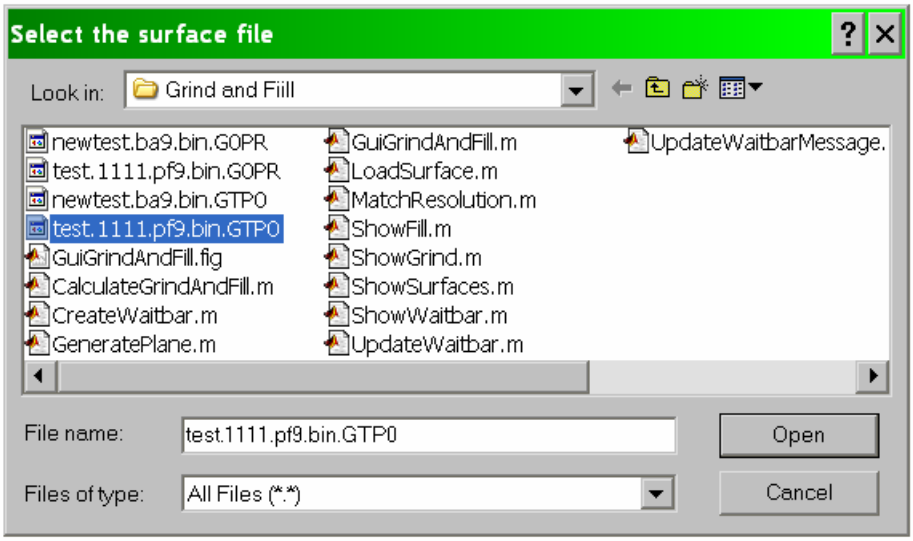
GRIND AND FILL

The Grind and Fill tool takes the differences between a surface and a plane in order to determine how much volume must be changed across the surfaces by grinding down a pavement or filling in a depression. The first surface is a target surfaces generated by the Data Transform Tool, which contains a transverse data reading or an acoustic data reading that has been rotated and matched to the profile. The second surface is a user defined plane that is at a given angle.

Loading the Surface

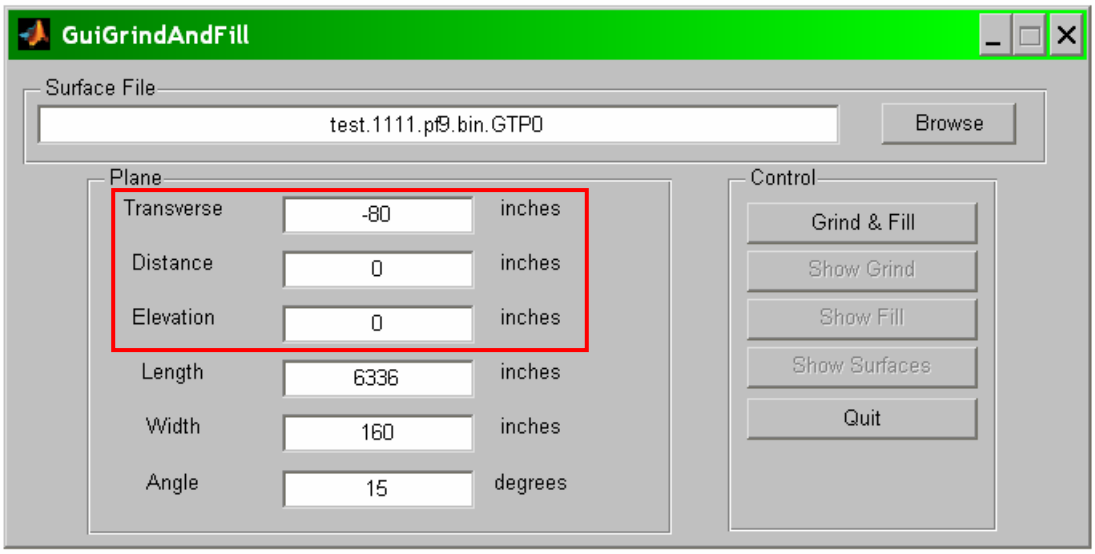


When the tool begins, the first step is to load the Data Match file from the Data Transform tool into the Grind and Fill. The Browse button needs to be selected.

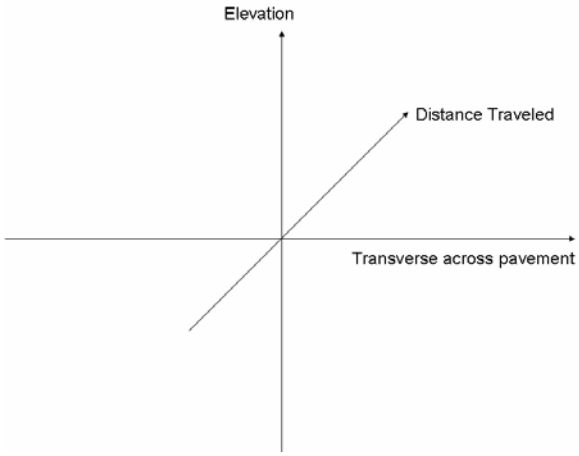


Now, the surface selection dialog box opens. Either a *.GTP0 or a *.GOPR file will need to be selected. A Transverse Profile Data Match file is marked *.GTP0, and an Acoustic Rut Data Match file is marked *.G0PR.

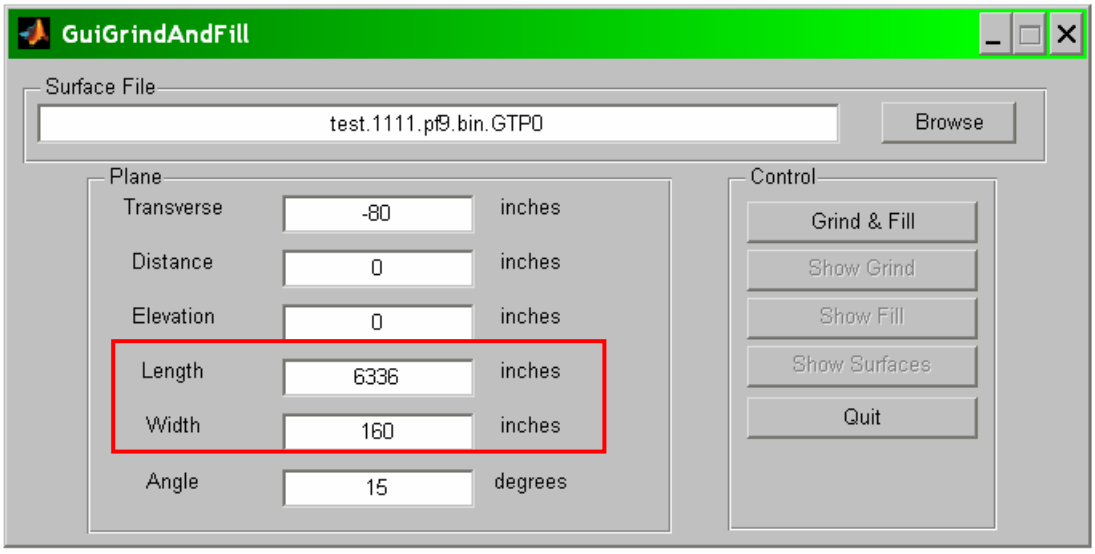
Defining a Desired Surface as a Plane



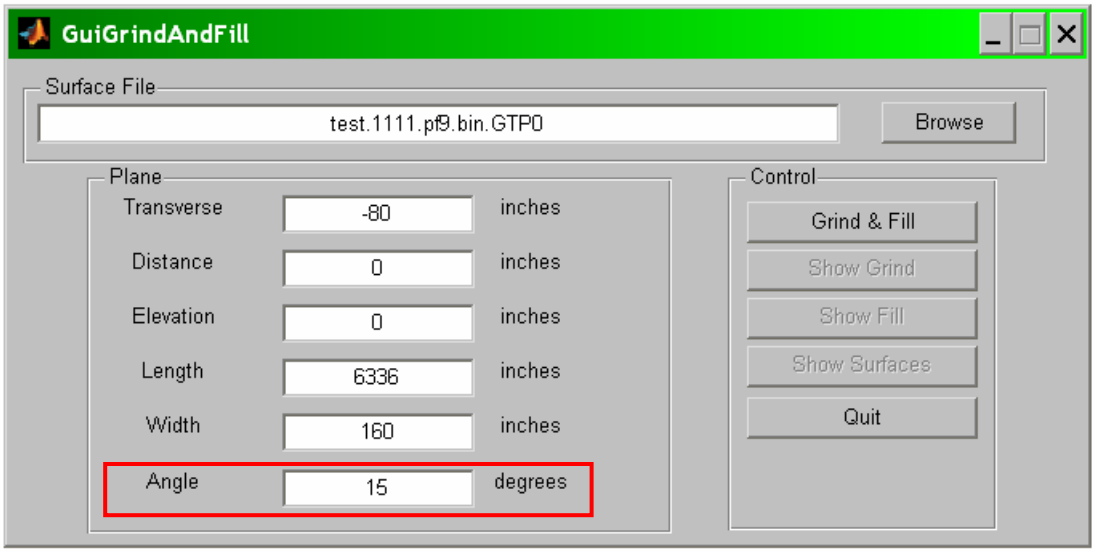
Now that the file has been selected, the Plane definition panel must be filled in with the correct coordinates. The first three fields, Transverse, Distance, and Elevation, describe the starting location of the plane.



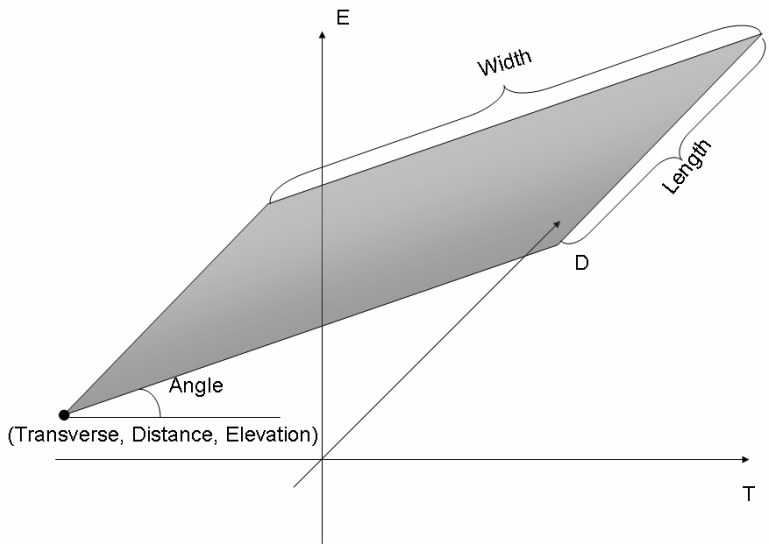
Defining the axes in 3-Dimensions



The plane then has some length in the distance direction, and some width in the transverse direction.



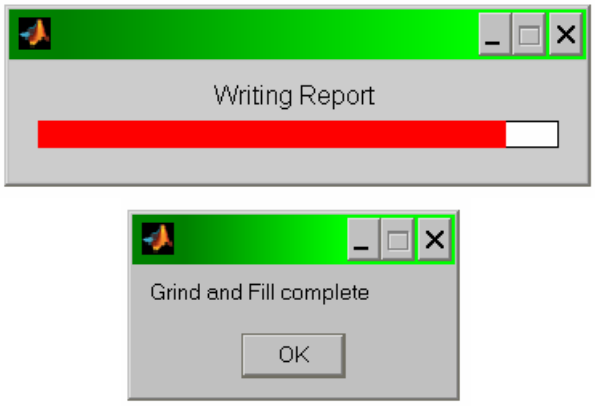
Finally, the plane is set at some angle with respect to the transverse direction.



Creating a desired plane

Calculating Grind and Fill

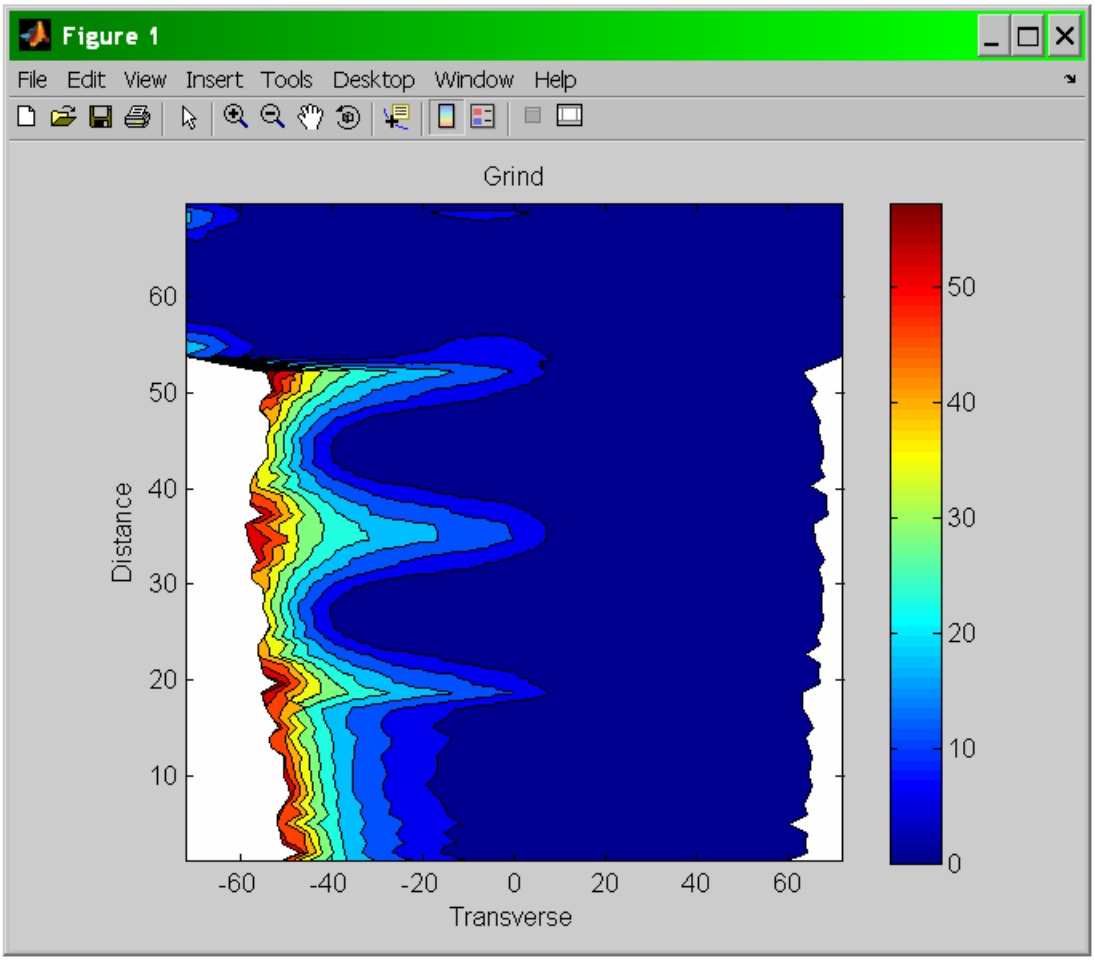
Once the plane has been defined, the Grind and Fill button can be selected. At this time, a "waitbar" will appear on the screen to show the user the system is still processing. At the end of the calculations, a Grind and Fill complete box will appear.



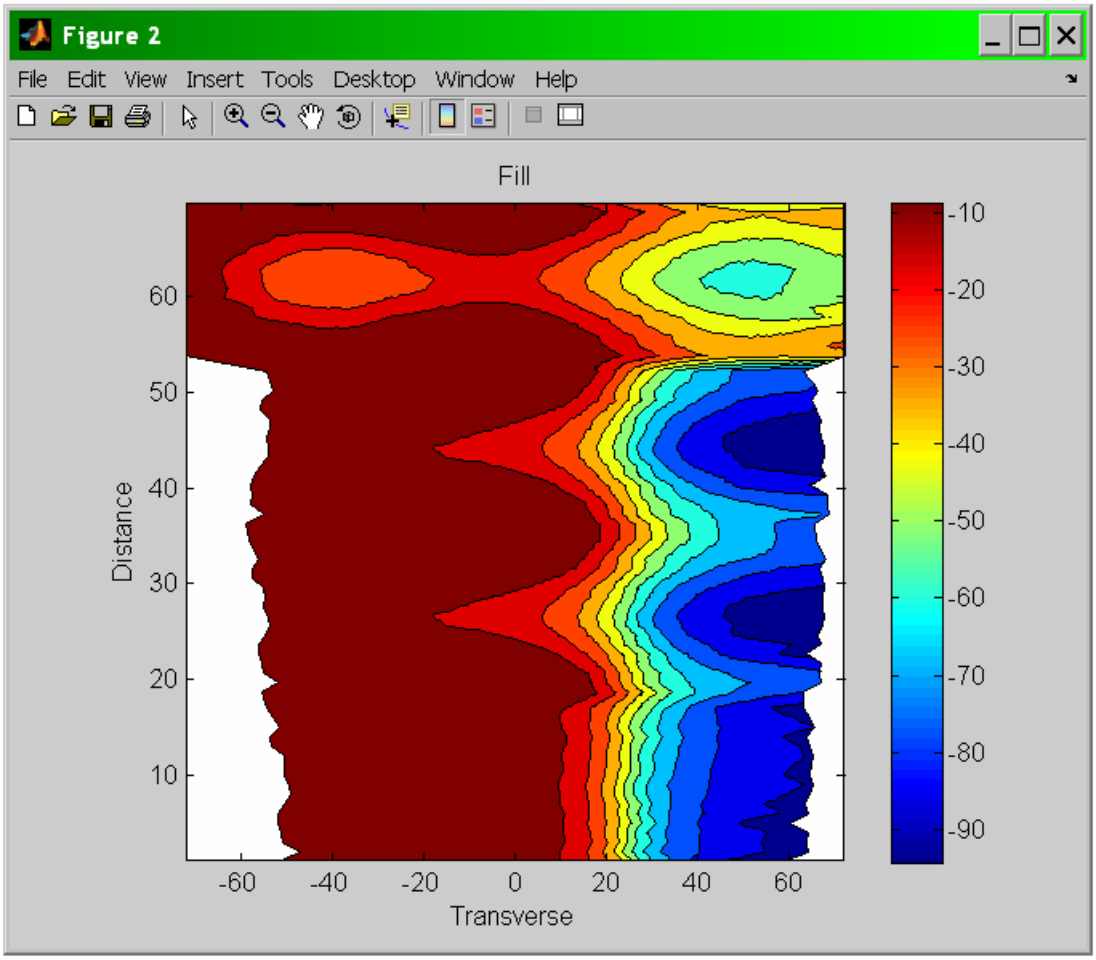
Once the Grind and Fill calculation is complete, the remaining buttons on the main dialog box will become active and a report of the data will be displayed.

Total volume of the surface: 151006.43 cubic inches Total volume of the plane: 527494.88 cubic inches Total difference of the volumes: -376488.45 cubic inches Total Volume to Grind: 121423.89 cubic inches Total Volume to Fill: 497912.34 cubic inches Total Volume Difference: 376488.45 cubic inches

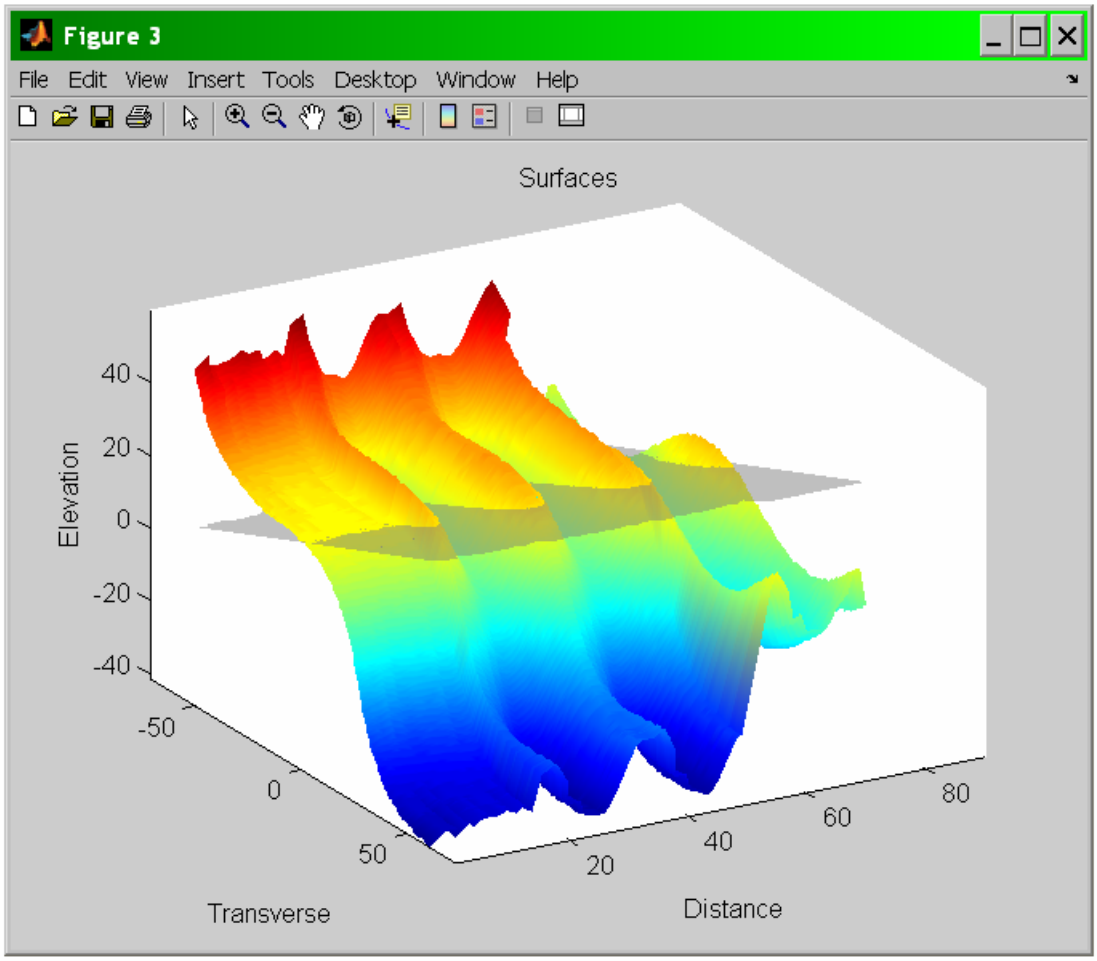
Three graphs are now also available to be shown to the user. The Grind map, the Fill map, and the representation of the two surfaces, the plane and the Data Match surface.



The Grind Map shows where the surface would have to be ground down to be the same surface as the desired plane.



The Fill Map shows the amount of material that needs to be added in order to bring the surface up to the desired Plane.

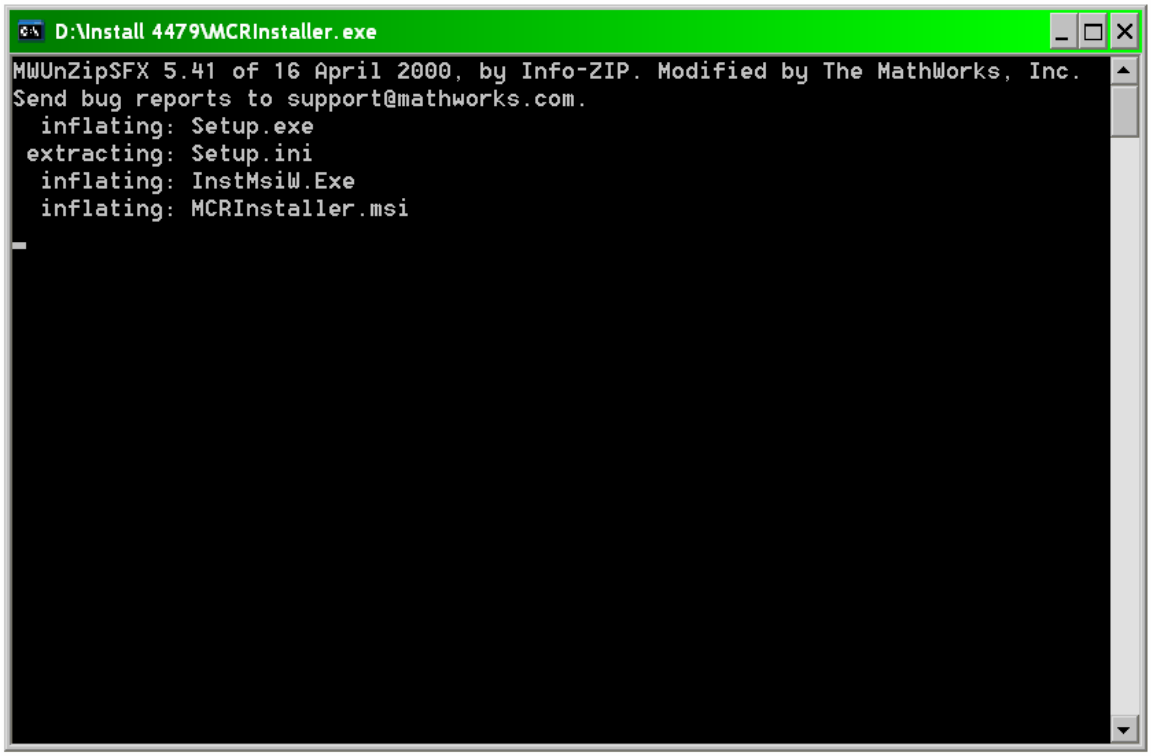


The final image is the comparison of the surface and the plane. In this case, the desired Plane displays in a transparent gray.

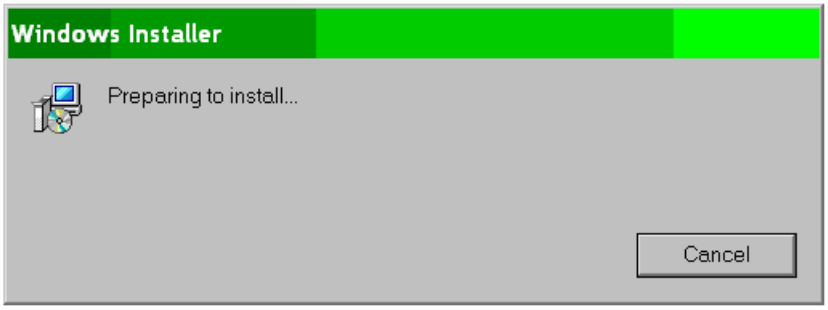
Installing the Matlab Runtime Component

Matlab provides a library for its internal routines to be used in deployment of software that comes with the Matlab Compiler Toolbox.

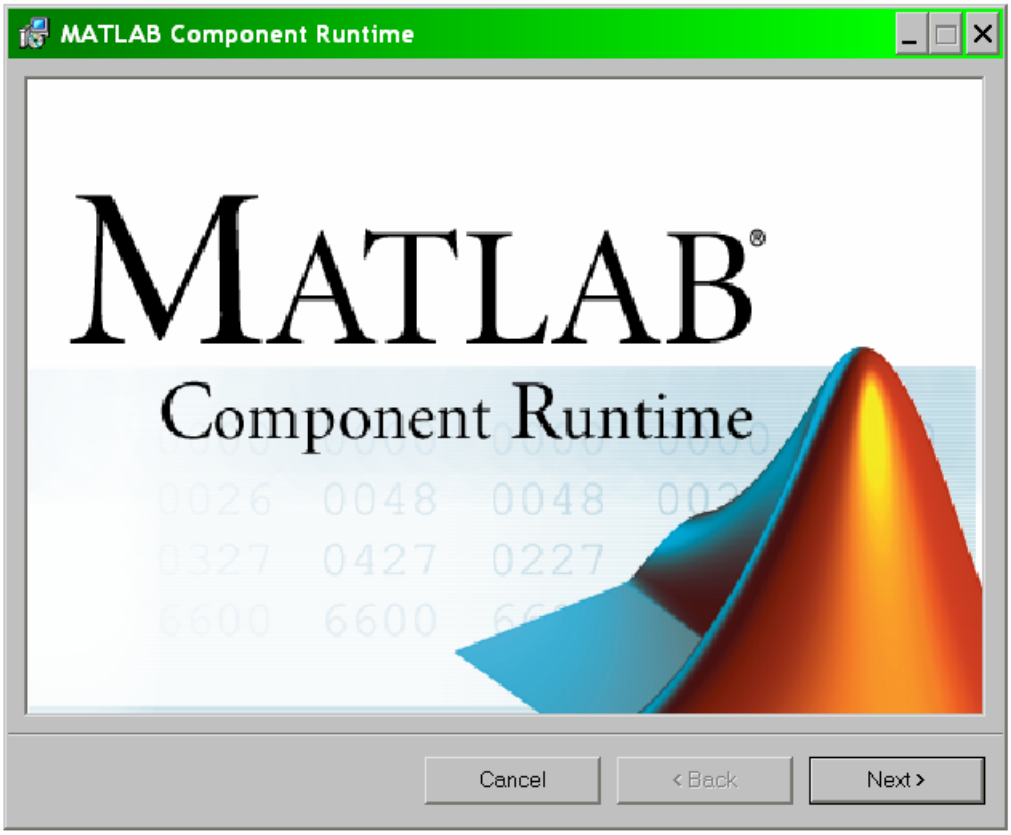
Make a directory on your hard disk, and copy the MCRInstaller.exe program to that directory. Next, execute the installer and the following command window will appear.



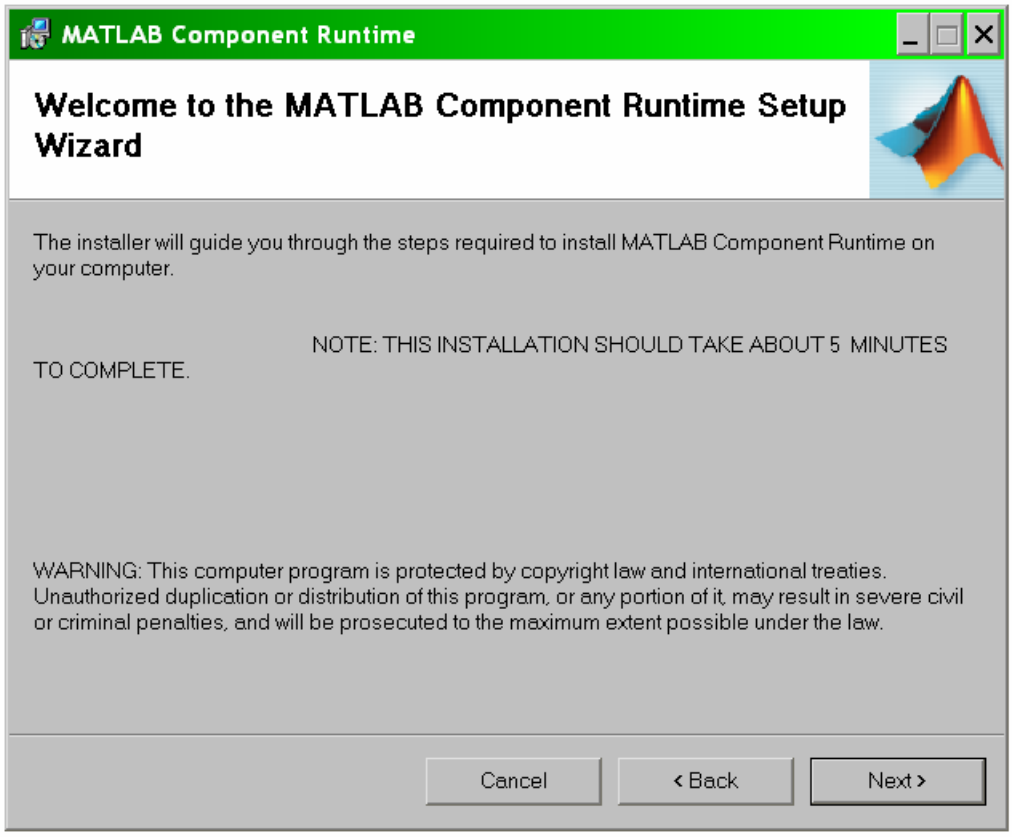
A few seconds after this window opens, the installation program will begin. The Windows Installer screen below opens up as the system gets ready to install.



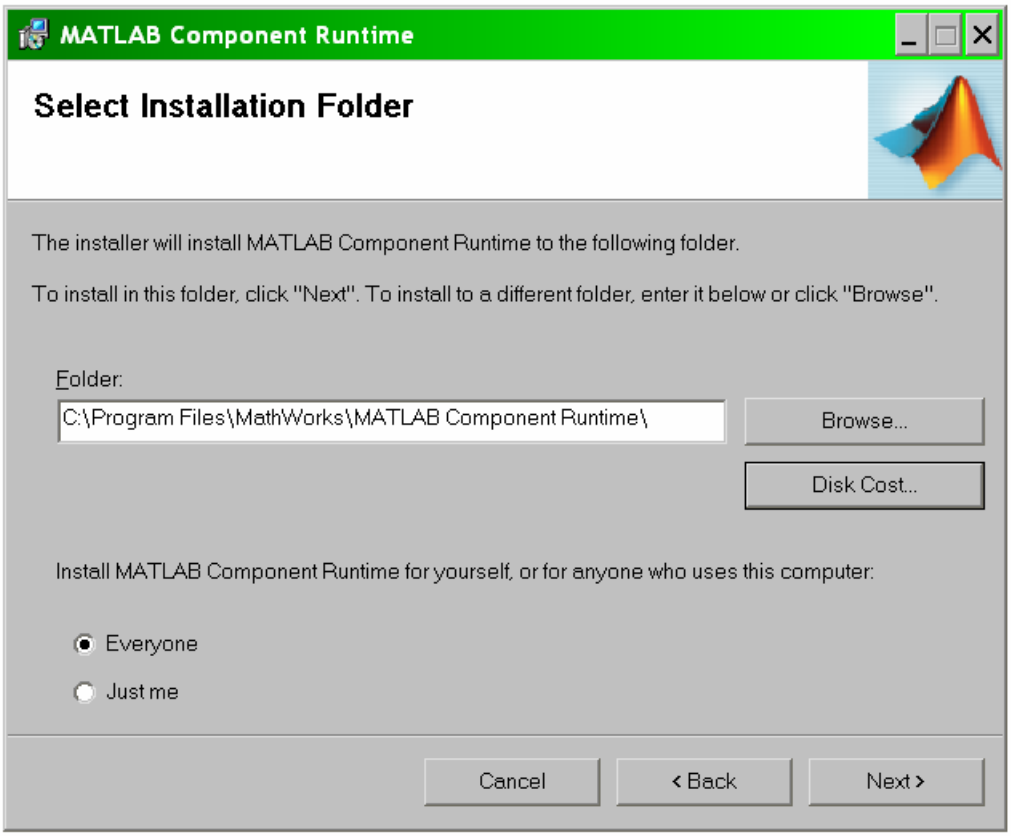
Next, the following splash screen will appear, and prompt the user to click next to install the Runtime Component. Click next to continue.



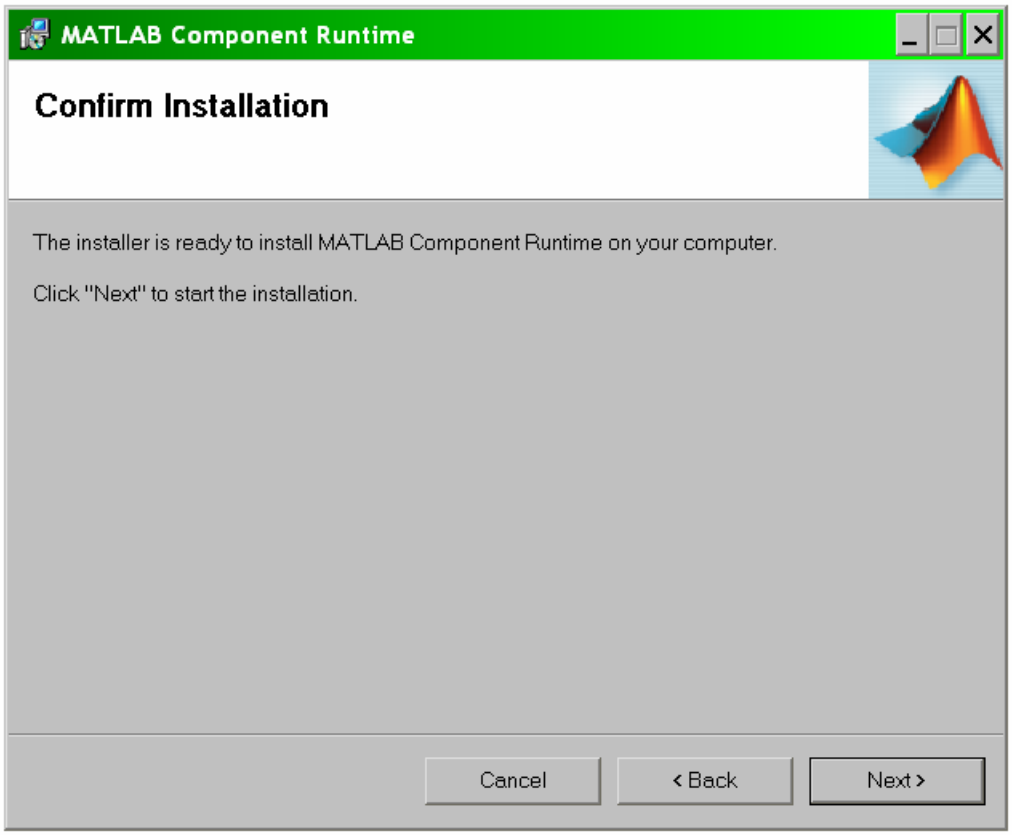
The next screen is the warning screen. Simply click next to continue.



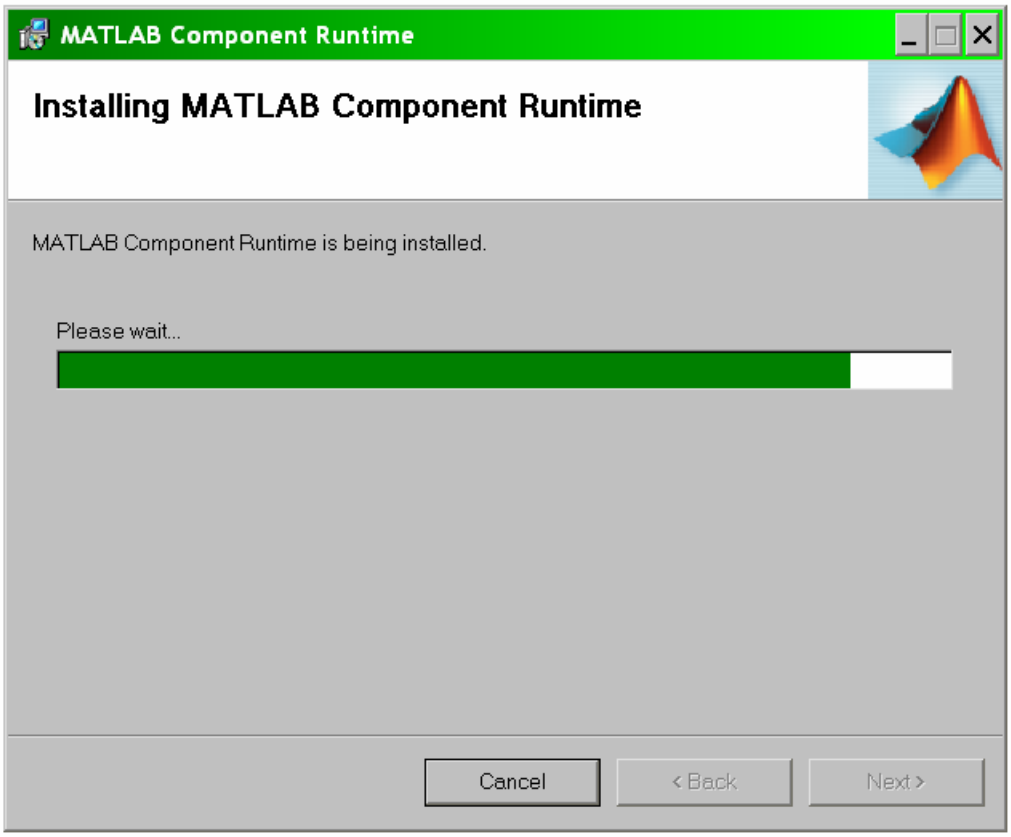
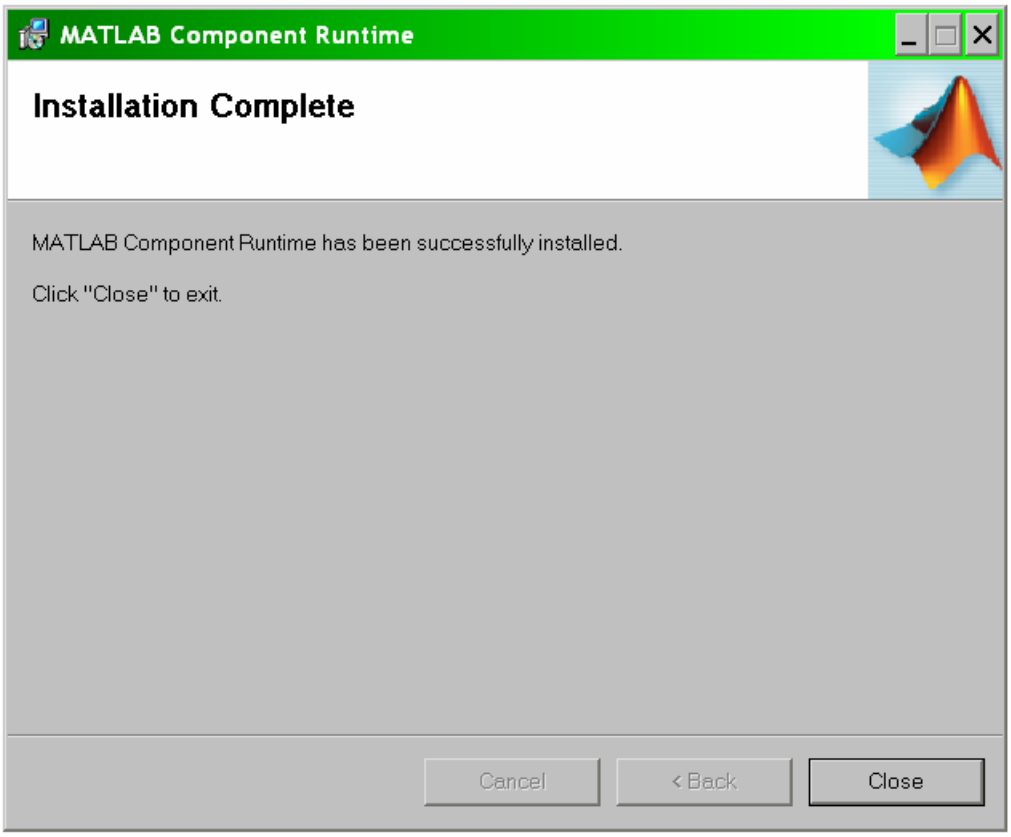
The following dialog is the installation folder dialog, which allows the user to install the runtime component on a different drive, or for specific accounts. For this project, the default folder was selected and the component was made available to everyone's account on the computer.



Then, the Confirmation screen appears, which gives the user one last chance to exit before proceeding with the final installation.



Now, the progress screen activates, and remains activated for about five minutes. It is recommended that the computer be left alone for a period of about five minutes while the program finishes its installation. The progress bar will fill up multiple times during the installation.



The final screen is the completion dialog, and then the installation is done.