ProForm User Manual

ISSUE 1.4

VERSION HISTORY

Version	Date	Remarks
1.0	17th Feb 2005	Base lined and Approved
1.1 Beta	11th Mar 2005	Added tilting feature and Rotational alignment about X and Y Axis and Evenness calculation
1.2 Beta	15th Mar 2005	Added Cross Section View, display of Cross hairs on Grid Views and Undo and Redo Alignment Options
1.21 Beta	22nd Mar 2005	Added Volume Calculation and Compensation Offset. Changed 3 Point leveling to be applied only on Modified Surface.
1.21 Beta 3	13th Apr 2005	Added Load Default and Set As Default Added Save Zoomed Area Only
1.3	18th May 2005	Application Name changed as ProForm
1.4	20th Feb 2006	Pivot Point Implementation, Icons Redesigned, 3 Datum Area Leveling on Zoomed Area Enabled

1. Introduction

1.1. Welcome to the ProForm

The **ProForm** is a powerful software application designed for analysing the difference between two surface-scans made by Proscan 2000 software accurately. This Manual will guide the user through each of the functions available in this software and also a detailed description of every operation performed by the **ProForm** software for aligning and studying the difference between the two scans.

2. Getting Started
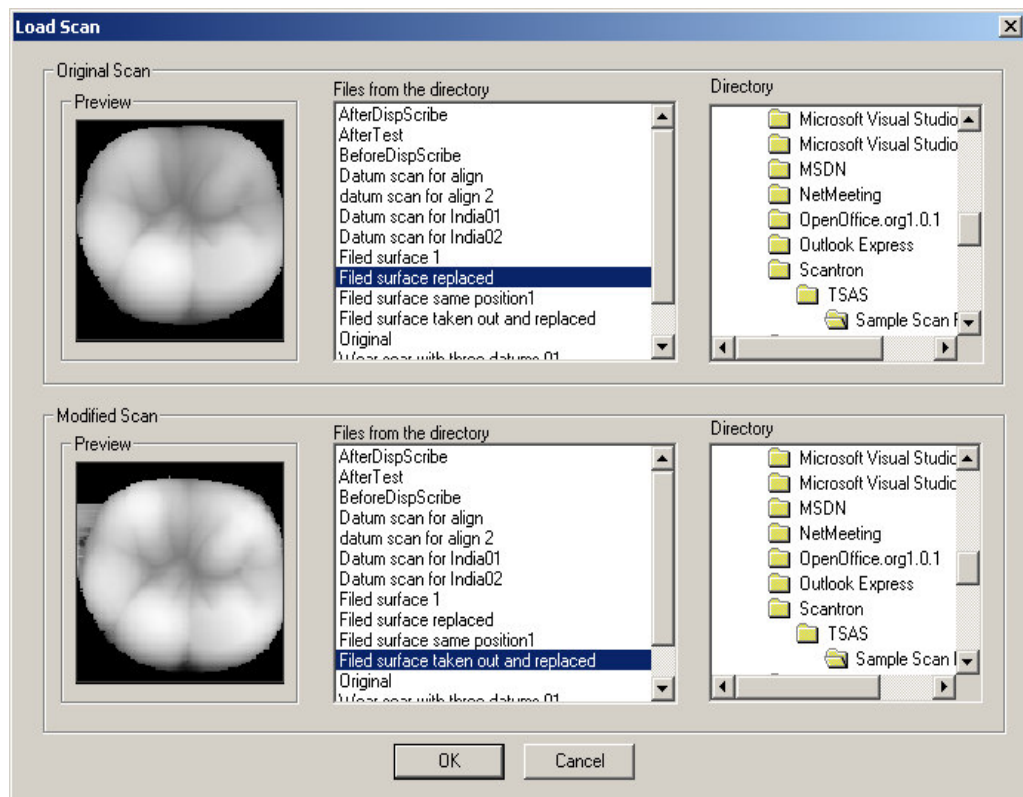
2.1. Introduction

This section describes the basic steps that should be taken when preparing to run this software for the Alignment.

2.2. Loading the PRS Files

The first step is to load the PRS files for the Alignment. The user can load them by selecting the **Load** button from the tool bar or select **'File/Load'** from the main menu. The user will see the following dialog.

2.3.   Selecting the PRS files

From the Load Scan Dialog, the user can browse through the directory to select the directory in which the scans of interest lie. The user will see the list box being populated with the scan file names in the directory selected. Select the Original Scan from the top and Modified Scan from the bottom list box. The user will see a Preview of the selected scans to the left of the list box. Press 'OK' to confirm selection. Clicking on **'Cancel'** aborts the loading of new scans.

2.4.   Selecting the Leveling Option

After the user has loaded the files, the **Options** Dialog will be displayed as follows.
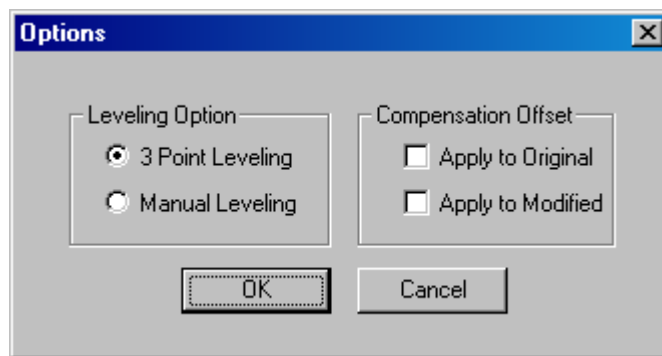
The user can choose the **Leveling Option** as either **3 Point Leveling** or **Manual leveling**. The user can also apply the **Compensation Offset** to Original and/or Modified Surface by selecting **Apply to Original** and **Apply to Modified**, to take care of data lost in the surfaces while they are rotated about X & Y Axis and also for the data lost in when the Z Movement is done.

After OK is pressed, the views will be created and displayed as shown below.
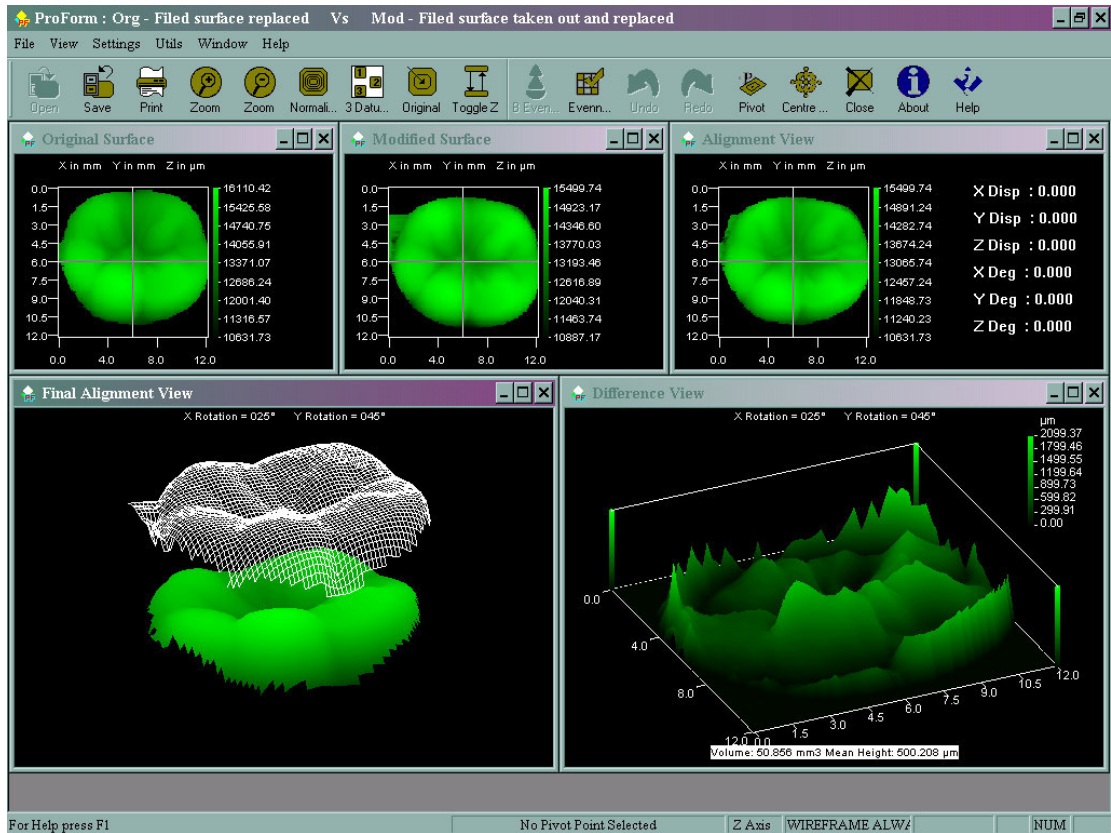
The different views created are

>
> **Planar Views:**
> - Planar View of Original Surface
> - Planar View of Modified Surface
> - Alignment View.
>
> **Grid Views:**
> - Final Alignment View
> - Difference View

In addition to the above views the following views can be created if the user needs them.

> - Eroded Areas View
> - Filled Areas View
> - Cross Section View

The Difference View, Eroded Areas View and the Filled Areas View are the **Resultant Views**. The Eroded Areas View and Filled Areas View can be

created from the **'Window/Create View'** from the main menu by the user.

Note: For detailed description of the views Refer section 4.

2.5.   Saving the Difference View

To save the Difference View, the user should select **'File/Save'** from the main menu or press **'Save'** button from the Tool bar. The software will prompt the user to enter the file name as follows.
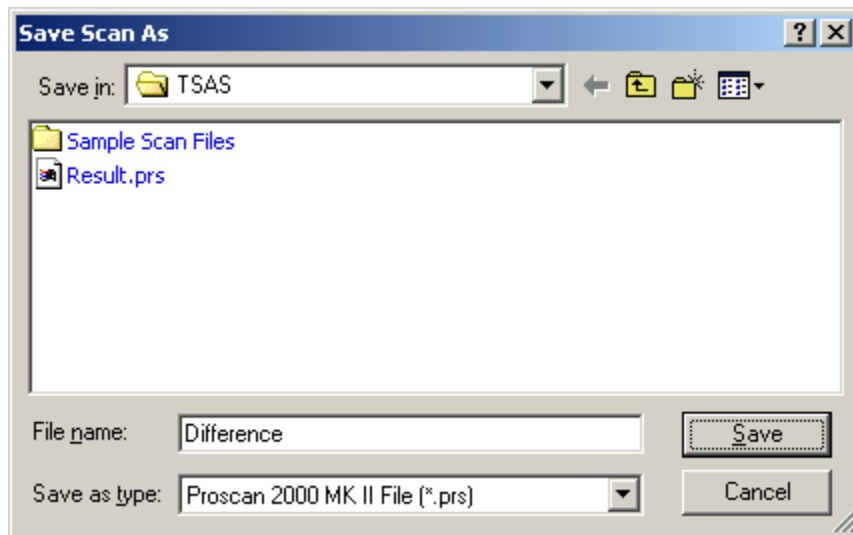
Save Zoomed Area Only

If this option is checked in the menu **'Settings/Save Zoomed Area Only'** then the Zoomed portion in the Difference View will be saved. If this option is unchecked, then the entire scan area of the Difference View will be saved as the Resultant scan file. This option is checked by default.

Note :   The Difference View by default will be saved as a .prs file.

2.6.   Printing Views

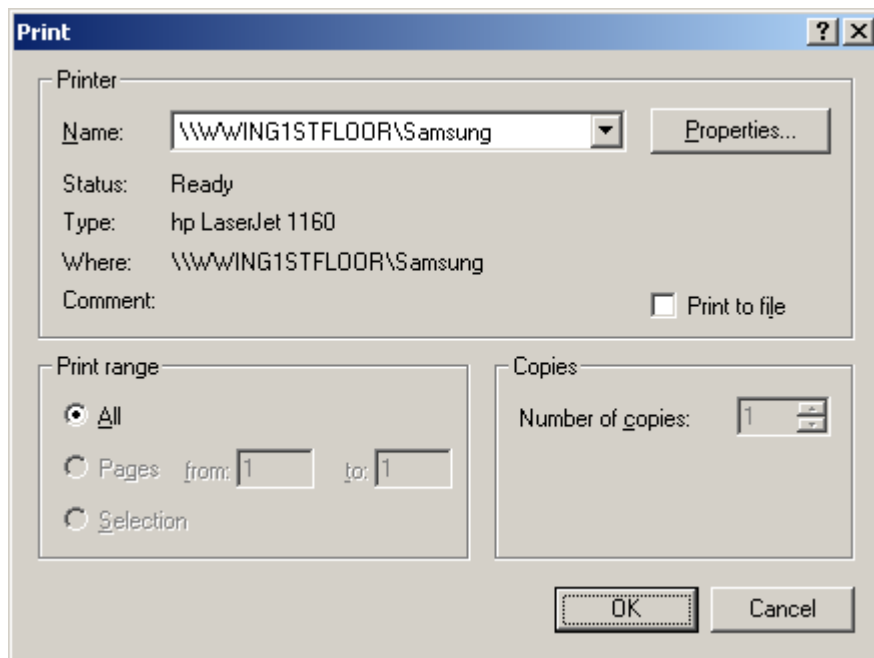In order to print any of the views, the user can simply right-click in the appropriate view and select **'Print'** from the context menu. The Printer Parameters can be specified by using the **'File / Printer Setup'** menu option from the main menu, which displays the standard Windows Printer Set-up screen as follows:

Note: Selecting **'File / Print'** from the main menu will print the active view. The active view can be identified by the highlighted title bar.

When the user right click on any of the views the context menu with **'Print'** and **'Print Preview'** options is displayed. The user can use these options any time when the user wants to print the view or view the preview. The user can also view the preview by selecting **'File/Print Preview'** from the main menu or **'Print Preview'** from the context menu.

3.   Views Elements

There are two types of views: **Planar View** and **Grid View**. These views have some common properties. This section describes them.

3.1.   Planar View

X, Y and Z Units:
The units of X and Y Axis are scaled in millimeter (mm) and Z Axis in micrometer (m).

Cross hair:
The cross hair is used on the Planar View to select a particular area for zooming or to select a Scribe Mark or Datum Area or any distinguished feature.

Colour Band Scale:
The Colour Band Scale shows the height value in micrometer along with a colour ruler. The colour range will vary depending upon the height.

3.2. Grid View

Evenness Values for Datum Marks:

When the user chooses the datum areas after clicking the **'Evenness Datum Areas'** button in the tool bar the evenness value for each of the datum area selected will be displayed. Once the user selected 3 datum areas, the **Current and Best Evenness Values** of the datum areas will be displayed. The evenness value ranges from 0 to 1 for each of the datum areas selected. Refer section 7.7 for detailed description.

The sample evenness values along with its total are displayed as follows.

Evenness: D1: 0.446 D2: 0.492 D3: 0.370 Cur: 0.865 Best: 0.865

Volume:

The volume of Eroded Areas, Filled Areas and Difference between Original and Modified scans will be displayed in the Eroded View, Filled View and Difference View respectively.

Mean Height:

The Mean Height of Difference, eroded areas and filled areas will be displayed in their respective Views.

X and Y Rotations:

The current grid rotation angles of X and Y are shown at the top of the Grid Views.

Note : Refer Section 4 for detailed description

Cross Hair:

The Cross hairs are displayed on both the Original and Modified Surfaces in the Final Alignment View and all the other Grid Views when the user selects the option **'Settings/Show Cross Hair'** from the main menu. The user should note that when this option is selected the **'Show Wireframe Always'** option from the settings menu is disabled with check option automatically.

4.   Views In ProForm

This section describes the various views created and displayed by this software.

4.1. **Planar View of Original Surface**

This view presents the Aerial View of the Original Surface Scan. It allows the user to select Scribe Marks - if any - on it. The typical Planar view of the Original Surface is shown below.
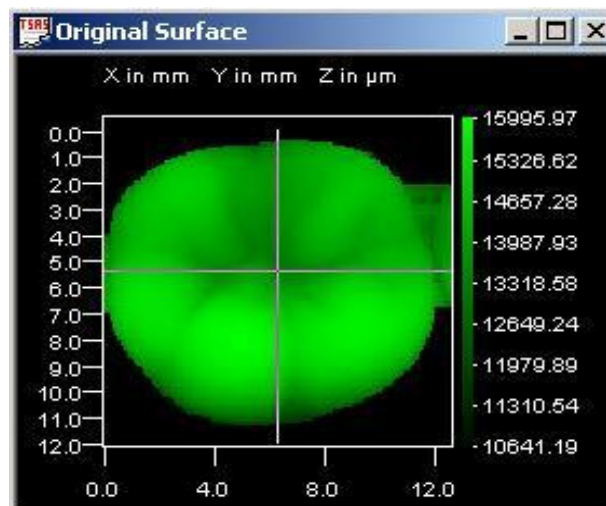
In this view the canvas size of the surface can be increased or decreased by selecting the **'Zoom Out'** or **'Zoom In'** buttons from the Tool bar. The user can zoom a Scribe Mark or a distinguished feature on it for aligning it with the Modified Surface.
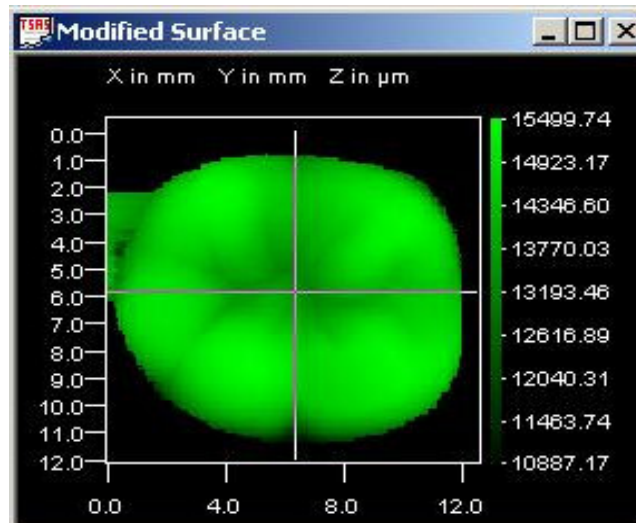
4.2.   Planar View of Modified Surface

This view presents the Aerial View of the Modified Surface Scan. It allows the user to select Scribe Marks – if any - on it. The typical Planar view of the Modified Surface is shown below.

In this view the canvas size of the surface can be increased or decreased by selecting the **'Zoom Out'** or **'Zoom In'** buttons from the Tool bar. The user can zoom a Scribe Mark or a distinguished feature on it for aligning it with the Original Surface.

4.3. Alignment View

This view shows a Superimposed Aerial View of the Original and Modified Surfaces. The user can match the two surfaces by aligning the Scribe Marks of Modified Surface with the Original Surface in X-Y displacement and/or Rotational Alignment. This view is useful for the Preliminary Alignment of the two surfaces. The typical Alignment View is shown below.
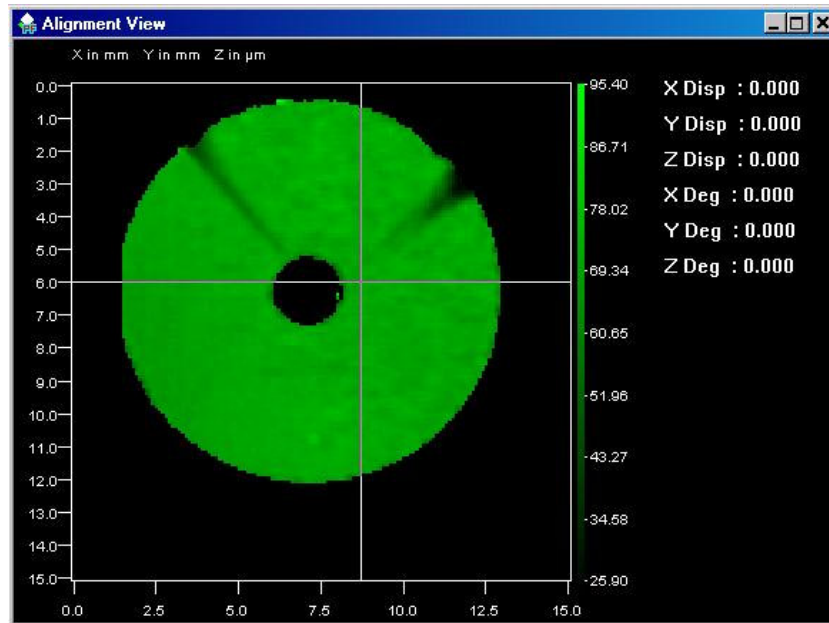

When translation and rotation are made on the Modified Surface, the changes will be reflected in all the views. This view will show the values of Alignment for **X, Y and Z Displacement** and the **Rotational degree** (i.e) the degree at which the Modified Surface is rotated for each axis (X, Y and Z) seperately, which can be seen in the right side of the view.

If any Scribe Marks or distinct features are there on the surface, the user can see them on both the Original and Modified Surface in the Alignment View. This is to have an easy understanding of how the Modified Surface is getting aligned over the Original Surface for a later study.

4.4.   Final Alignment View

This view shows the Original Surface as Solid and Modified Surface as Wire frame in the 3D view. The Modified Surface will be shown on top of the Original Surface initially. If the user wants to see the actual placement of the two surfaces then the user can press **Toggle Z** button from the Tool bar which will place the surfaces in their original place. This view is only used to explore the dimensions of Wire frame and Solid surfaces. The typical Final Alignment View is shown below.
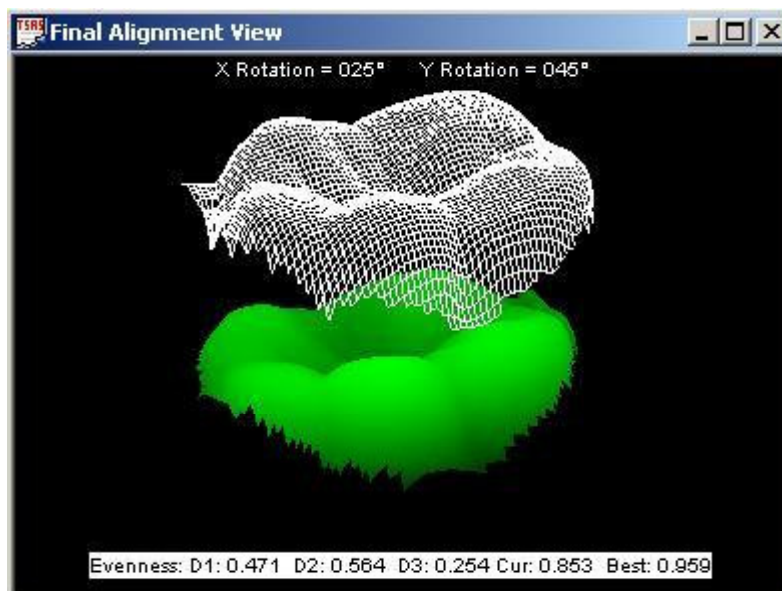
This view shows the Evenness values of the datum areas along with their current and best evenness values which will help the user for best alignment. Refer Alignment in Section 7.7 for more explanation on how to use Evenness values to achieve best alignment.

In this view the canvas size of the surface can be increased or decreased by selecting the **'Zoom Out'** or **'Zoom In'** buttons from the Tool bar.

4.5.   Difference View

This view shows the difference between the Original and Modified Surfaces that is being translated for alignment. The typical Difference View is shown below.
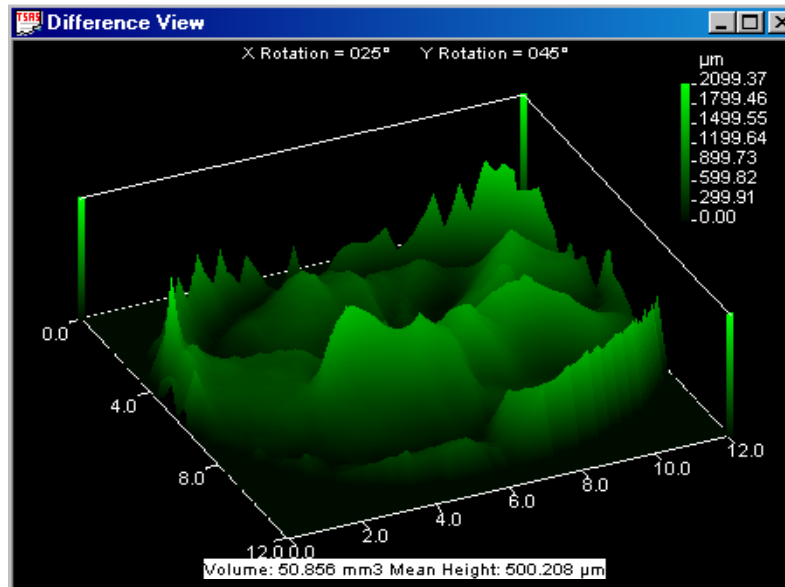

This is the default view of the three Resultant Views. To have one of the other two views viz., Eroded Areas View and Filled Areas View in this place the user can use **'Window/Create View'** menu command. It will display the volume of the difference between the Original and Modified Surface and also the mean height value in micrometer.

Once the alignment is done and the difference view is obtained the view can be saved in .PRS file format. The canvas size of the surface can be increased or decreased by selecting the **'Zoom Out'** or **'Zoom In'** buttons from the Tool bar.

4.6.   Eroded Areas View

This view shows the eroded areas from the Original Surface in the Modified Surface which is being aligned. It displays the volume of the eroded areas and the mean height value. The Colour Band Scale Value will indicate the user that how much volume of area is eroded in the Modified Surface. A sample eroded area view is shown below.
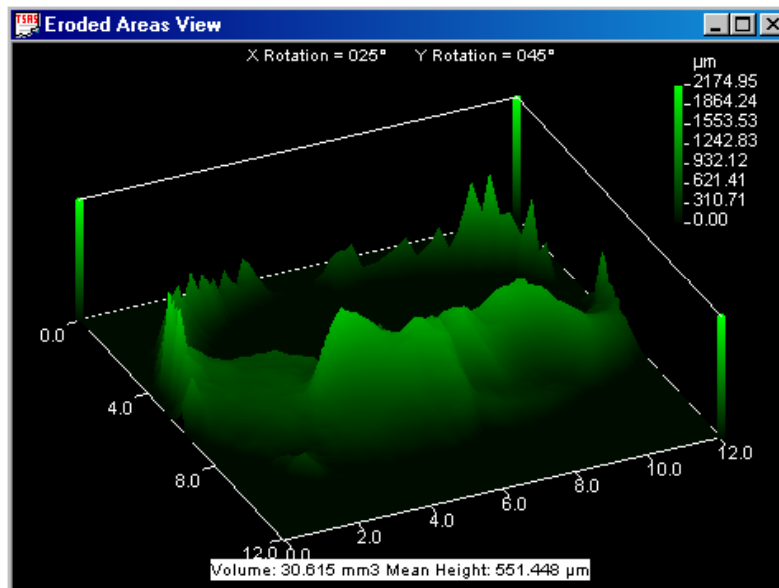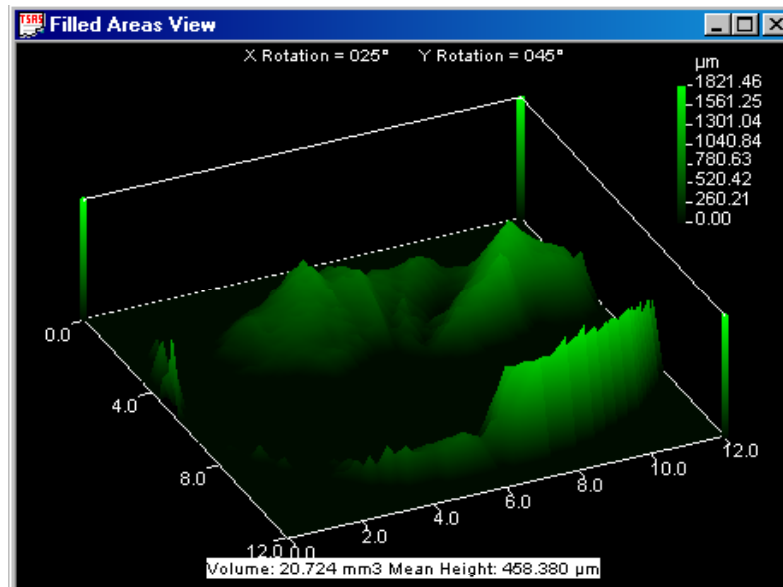

This view can be **created** by selecting **'Window/Create View/Eroded View'** from the main menu.

In this view the canvas size of the surface can be increased or decreased by selecting the **'Zoom Out'** or **'Zoom In'** buttons from the Tool bar.

4.7.   Filled Areas View

This view will show the filled areas in the Modified Surface in the 3D view. It will display the volume of filled areas and the mean height. The Colour Band Scale Value will indicate the user that how much volume of area is filled after the object has undergone some tests. A sample filled areas view is shown below.
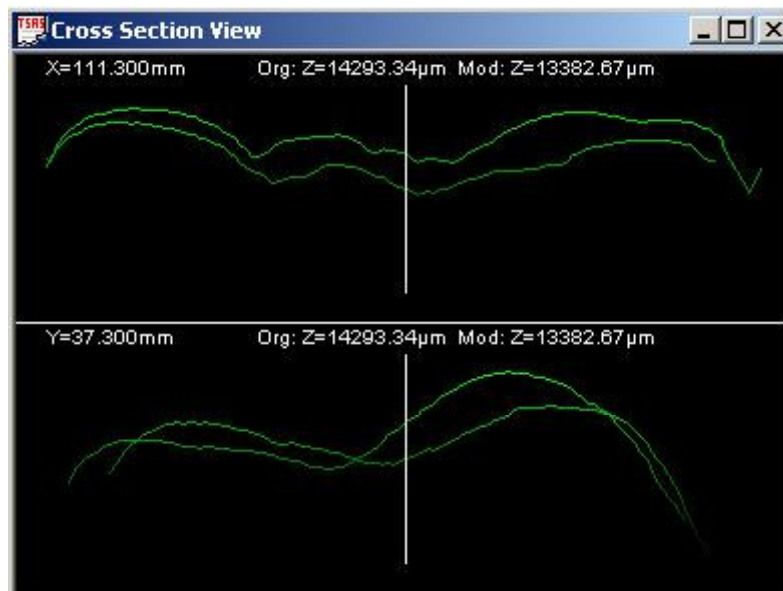

This view can be **created** by selecting **'Window/Create View/Filled View'** from the main menu. The canvas size of the surface can be increased or decreased by selecting the **'Zoom Out'** or **'Zoom In'** buttons from the Tool bar.

Note: Please note that Colour Band Scale in the top right corner keeps changing as the user aligns.

4.8.   Cross Section View

This view will show the Cross Hair selected lines of both Original and Modified Surfaces. If the mouse cursor is clicked on any one of the Planar Views, then the Cross Section View will represent the entire width of both the Original and Modified Surface scans at the current mouse position. If Plan Views are zoomed then this view will show only the zoomed surfaces current mouse position. Note that the zoomed scan may indeed also represent the entire data area.


This view can be created by selecting **'Window/Create View/Cross Section View'** from the main menu.

4.9.   Zooming Facility

The ProForm software allows the user to zoom a specific area of the scan by selecting a rectangular area or a circular area. To zoom in, the user should perform the following procedure.

1 Press and hold **Shift** (for rectangular area selection) or **Ctrl** (for circular area selection).
2 In case of rectangular area selection Left Click on the top left position of the required area (on either of the Planar Views) and Drag a rectangle, and in case of circular area selection Click on the point to be zoomed and drag the mouse outwards to select the area.

When the user releases the Mouse Button and the SHIFT or CTRL key, the zoomed in area will be drawn. To Zoom out and revert the full scan size, simply the user can press SHIFT and Double Click (Left Button) the Mouse on the Plan View.
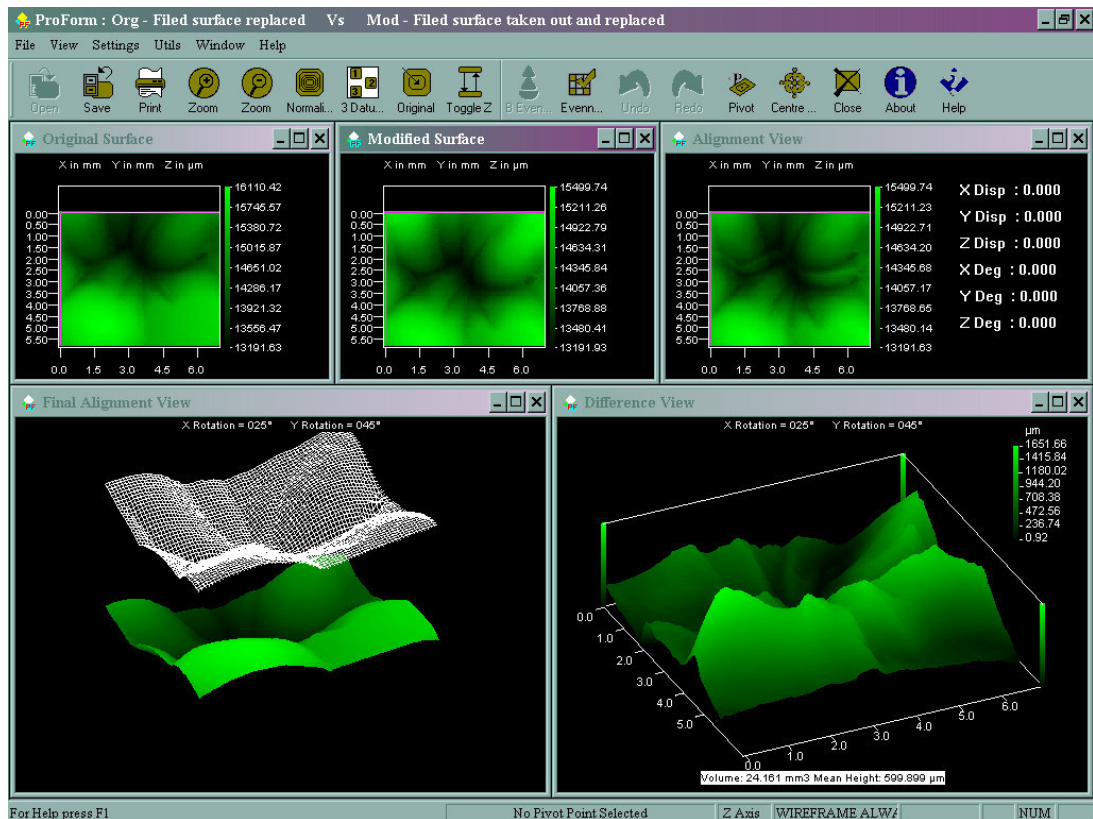
The screen above shows a typical Zoomed portion in all the views.

5.   Aligning the Surfaces

This section describes the Procedure of doing Alignments in order to get the difference between the Original Surface Scan and Modified Surface Scan.

5.1. Steps for Alignment

1. Select and load the original and modified surface scans into the ProForm Application by selecting 'File/Load' from the main menu or using Ctrl+O. The views will be created and displayed.
2. The **Options** Dialog will be displayed. The user can set the Leveling Option by selecting either **3 Point Leveling** or **Manual Leveling**. The user can also apply the Compensation Offset to Original and/or Modified Surface to take care of data lost in surfaces while they are rotated about X and Y Axis and also for the data lost in when the Z Movement is done. It is done by checking the options, which are **Add to Original** and **Add to Modified.** Press OK for the selection. The views will be created and displayed.
3. Select three datum marks as rectangular areas using the cross hair by holding down the shift key and dragging the mouse after clicking the **'Evenness Datums'** button from the Tool bar. Once the datum areas are selected it will be displayed on all the three planar views. The user can make the datum areas to be shown or hidden by clicking the 'Evenness Datum' toggle button.
4. Once the datum areas are selected, the Evenness values for each of the datum areas and its current and best evenness values will be displayed in the Final Alignment View if the 'Evenness Datums' from the Tool bar is selected. The user can show/hide the datum areas and the evenness values.
5. Start aligning the surfaces by doing any of the transformations such as X and Y translations, Rotations about Z Axis and also Z Alignment such that the **best evenness value (approximately 1**) is achieved. This shows that the datum areas selected have been matched or aligned closely on both the surfaces.
6. If the user is not able to align it closely and if wants to go back to the previous best Evenness value, the user can click **'Best Evenness'** button in the Tool bar.

7. If the user chooses the 3 Point Leveling option, then 3 Datum areas can be selected by clicking the **'3 Datum Areas'** button from the Tool bar or selecting **'Utils/3 Datum Areas Leveling'** options from the main menu. Selecting these datum areas will do the 3 point leveling on Modified scan such that the scans will be leveled to the 3D plane. If user chooses the Manual leveling option, then rotations about X and Y axis can be done.

8. Once the above steps are done the user can see the actual difference between the Original and Modified surfaces in the Difference View.

5.2.   X-Y Alignment

The X-Y Alignment is done to align the Modified Surface with the Original Surface along X and Y Axis.

The key combinations used for **X-Y Alignments**:

> **CTRL + UP ARROW**   -   For moving the Modified Surface towards top.
>
> **CTRL + DOWN ARROW**   -   For moving the Modified Surface towards bottom.
>
> **CTRL + LEFT ARROW**   -   For moving the Modified Surface towards left.
>
> **CTRL + RIGHT ARROW**   -   For moving the Modified Surface towards Right.

5.3.   Rotational Alignment

ProForm provides provision for rotating the surfaces about the three axis namely X,Y and Z Axis. These rotations are very useful for performing alignment of the surfaces.

Rotation about Z – Axis:
The user can change the current rotational axis as Z axis by pressing the function key F9 or selecting the **'Utils/Rotate Plane/Z Axis'** from the main menu.

Rotation about Y – Axis:
        The user can change the current rotational axis as Y axis by pressing the function key F11 or selecting the **'Utils/Rotate Plane/Y Axis'** from the main menu.

Rotation about X - Axis:
        The user can change the current rotational axis as X axis by pressing the function key F10 or selecting the **'Utils/Rotate Plane/X Axis'** from the main menu.

The key combinations used for **Rotational Alignment**:

> **ALT + UP ARROW**   **-** To move the Modified Surface in Counter Clockwise.
> **ALT + DOWN ARROW -** To move the Modified Surface in Clockwise.

Note: By default the rotation will be done about the Z Axis

5.4.   Z Alignment

The Z Alignment is done to align the Modified Surface with the Original in the Z Axis to make them to be in the same height.

The key combinations used for **Z Alignment**:

> **SHIFT + UP ARROW**   - To move the Modified Surface upwards.
> **SHIFT + DOWN ARROW** -   To move the Modified Surface downwards.

5.5.   Undo and Redo Alignments

ProForm provides provision for undoing and redoing the last alignment performed. The user can **Undo** the alignment performed last by pressing **Ctrl+Z** and also **Redo** the last alignment undone by pressing **Ctrl+Y**.

5.6. Pivot Point Rotation

The user can select any point on the Modified Surface and can rotate the surface about it (i.e) the modified surface can be rotated with the pivot point as the center of rotation. The Pivot point can be chosen on any position on the scanned surface and can be rotated.

➢ Pivot Point can be selected by clicking the **'Choose Pivot'** button from the Toolbar or using the hot key **Alt + P**.
➢ To select the Center of the surface as the Pivot Click **'Centralize Pivot'** or use the hot key **Alt + R**.
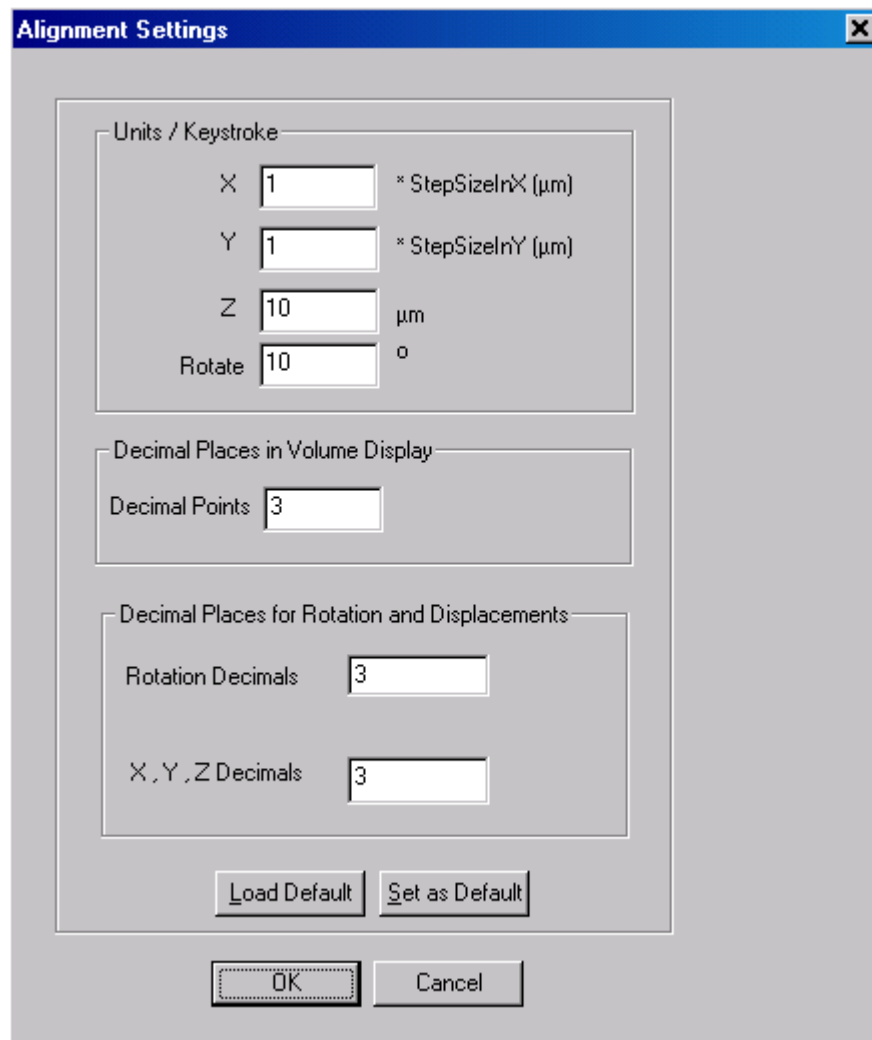
Note: When Pivot point is selected the rotation can happen only on the XY Plane (i.e) about the Z Axis. Hence in Manual Leveling user will be asked whether to change the axis of rotation about Z axis if pivot point is selected. If the user doesn't want to change the axis of rotation the selection of pivot point will be discarded. If the user selects yes the axis of rotation will be changed to Z-Axis and the other Rotational axes will be grayed out.

6.   Settings

Selecting the **'Settings'** option from the main menu will allow the user to alter the settings pertaining to display and alignment. The parameters available are described in the following sections.

6.1.   Alignment Units

By selecting the **'Settings / Alignment Units'** from the main menu Alignment Units Dialog will be displayed as follows.

Here the user can set the number of units for X-Y Alignment, Z Alignment and the degree for Rotational Alignment. Also user has options for loading default settings and setting the default settings as per user needs.
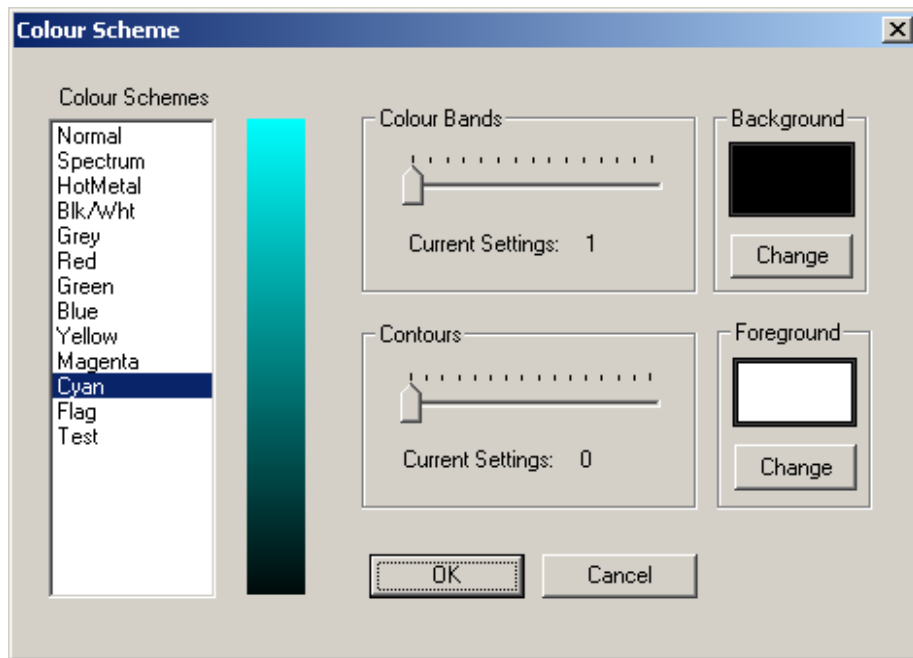
6.2.   Colour Scheme

The Colour Scheme allows the user to select the colours which will be used to represent the views, as well as selecting any of the Pre-defined Colour Schemes.

By selecting the **'Settings/Colour Scheme'** from the main menu, Colour Scheme Dialog will be displayed as follows.
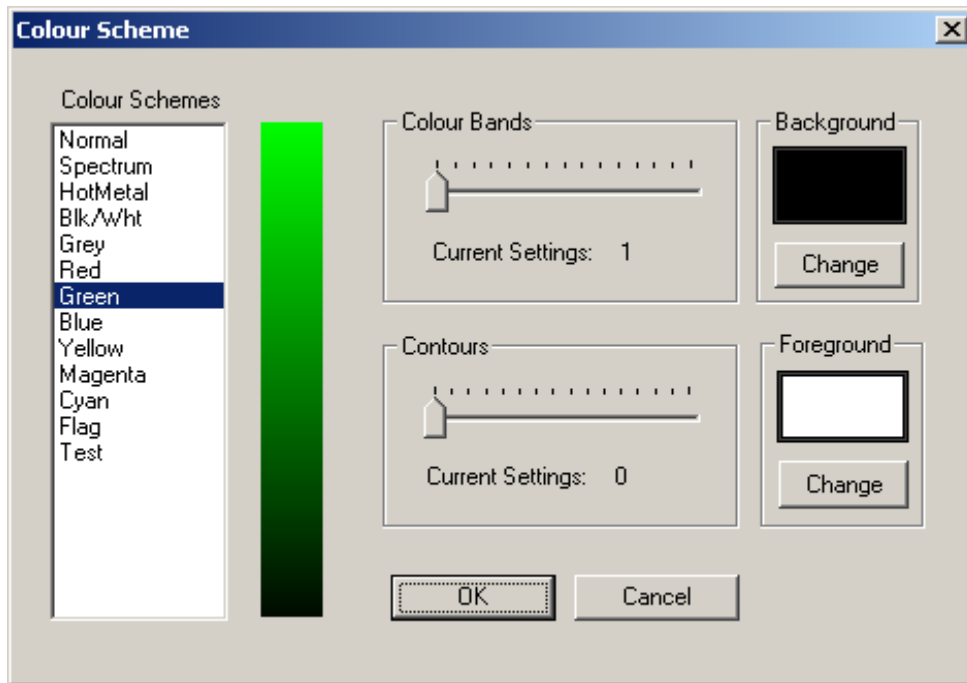
**Cyan**

6.3.   Setting Colour Bands

The use of Colour Bands allow the currently selected Colour Band to be 'repeated' at even intervals in the scan range. This allows for final height details to be detected. However, using too many colour bands can make the image rather confused, so care should be taken when setting the number of colour bands to anything greater than 2. The user can set the colour bands ranging from 1 to 15.

The sample images below show how a typical view would look like with 2 and 3 colour bands selected. The default Colour Band setting is 1.

**2 Colour Band Selected**
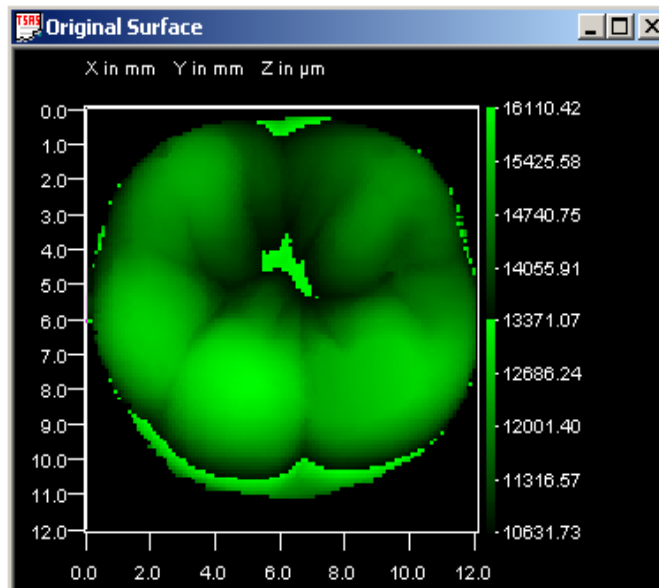
3 Colour Band Selected
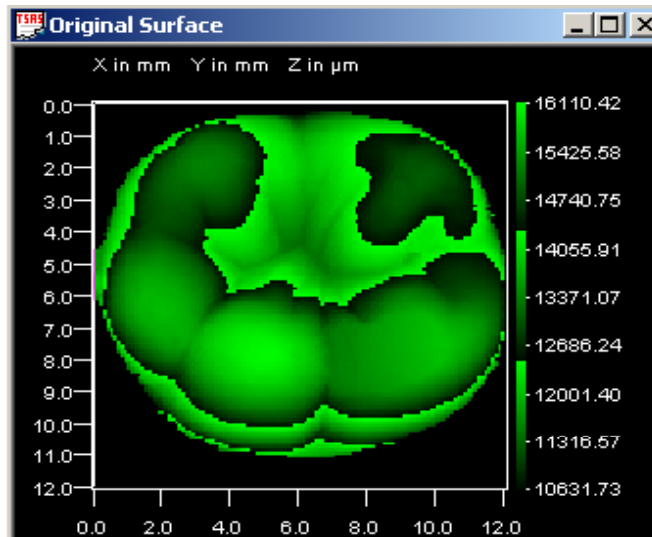
6.4.   Using Contours

This function allows the user to place unto a maximum of 15 contour lines on the scan. This is particularly useful for identifying points of a scan that are on the same plane. Move the contours slide to select the desired number of contour lines. The range of contour is from 0 to 15. The default setting is at 0. The sample images below show a typical view when 2 and 3 contours have been selected.

2 Contour selected
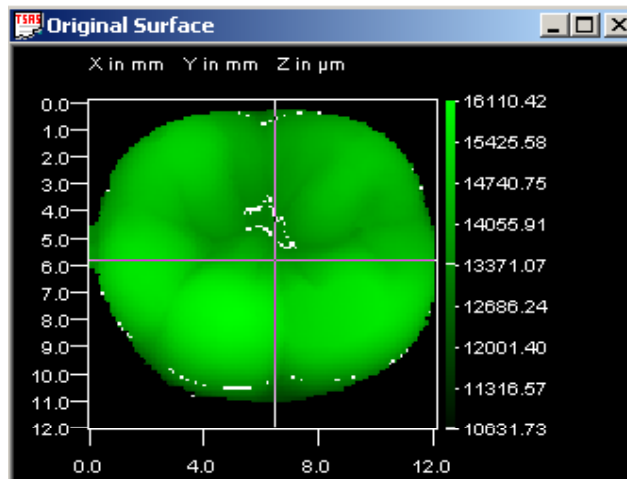
**3   Contour selected**
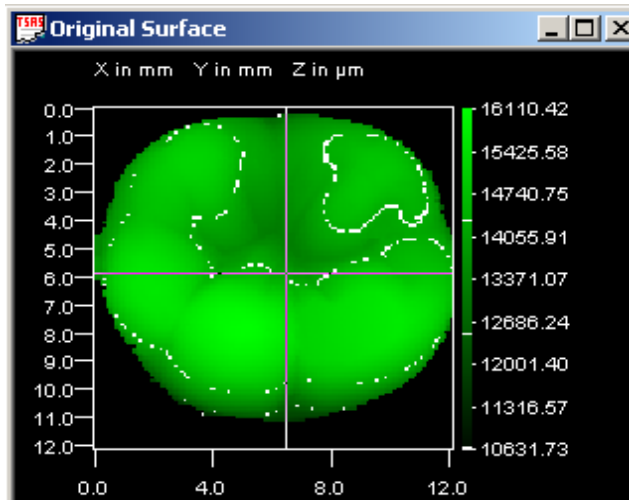
6.5.   Showing Wireframe

In the Final Alignment View the user can have either the Wireframe shown always when the user move it across the solid surface or make it cut through it exposing partially either Wireframe or the Solid Surface based on their heights. To show the Wireframe always the user can select the option **'Settings/Show Wireframe Always'** from the main menu.
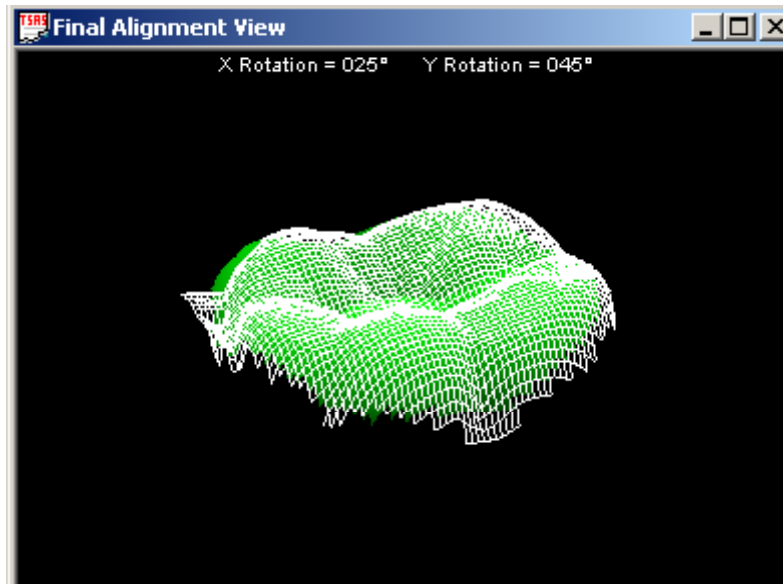
The screen above shows the Final Alignment View when the **'Show Wireframe Always'** option is selected.
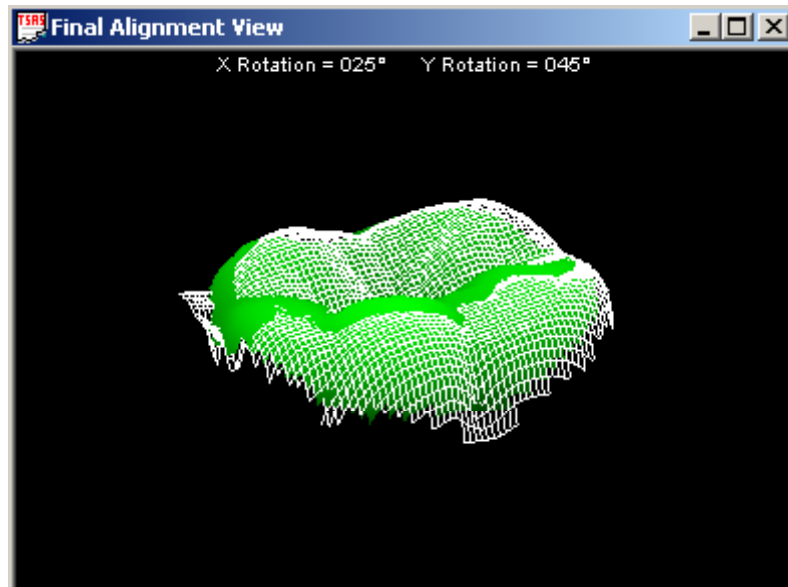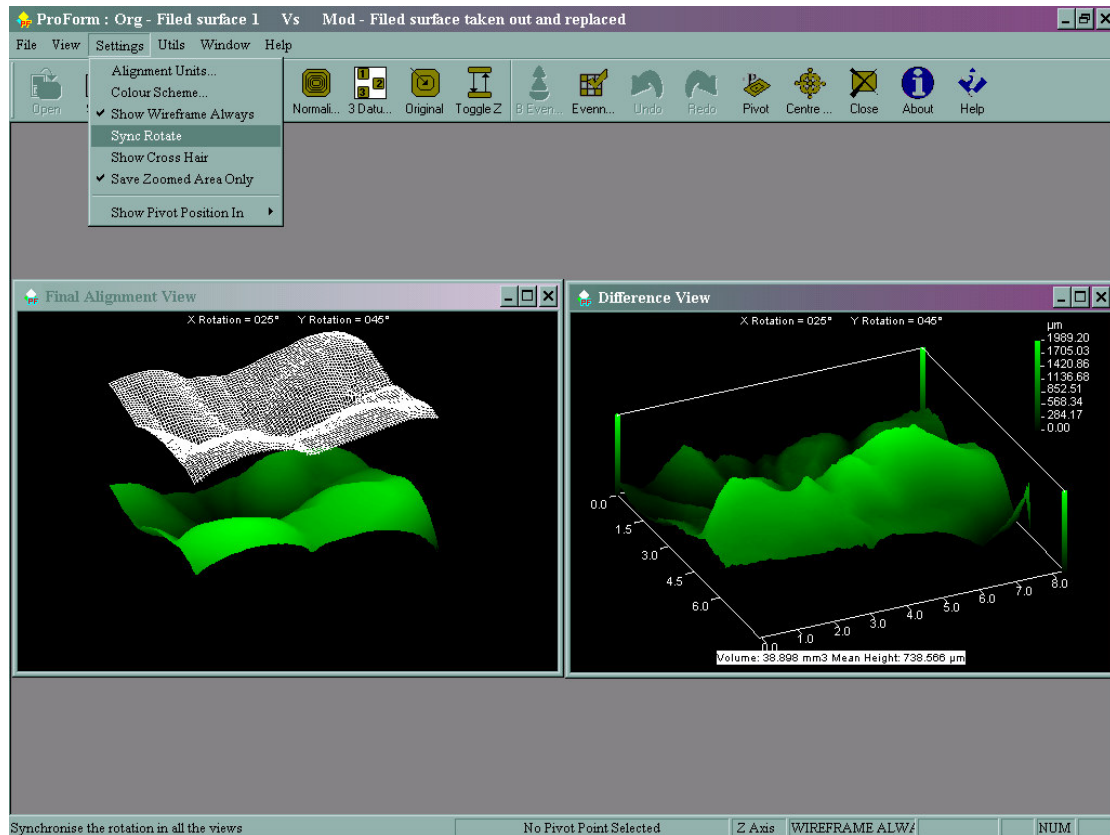
The screen above shows the Final Alignment View when the **'Show Wireframe Always'** option is not selected.

Note: By default the **'Show Wireframe Always'** is Selected.

6.6.   Sync Rotate

When we select **'Settings/Sync Rotate'** from the main menu the same
Rotational Angle will be applied to Final Alignment View and all the three
Resultant Views.

6.7.   Save Zoomed Area Only

When we select **'Setting/Save Zoomed Area Only'** from the main menu only
the Zoomed portion in the Difference View will be saved.

7.   Common Functions

The following sections describe the various functions like Normalise, Datum Areas and Selection, Restore Original and Toggle Z which are used in ProForm. The tool bar buttons' description as follow.

7.1.   Normalise

This function restores the views resized or closed into their respective positions. When the user wants to rearrange the view windows to their respective default positions if the user clicks the Normalise button from the Tool bar or selecting the option '**Windows/Normalise'** from the main menu.
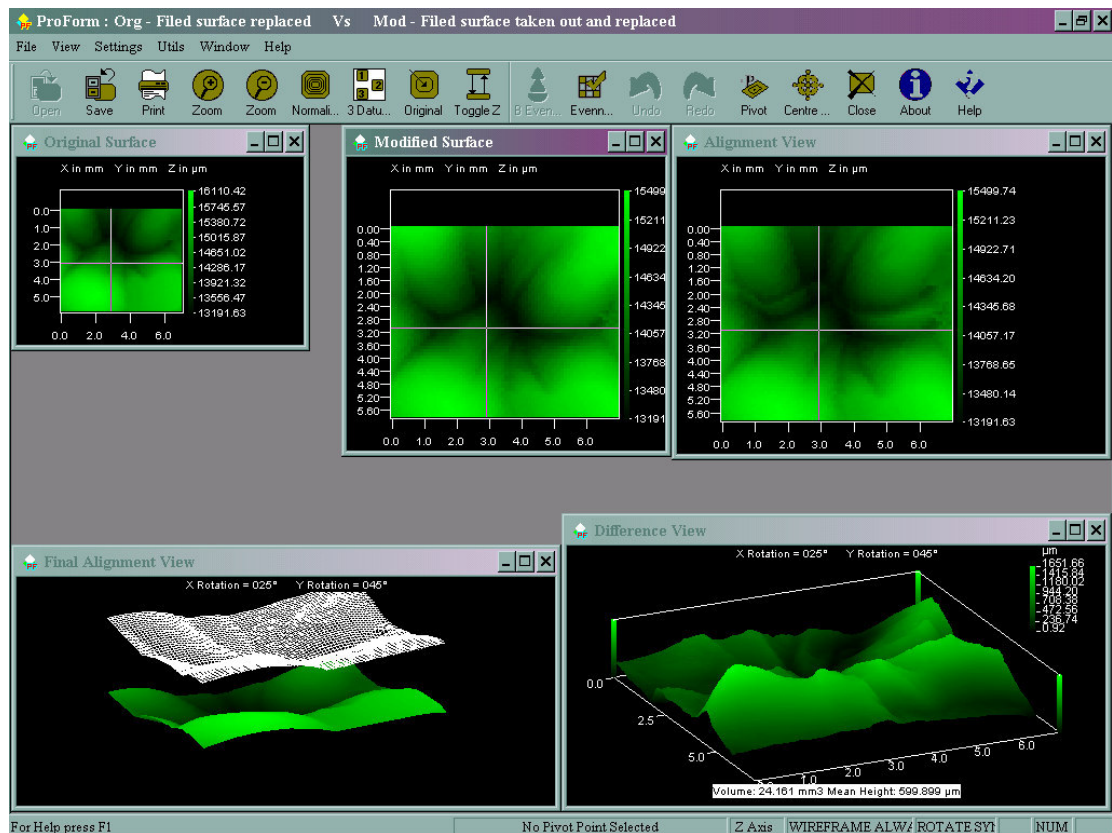
The view windows resized and shown (Before Normalise)
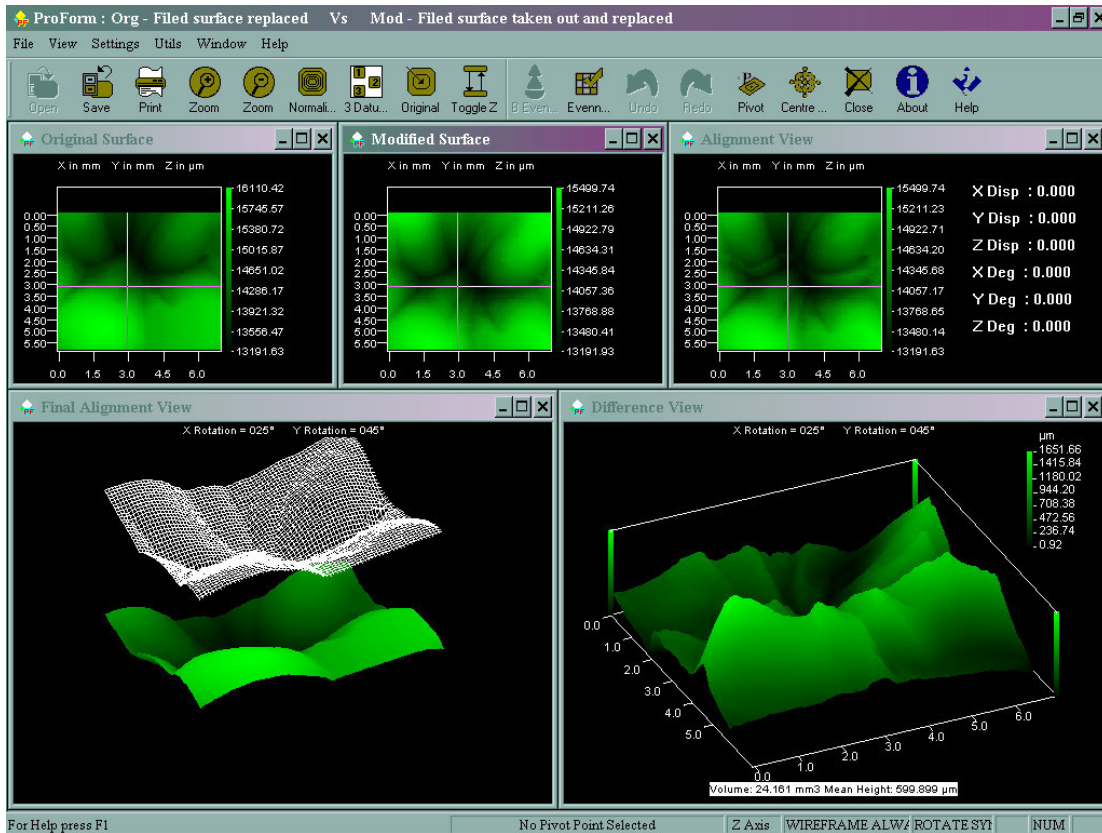
The View windows Rearranged and shown (After Normalise)

7.2. 3 Datum Areas leveling

This utility enables the user to select the datum areas (maximum of 3) on any of the Planar Views. The selection of datum areas are displayed on all the 3 Planar Views. To select the datum areas the user can select Datum Areas button from the Tool bar or **'Utils / Datum Areas'** from the main menu. Once the user selects it a Hint Window is displayed as follows.
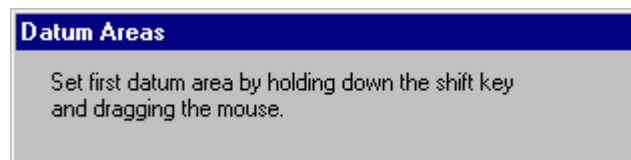
Now, the user should select 3 datum areas by holding the shift key and dragging

the mouse. Once the user has selected all the datum areas 3 point leveling will be applied automatically to Modified surface.
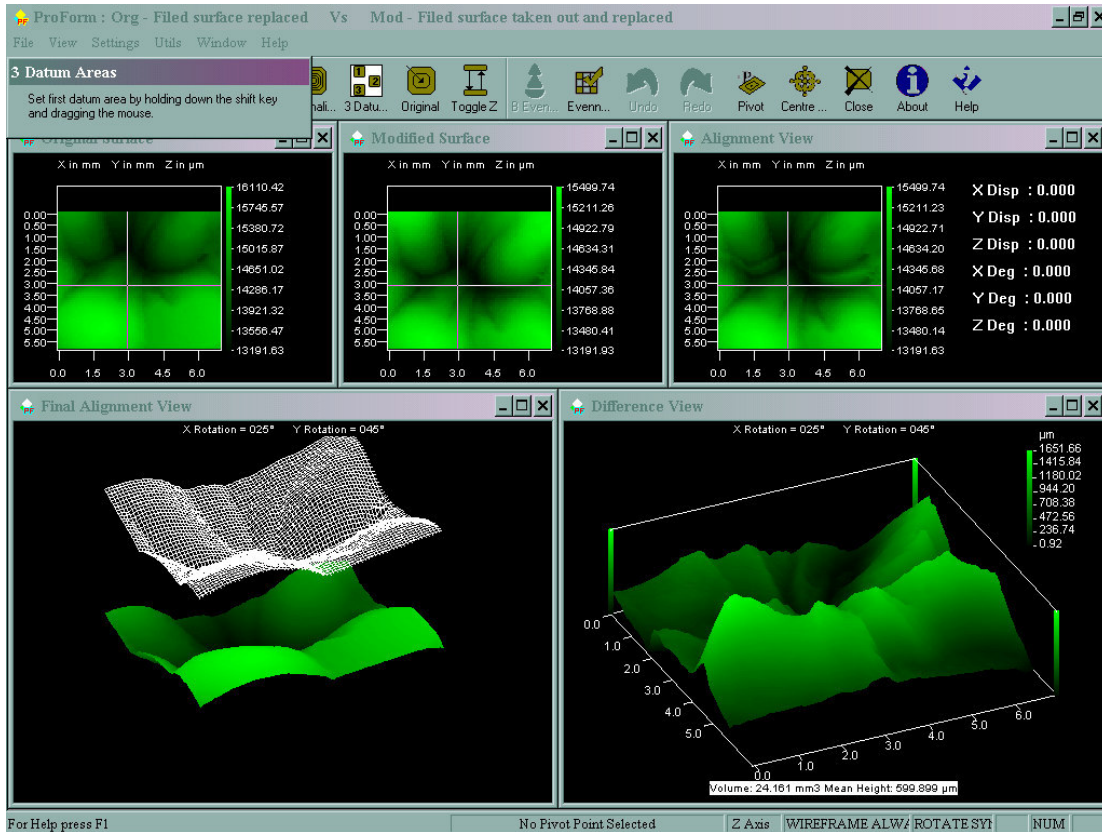
When the datum areas are selected the compensation plane will be calculated and added to the Modified Surface. Since the datum areas are selected as a rectangular area, 3 Point Leveling is done to level the scan to the 3D plane that matches the 3 datum areas by taking the center point of the rectangle and its average height of every datum area.

Datum Area Leveling on the Zoomed Area
The user can also choose 3 datum areas after Zooming the scanned surface. The user has the provision to zoom any specific area and then choose the datum areas.

Note: The user must take care that the datum areas selected should have a **stable distinct feature**. It should not be flat and also not be symmetrical.

7.3.   Zoom In and Zoom Out

On clicking the Zoom In and Zoom Out buttons from the tool bar the user can zoom/un zoom the views. Note that only the view which is active is affected.

7.4.   Restore Original

Restore Original function cancels all the alignments done by the user and restores the scans in the views to the originally displayed place.

7.5.   Toggle Z

When **Toggle Z** button in the Tool bar is pressed the surfaces on the Final Alignment View will be moved to the actual position. Pressing the **Toggle Z** button again will make the scan surfaces pull apart from each other giving the user better visibility of both the surfaces. This enables the user to view both the surfaces more clearly at various angles.

7.6.   Goto Best Evenness

This function keeps track of the 'Best Evenness Value' obtained during alignment and allows the user to get back to that alignment (i.e) the best evenness value achieved previously by clicking the **Goto Best Evenness** button from the Tool bar.

7.7.   Evenness Datum Areas

This function is used to find the evenness of the datum areas selected and also helps the user to know whether the datum areas selected have been matched or not during alignment. When the user chooses three datum areas after clicking the **'Evenness Datum Areas'** button in the Tool bar, the evenness value for each of the datum area selected will be displayed in the Final Alignment View and also the current and the best evenness value of the datum areas will be displayed. This evenness value is a numerical ratio which tells the user the evenness of the selected datum marks. The evenness value ranges from 0 to 1. When the best evenness value is approximately equal to 1 then the user can understand that the datum marks are exactly matched and hence the surfaces are aligned.

The **'Evenness Datum Areas'** button acts as a toggle button which shows the datum areas selected when enabled and hides the datum areas when disabled. Note that the evenness information of the datum areas remains displayed in the view once they are selected.

7.8. Remove Compensation

This option removes the Compensation Offset applied to the Original and/or Modified Surfaces by clicking the **'Utils/Remove Compensation'**.

8. **HOT KEYS AND KEYBOARD ACCELERATORS**

 HOT Keys

The following Hot Keys are supported by this application:

Ctrl + O	Load the PRS files
Ctrl + S	Save the current Difference View
Ctrl + P	Print the active View
Ctrl + Z	Undo the Last Alignment Done
Ctrl + Y	Redo the Last Alignment Undone
Ctrl + Tab	Switches between the view windows
Alt + P	Select Pivot Point
Alt + R	Centralize Pivot

Keyboard Accelerators

The following Keyboard Accelerators are used in this application:

Alt + F + O	Load the PRS files
Alt + F + S	Save the current Difference View
Alt + F + A	Save the document in a different .PRS files
Alt + F + P	Print the active view
Alt + F + V	Print Preview of the active View
Alt + F + R	Displays the Print Setup Dialog
Alt + F + C	Close the loaded files and views
Alt + F + X	Exit the Application
Alt + V + T	Display Tool bar
Alt + V + T	Display Status bar
Alt + S + A	Set Alignment Units
Alt + S + C	Display Colour Scheme Dialog
Alt + S + W	Show Wireframe Always
Alt + S + S	Sync Rotate
Alt + S + H	Show Cross Hair

Alt + O	Show Pivot Position in Original Surface
Alt + M	Show Pivot Position in Modified Surface
Alt + A	Show Pivot Position in Alignment View
Alt + U + D	Option for selecting Datum Areas
Alt + U + R	Selecting the Rotation Plane
Alt + U + R+ X	Rotation about X Axis
Alt + U + R+ Y	Rotation about Y Axis
Alt + U + R+ Z	Rotation about Z Axis
Alt + U + E	Select Evenness Datum Areas
Alt + U + G	Goto Best Evenness
Alt + U + T	Toggle Z(Merged)
Alt + U + T	Remove Compensation
Alt + W + C	Cascade Windows
Alt + W + T	Tile Windows
Alt + W + A	Arrange Icons
Alt + W + Z	Normalise Views
Alt + W + V	Create View
Alt + W + V+ E	Eroded Areas View
Alt + W + V+ L	Filled Areas View
Alt + W + V+ C	Cross Section View
Alt + W + 1	Difference View
Alt + W + 2	Original Surface View
Alt + W + 3	Modified Surface View
Alt + W + 4	Alignment View
Alt + W + 5	Final Alignment View

(**Note:** The above listing is based on the window creation order.)

Alt + H + A	About ProForm
Alt + H + M	Manual
Alt + H + H	Help

F9	Rotation about Z Axis
F10	Rotation about X Axis
F11	Rotation about Y Axis

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