V-STARS 4.4
Release Notes

December 2004

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Introduction

The following release notes describe the significant new features that are available in V-STARS Version 4.4.

The release notes also describe many of the software fixes implemented since the previous release (V-STARS Version 4.3).

All care has been taken to ensure that the software is functional and operates as it should. This software has passed all internal testing. Although this testing is thorough, it is by no means complete. We cannot run through all the possible combinations and applications that our large and varied user base performs. We therefore urge you to try out the new features as much as possible in the next few weeks to confirm that they work properly. Please notify us as soon as possible of any problems you find so they can be fixed in the next formal release.

Throughout this guide **NOTE:** will be used to indicate particularly useful information. Additionally, **WARNING!** will be used to indicate when special attention should be paid to the information provided to avoid an undesirable result.

Known Issues

Opening or Importing Projects from CD-ROM or DVD

V-STARS 4.4 will not open projects stored on a CD-ROM or DVD. Additionally, no files stored on a CD-ROM or DVD can be imported into a V-STARS project. This is a Microsoft software problem and is not a problem with the V-STARS 4.4 software. The workaround for this issue is to simply copy the project or files from the CD-ROM or DVD to the computer hard drive and open or import from there. We will let you know if and when Microsoft fixes this problem.

Thumbnail Display

Due to a Windows limitation, V-STARS will not display more than 322 rows of thumbnails. If there are more than 322 pictures in a project, all of the thumbnails may be displayed by expanding the width of the thumbnail display to display more columns. If there is still a problem, pictures may be opened by double clicking the picture icons on the project tree.

Important Changes

The following items are considered very important changes in V-STARS.

M-Mode Trigger Icon Changed

The M-Mode trigger icon has changed from a picture of a probe to the letter "**T**" (**Figure 1**) to better reflect what this button does, and also because a probe button is now used on the new M-Mode measurement type toolbar (see below). To help avoid confusion, the new probe button has a different appearance.

Figure 1: Old Picture Bar with probe trigger icon (left). New **T** icon (right).

M-Mode Measurement Type Toolbar Introduced

GSI has added the **Measurement Type Toolbar** (**Figure 2**). This toolbar is available in M-Mode only and is displayed by selecting **View->Measurement Type Bar** from the V-STARS main menu. For more details see the section V-STARS M-Mode Features.
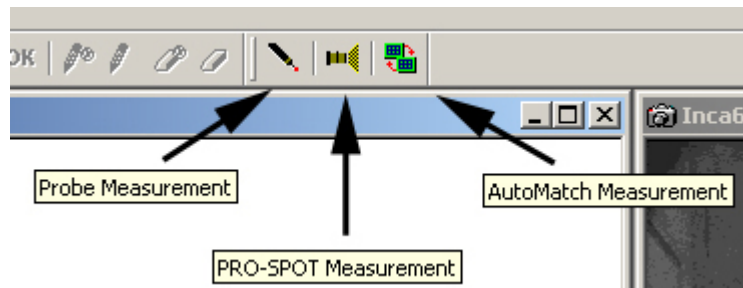
Figure 2: M-Mode Measurement Type toolbar with new Probe, PRO-SPOT, and AutoMatch icons.

V-STARS INCA3 Camera Support

The following features were added to support new INCA3 functionality.

Wireless Interface

Wireless capability has been added to V-STARS when using an INCA3 camera. The wireless interface works the same way that a wired connection works for an INCA camera.

Pictures can be taken from the camera or from V-STARS in any combination. Images are acquired by pressing the trigger switch on the camera or by pressing the camera icon button 📷 in V-STARS. The picture is automatically transferred to V-STARS and displayed in a picture window. To save the picture, simply close the picture window. To save the picture and take a new one, press the INCA3 trigger switch again or in V-STARS, press the right arrow button ➡ on the toolbar. To overwrite the picture, press the camera icon button again.

The Delete switch (the small red switch on the front of the camera) is used to delete unwanted pictures. Hold down the Delete switch until the LCD screen displays the delete message. Each time the delete switch is pressed and released, the last picture taken is deleted. **NOTE:** Deleted pictures CAN'T be recovered.

For more information about INCA3 and wireless networking, refer to the INCA3 Camera Manual. It explains in detail how to setup and use an INCA3 camera with a wireless network.

Strobe Levels

Inca3 cameras have an internal strobe with more power levels than the INCA 1 and 2. V-STARS 4.4 allows the user to select from strobe power levels 0-21 and OFF, if an INCA3 is connected to V-STARS (**Figure 3**).

In addition to more levels, the INCA3 camera has more resolution. For INCA3 the power doubles for every change of 3 levels (as opposed to the INCA1 and INCA2 cameras in which the power doubles for every change of 2 levels). For example, level 9 is twice as powerful as level 6. Typically the power level is between 6 and 12.
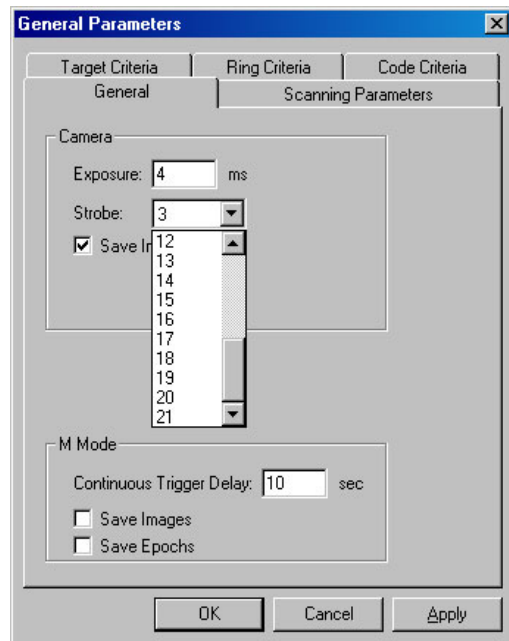
Figure 3: Selecting INCA3 strobe level.

V-STARS General Features

Multiple Coordinate Systems

V-STARS now supports multiple coordinate systems. The **Alignment** dialogs now have two Coordinate System fields (**Figure 4**). The **Current** field displays the name of the current coordinate system. The **New** field displays the name of the new coordinate system that will be created when the alignment is done. The default name for the new coordinate system can be changed by typing in the **New** field.
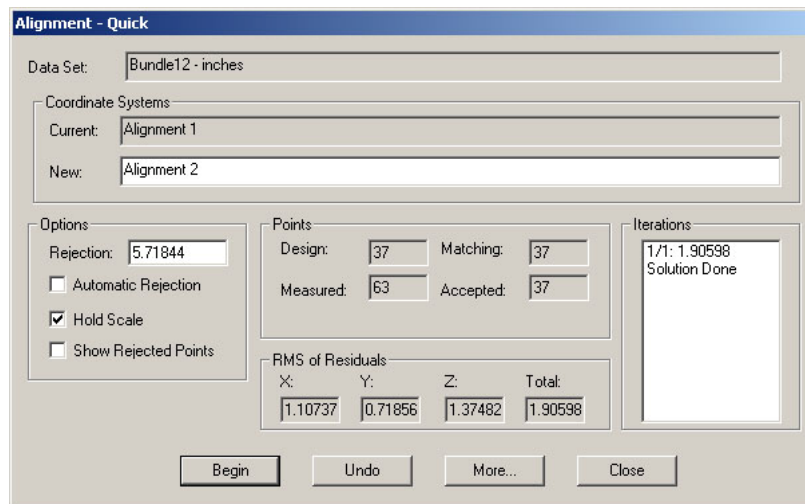
Figure 4: Alignment dialog showing Current and New Coordinate System fields.

All coordinate systems are displayed in the graphical view (**Figure 5**). The current coordinate system is displayed in color while the others are grey. The coordinate
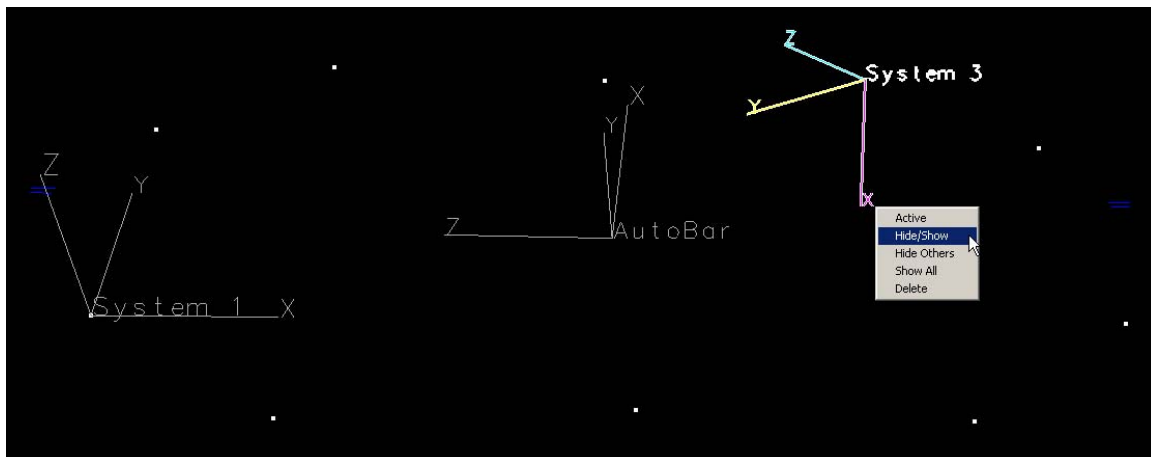
Figure 5: Multiple coordinate systems displayed in V-STARS graphical view.
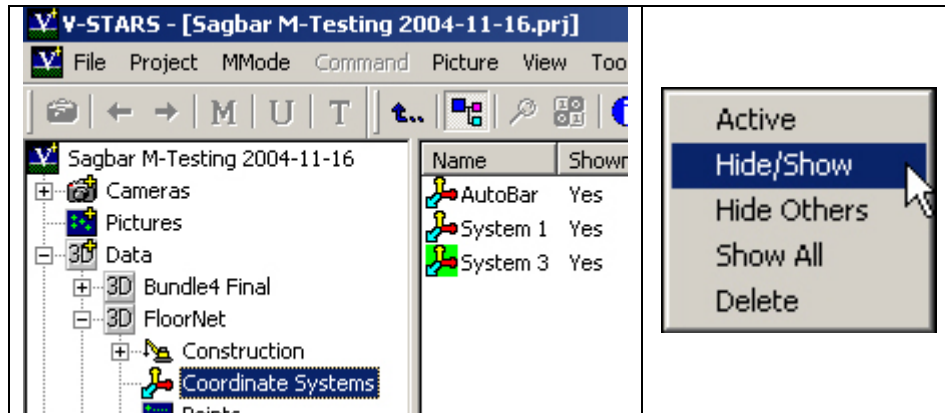
Figure 6: Multiple coordinate systems displayed in project right-hand list view (left). Popup menu to change coordinate system display options (right).

system name is also displayed. Coordinate systems are also listed in the right-hand view when the **Coordinate Systems** node of a 3D file is highlighted on the project tree (**Figure 6 left**).

Right-click on a coordinate system in either the graphical view or list-view to display a popup menu with available commands (**Figure 6 right**). Double-click on an inactive coordinate system in either view to activate that system or, alternatively, right-click on the coordinate system and select **Active** from the popup menu. To hide a coordinate system, select it, right-click, and choose **Hide/Show** from the popup menu. To show hidden coordinate systems, right-click in the view and select **Show All** from the popup menu. Delete a coordinate system by selecting it and choosing **Delete** from the popup menu or by simply using the Delete key. To rename a coordinate system select the system in the list view. Once selected, click on the system again. A new name may then be entered for the coordinate system.

Better CAD Import

Improved IGES

The IGES import functions have been completely rewritten to support a wider range of surface types. Files with both an .igs and .iges extension are imported as IGES files.

VDA support

VDA (*.vda, *.vdafs) files can now be imported to V-STARS.

Design Point Sigmas Now Can Be Edited

The sigmas of points in the design folder of a 3D file can now be edited directly in the right-hand list view.
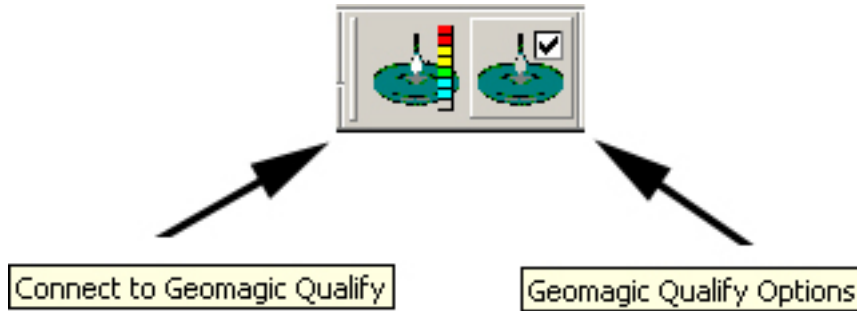
Figure 7: Geomagic Qualify interface toolbar.

Best-fit Capability Added via Geomagic Qualify

V-STARS now supports an interface to Raindrop Geomagics' *Qualify* program which can best-fit a cloud of points to a surface model. The use of the *Qualify* interface requires a license from GSI. Access is through the *Interface* toolbar (**Figure 7**) which is displayed from the **View->Interface Bar** menu item.

Pressing the right toolbar button displays the Geomagic *Qualify* Setup dialog (**Figure 8**). Here, the point-to-surface fit options are set. Following is a description of the Setup dialog options.

Best Fit Settings

It is recommended that the settings in this dialog **NOT** be changed.

Enable: This check box enables the point-to-surface best-fit in *Qualify*.

Apply Transformation: When checked, the transformation calculated in *Qualify* is applied to the corresponding 3D file in V-STARS.

Sample Size: The sample size specifies the number of points on the surface of each object that will be compared during the best-fit alignment process. A lower number may give faster but less precise alignment. Typically, one should accept the default value. The default value is 300 when **Check Symmetry** is checked and 1500 when **Fine Adjustments Only** is checked.

Cutoff: This field is not applicable when **Fine Adjustments Only** is checked. The cutoff value specifies the degree of permissible error in the **Check Symmetry** phase.

Check Symmetry: If checked, *Qualify* attempts the best fit alignment from several angles, **not** assuming

Figure 8: Geomagic Qualify Setup dialog showing default settings.

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that the objects are already *almost* aligned. Then, the sample size is automatically changed to 1500 and a second Fine Adjustments phase is performed.

Fine Adjustment Only: This setting specifies whether to skip the **Check Symmetry** phase. This is useful when the object is assumed to be close to correct alignment already.

Automatic Deviator Eliminator: Checked by default, this setting enables the automatic removal of outliers in the best-fit.

Show Toolbar: When checked, a V-STARS Trigger toolbar is displayed when the *Qualify* program is hiding V-STARS (**Figure 9**). This allows triggering without having to minimize *Qualify*. This option is checked by default.

Figure 9: Qualify Trigger toolbar.

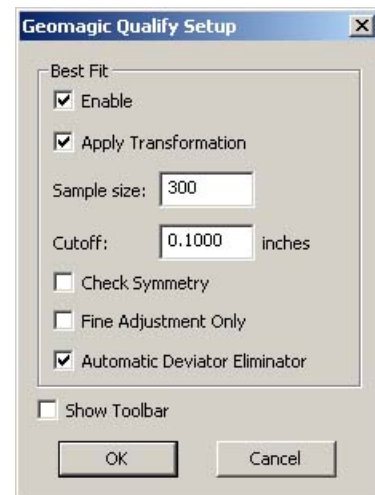## Starting Geomagic Qualify

To start Geomagic *Qualify*, from the **Start** button select **Programs->Raindrop Geomagic->Geomagic Qualify X**, where X represents the program version number.

Connecting V-STARS to Geomagic Qualify

With *Qualify* running, select the **Connect to Geomagic Qualify** button from the Geomagic *Qualify* interface toolbar (**Figure 10**). The *Qualify* Trigger toolbar (**Figure 9**) should appear. If it doesn't, switch to *Qualify* and select **Macros->Enable Macro Server** from **Tools** on the main menu. Then, in V-STARS, again select the **Connect to Geomagic Qualify** button.
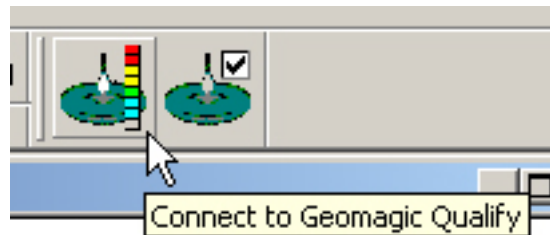
Figure 10: Connecting to Geomagic Qualify.

Importing a Surface Model into Geomagic Qualify

To import a surface model in *Qualify*, select **File->Import** from the *Qualify* main menu. From the displayed **Import Files** dialog box, browse to the directory where the surface-model file is located. Select it and click the **Open** button.

Performing the Best-Fit

With the interface configured, the left toolbar button is pressed to connect to Geomagic *Qualify*. When V-STARS is connected to *Qualify*, Any set points in a 3D data set can be sent to Geomagic to be best-fit to a surface-model. This can be done in either the graphical view or the points-list view of a 3D data file. To do this, first make sure that V-STARS is connected to *Qualify* as described above in the section Connecting V-STARS to Geomagic Qualify. Then select the points for

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the best fit in the graphical or points-list view. Right-click and select **Send To->Geomagic** from the resulting popup menu (**Figure 11**).

When V-STARS is connected to *Qualify* in M-Mode, all triangulated points are automatically sent to *Qualify* where the best-fit to the current reference model is performed. The transformation between the point cloud and the model determined by Qualify is then applied to the triangulated data set in V-STARS. Points can be sent manually to *Qualify* by selecting them in either the points list or graphical views and selecting **Send To->Geomagic** from the right-click popup menu. As before, these points are best-fit to the reference model in *Qualify*. If **Apply Transformation** is on, the resulting transformation is applied to the source 3D data set in V-STARS. A new coordinate system is created for the newly transformed file as described in the section Multiple Coordinate Systems. **Figure 12** on the following page illustrates the use of *Qualify* to best-fit a point cloud to a surface model.

Figure 11: Sending points to Geomagic Qualify for best-fit via the **Send To** popup menu option.

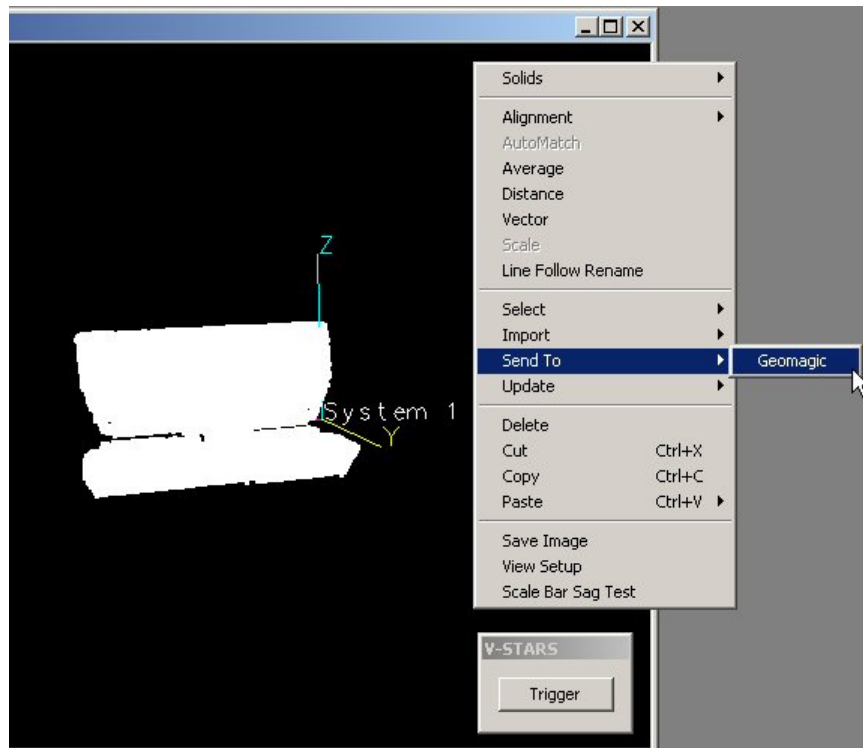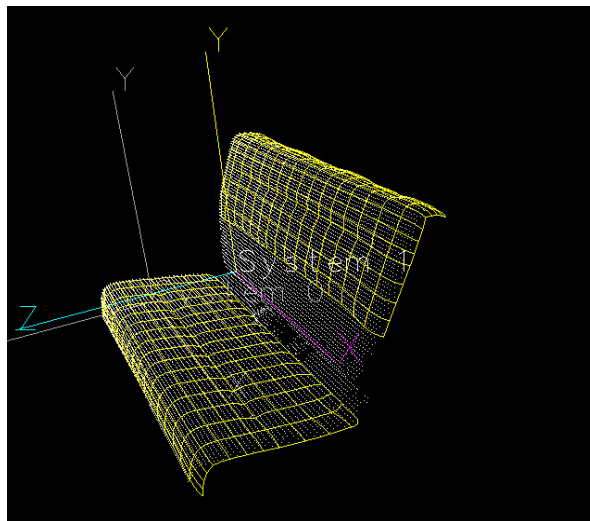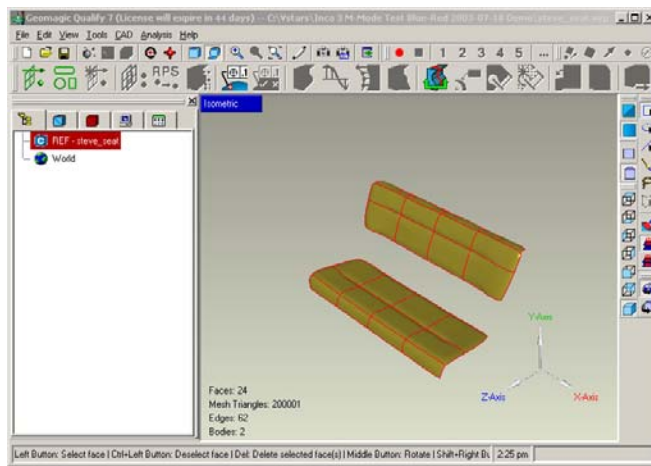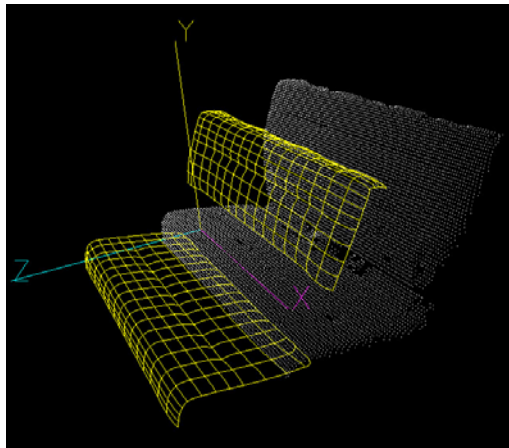Figure 12: Using Geomagic Qualify to best fit a point cloud to a surface model. Points and model in V-STARS (top). Best fit in Qualify (middle). Points and model in V-STARS after best fit (bottom).

V-STARS S-Mode Features

The following features are used in S-Mode measurements.

Faster Bundle

The bundle adjustment is now much faster than in Version 4.3. Small bundles (tens of pictures, hundreds of points) are at least 2-5 times faster. Larger bundles (hundreds of pictures, thousands of points) are even faster (10-50 times faster). Bundles that previously took an entire day (and night) are now done in less than an hour!

As part of this development, GSI created a spreadsheet to estimate the time required for large bundles. The spreadsheet is called "Customer Bundle Speedup Spreadsheet.xls" and is located in the GSI/HELP directory. To use it, just fill out the necessary field describing computer speed (i.e. 2GHz) and the bundle parameters (number of pictures, points, iterations, etc.) and it will calculate the estimated time for the old (Version 4.3) and new (Version 4.4) bundle. The spreadsheet includes an example.

Picture Names Changed

The picture file naming convention has changed. This was done so that pictures are shown in the order they were taken when taking more than 999 pictures on a job. To do this and remain within the 8 character file name limitation of INCA pictures, the file names have been changed from Frame###.pic to Frm#####.pic.

Updated Picture Information Window

The Picture Information Window (**Figure 13**) now provides more information for Inca3 pictures. It now contains settings of the camera at the time the picture was taken. Settings like the exposure, strobe level, and other various settings are now available by right-clicking with the mouse on the picture icon or thumbnail and selecting **Information** from the resulting popup menu.

NOTE: Pictures saved on a PCMCIA disk with an Inca3 camera with
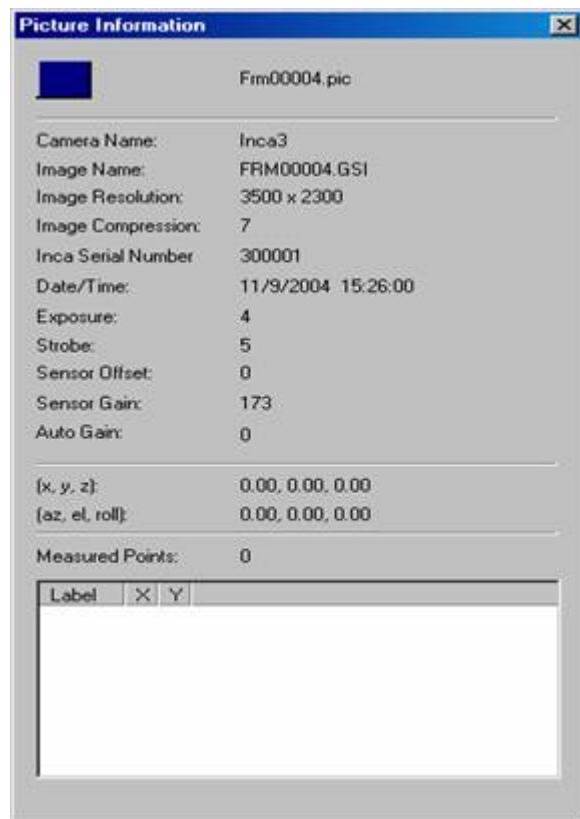
Figure 13: Picture Information window.

firmware 04.08.02D and earlier will display a strobe level that is 1 value higher than was actually set on the Inca3 camera. For example, if the strobe level was 6 on the Inca3 camera the *Picture Information Window* will display 7. In INCA3 firmware version 4.08.02E and later, the strobe level displayed in the *Picture Information Window is correct.*

Image Path Can Now Be Relative or Absolute

A new feature in V-STARS 4.4 is the use of *absolute* and *relative* image paths. When a project is copied from its original location this new feature allows V-STARS to always know the correct image path. The image path is said to be relative when the images are directly in the V-STARS project directory or in a sub-directory of the project directory. The image path is said to be absolute when the images are located outside of the V-STARS project directory (**Figure 14**).
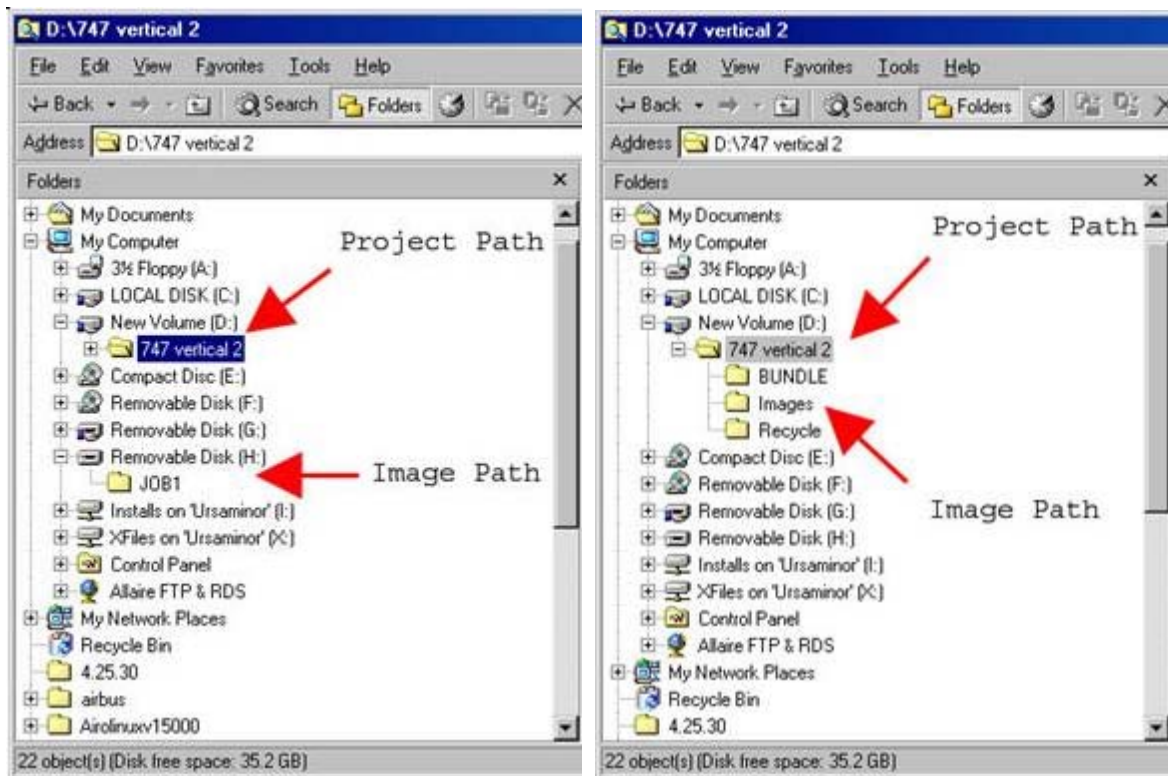
Figure 14: Absolute Image Path (left). Note that images are outside of the Project Path. Relative Image Path (right). Note that images are under the Project Path.

Scale Bar Enhancements

Multiple Length Scale Bars

The scale bar file format has changed to allow multiple lengths on one bar. For example, if there are twenty-four scales on a bar, it was previously necessary to have twenty-four scale bar files in the V-STARS project. Now, one file is used for all twenty-four scales. The new format also handles multiple length "code-aided" scale bars. Treatment of scale in the bundle adjustment remains unchanged. When running V-STARS version 4.4 for the first time, all scale bar files in the GSI/System directory are converted to the new format and copied to files with the extension *sb4*. The original files are retained for compatibility with previous versions of V-STARS. When opening a project created with V-STARS 4.3, all scale bar files in the project directory are converted to the new format and copied to files with the extension *sb4*. Again, the original files are retained.

Display

Display of scale bars is shown in **Figure 15**. When the *ScaleBars* node of the project tree is highlighted, a list of project scale bars and their properties is displayed in the right-hand list view. These consist of the bar name, number of
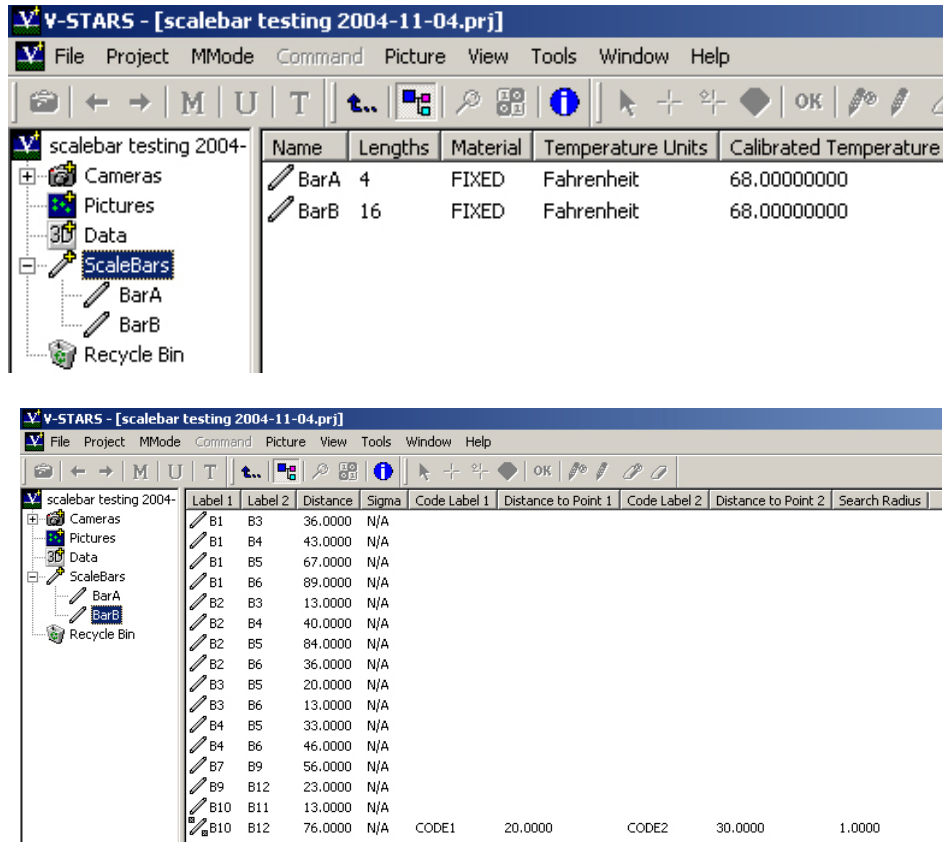
Figure 15: Scale bar display in V-STARS.

lengths, material, temperature units, and calibrated temperature. When an individual bar node is highlighted on the project tree, the properties of each scale length for that bar are displayed in the right-hand list view. These consist of the labels of the length end-points, the distance itself, the sigma of the length (not currently used), and code-aided properties if applicable.

Editing Bar Properties

Bar properties may be edited directly in the right-hand list view (**Figure 16**). To change the bar name, click once with the mouse to select the bar (the bar name is then highlighted), then click a second time to open a box to perform the edit. To change the bar material, double click on the current bar material to display a dropdown edit box from which a new material may be chosen. Similarly, to change the temperature units, double click on the current bar temperature units to display a dropdown edit box from which either Fahrenheit or Celsius may be chosen. The calibrated temperature may be changed by double clicking on the current bar calibrated temperature to display an edit box in which the new temperature is entered.
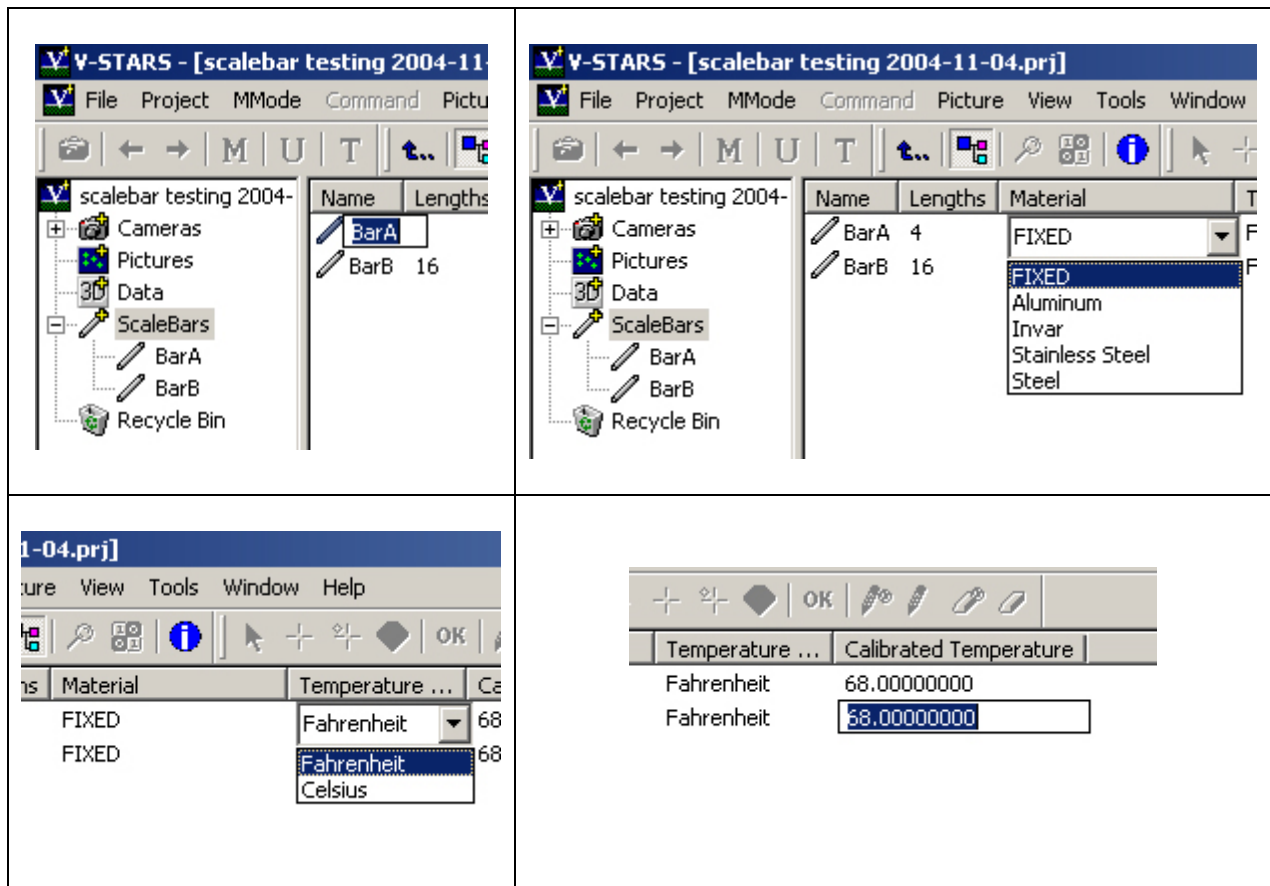
Figure 16: Editing scale bar properties. Renaming a scale bar (upper left). Changing bar material (upper right), temperature units (lower left), and calibrated temperature (lower right).
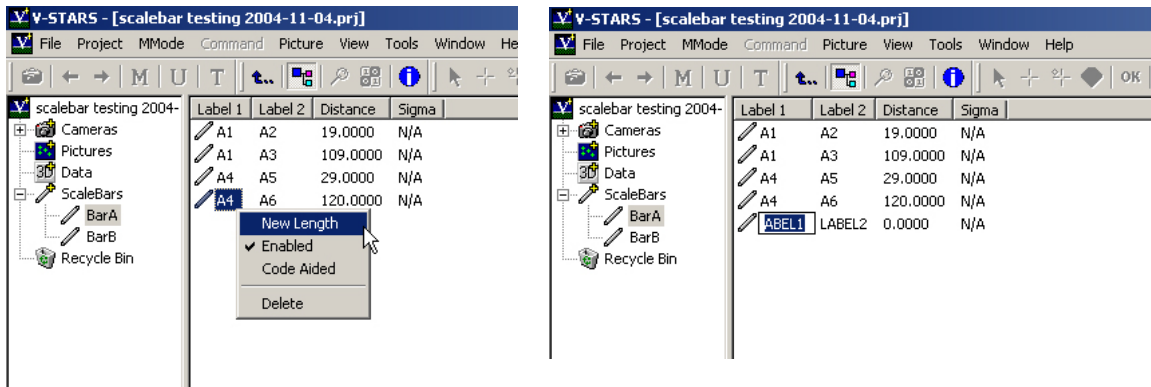
Figure 17: Adding a scale bar length (left) and editing new length (right).

Managing Bar Lengths

In the right-hand bar-length list view, new lengths can be added, deleted, enabled, disabled, or flagged as "code-aided". These options are available in a popup menu displayed by right-clicking in the view. A new length is added to a bar by right-clicking in the list view and selecting **New Length** from the popup menu (**Figure 17**). The new length is added to the list view with point labels Label1 and Label2, and a distance of 0.00. These entries must be changed to their true values. A length is deleted by highlighting it, right-clicking, and selecting **Delete** from the popup menu. Alternatively, after highlighting the length, press the *Delete* key.

Import Scale Bars from Text File

Scale bars can be imported from a text file by right-clicking on the ScaleBars node in the V-STARS project tree view and selecting **Import From Text** from the resulting popup menu (**Figure 18**). This displays the *Import Scalebars From Text*
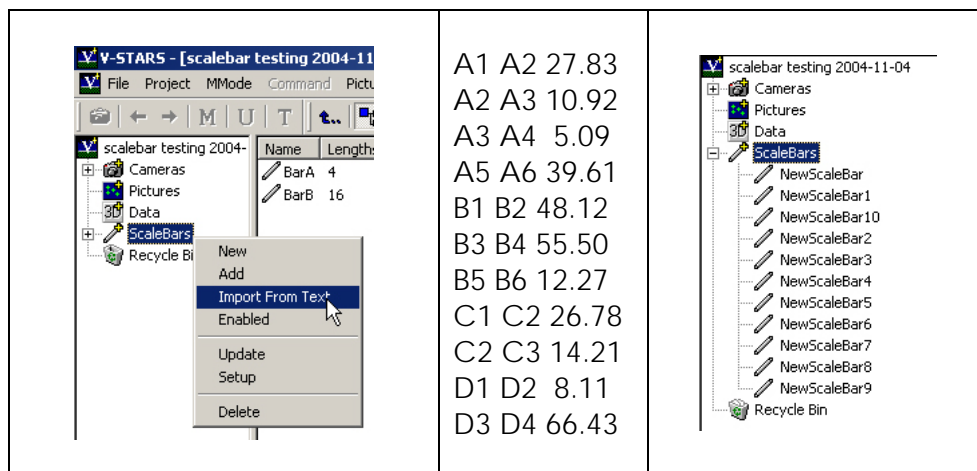
Figure 18: Import scale bars from text (left). File format (center). Imported bars (right).

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dialog. The text file is formatted such that the data for one scale bar length is on one line. Each line must contain the label for the first point, the label for the second point, and the distance between them, separated by one or more spaces. Each line is imported as a separate scale bar with a single length. Each bar is given the default names NewScaleBar, NewScaleBar1, NewScaleBar2, etc. The bar name and properties can be modified after import.

Blunders Removed From Resection

The resection procedure can fail when one or more points have a very large error. These blunders or gross errors typically occur when a point is misidentified or it has moved significantly (a code that has fallen off the part for example). What happens is these "bad point(s)" are so bad they overwhelm the good points and cause the bundle to fail. V-STARS 4.4 has a new technique for detecting these blunders and automatically removing them so the resection does not fail. Blunder points will have a red **X** icon next to them in the **Residuals** list of the **Resect Picture** dialog (**Figure 19**). Blunders that have been removed are designated by a red **X** icon, and do not contribute to the resection. However, they are included in the bundle adjustment.

Figure 19: Resection dialog showing removed measurement blunders indicated by the red, **X** icon.

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V-STARS M-Mode Features

The following new features have been implemented for V-STARS M-Mode measurements.

Keyspan Remote Trigger

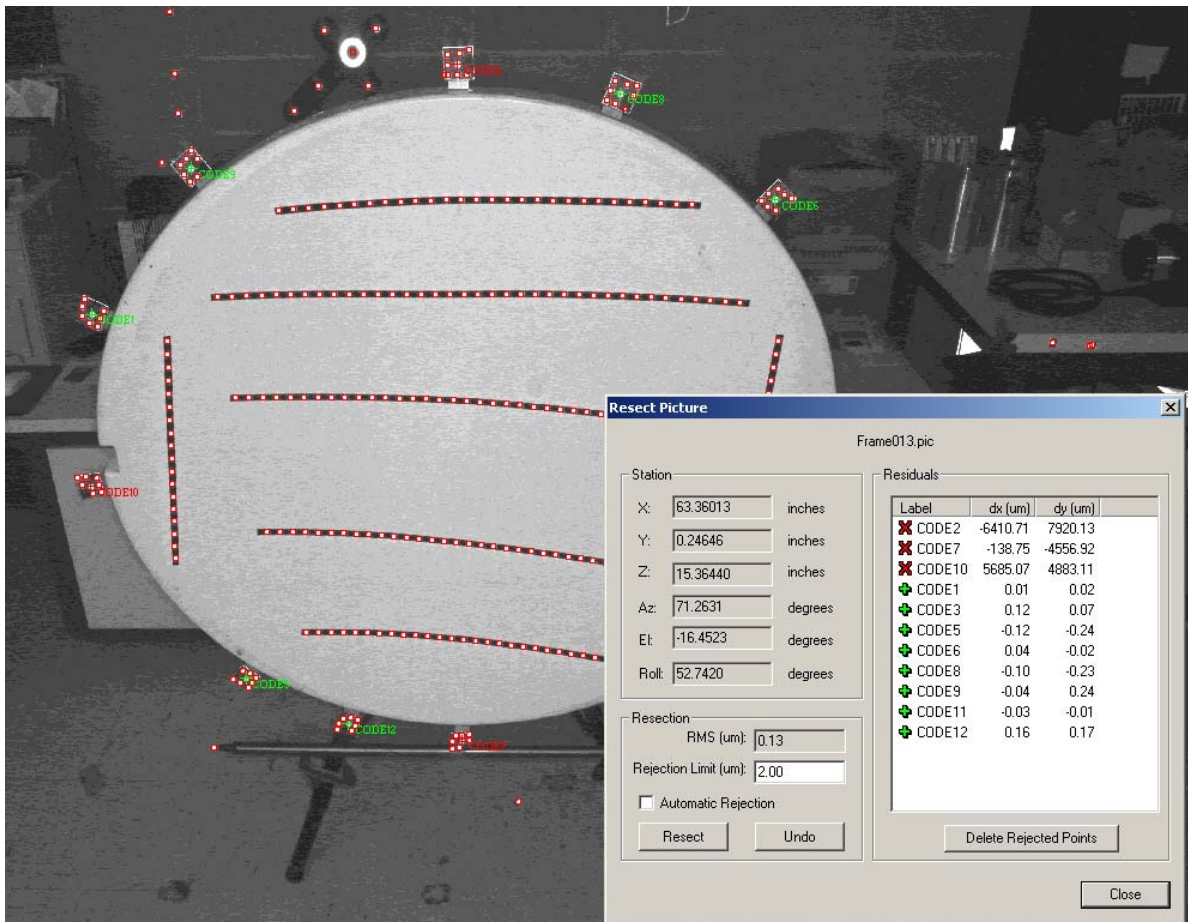V-STARS now support a radio remote trigger (from Keyspan) which does not have the line of sight limitations of our earlier IR based remotes (**Figure 20**). The remote trigger interfaces via a USB port and its range is typically 33 feet (10 meters). Its primary use in M-Mode is to trigger a measurement. However, the remote can also be used to delete the most recent probe measurement and act as a remote mouse.

NOTE: Use of the remote requires *key coding* software that must be installed and run on the computer. This is done on any computers GSI provides. To install the Radio Remote on another system, please refer to the Geodetic Systems guide entitled, *Installation of Keyspan Remote*.

Figure 20: Keyspan remote (left) with USB RF receiver.

To setup the Keyspan Remote for use in M-Mode, do the following:

1. The USB receiver must be plugged into the computer's USB port
2. V-STARS must be in M-Mode
3. The **Remote Trigger** option must be on in the M-Mode dropdown menu
4. The remote must be in **Media Mode**. Press the Media Mode Button; it should turn green for a few seconds and then blink green regularly to indicate it is in Media Mode.

   NOTE: If the Media Mode button does not light up when pressed, the remote may be broken or the battery may be dead. Replace the battery and try again. If it still fails, replace the remote.

When in *Media Mode,* pressing the blue **Trigger** button at the top of the remote will trigger the cameras. The last probe point can be remotely deleted by pushing the delete button (see **Figure 20**) into the up or forward position. V-STARS will first display a message to confirm the delete. Confirm the point delete by pushing the delete button into the down or back position. To cancel the delete, simply push the delete button in the up or forward position.

The remote can also function as a mouse. The circular button directs the cursor movement while the rocker button beneath it acts as a left and right click button.

NOTE: The remote will exit Media Mode after about four minutes of inactivity. Pressing the *Media Mode* button will immediately take the remote out of *Media Mode* (so avoid doing this). Pressing any other button will keep Media Mode active.

Troubleshooting NOTES:

If V-STARS doesn't respond, make sure the USB device is plugged in, the Remote Trigger flag is on, and that the remote is in Media Mode (is the Media Mode button blinking green?). If there is still no response, try pointing the remote at the receiver (although the device is radio based it still helps to have a clear path from transmitter to receiver). If this is still unsuccessful, the device may be out of range; move closer to the receiver and try again. If the range is the problem, try moving the notebook closer, or use a USB extension cable to place the receiver closer to the transmitter. If the range is less than normal, try replacing the battery.

If the trigger fails to operate, try using the remote mouse. If the mouse does not work, try replacing the USB receiver. If the mouse works, try pressing CTRL-SHIFT-ALT-F5 (press all four keys down simultaneously). If the cameras trigger, the remote is not working properly in Media Mode. Try re-programming the remote (see the *Installation of Keyspan Remote Guide*). If it still fails, try another remote.

M-Mode Measurement Type Toolbar

The V-STARS M system is an increasingly versatile measurement tool. One can measure using individual targets, coded targets, multiple hand-held probes, Pro-Spot, and Feature Targets. In addition, there are different ways to measure individual targets.   Moreover, it may be necessary to perform all of these tasks within a single V-STARS project and to quickly alternate between them.   Finally, some of these tasks can be done at the same time, and some cannot. To make all this power and versatility easier to manage, GSI has added the **Measurement Type Toolbar** (**Figure 21**). This toolbar is available in M-Mode only and is displayed by default. The toolbar can be hidden or re-displayed by selecting **View->Measurement Type Bar** from the V-STARS main menu.
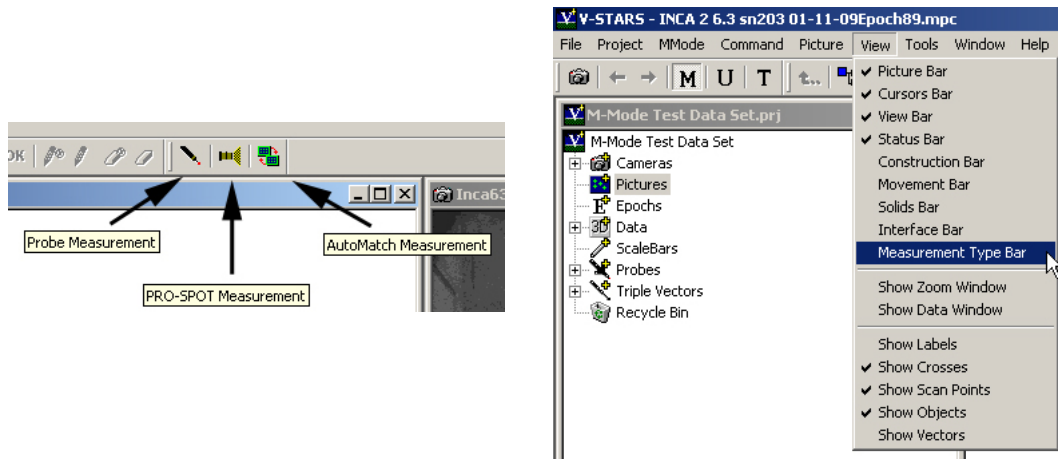
Figure 21: Toolbar button description (left). Displaying the M-Mode Measurement Type toolbar (right).

As of the 4.4 release, the toolbar consists of three icons for probe, PRO-SPOT, and AutoMatch measurements respectively. Now, the desired measurement type can often be set by just pushing the appropriate buttons on this toolbar.

NOTE: A Probe and Pro-Spot can't be used at the same time. Also, Pro-Spot and AutoMatch can't be used at the same time. Therefore, the Toolbar will not allow these combinations.

NOTE Pro-Spot Measurement: When Pro-Spot is first selected for measurement, if there are no projectors in the project, the **Select Projector(s)** dialog is displayed, allowing the user to import a projector. Even if there is only one physical projector, the software treats each projector with a different slide as a projector and it is necessary to select which one is currently being used.

Helper Points in M-Mode

Sometimes in M-Mode the distribution of control points may be deficient in number or location for a variety of reasons. There may be few places on a rigid permanent structure to place control points, temporary physical obstructions may block some control points, or the user himself may hide some control points when probing. So-called *helper points* can help in many of these situations. Right now, coded targets must be used for helper points (in the future other types of targets will also be used). To use helper points, place the helper targets at useful places in the scene. These points should help surround the area of measurement when possible. Like control points they must be stable during the measurement but unlike control points XYZ coordinates are not needed. So they can be put on stable places as needed. The other requirements are that the codes must be unique (no duplicates and not in the driver file), and the codes must be seen by both cameras. Helper points are used in the *Unstable Camera Orientation* procedure when the **Helper Points** box is checked in the **M-Mode Setup Dialog** (**Figure 22**). When the *Unstable Camera Orientation* is performed, coded targets

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that are seen in both images and are **NOT** in the driver file are triangulated and added to a new driver file called, by default, *Helper_Driver.3D*.

PRO-SPOT Speed, Reliability, and Setup Improved

The speed and reliability of PRO-SPOT in M-Mode has been improved. Additionally, the projector setup is simpler. The *Projector Match Setup* Dialog is shown in **Figure 23**. The dialog has settings to *Label Points by Epoch*, *Create Log File*, a *Planes Filter* and *Surface Projection Filter.*

Figure 22: Helper Points check box in M-Mode Setup dialog.

The *Planes Filter* speeds up the process of projecting points to model surfaces by eliminating any points on defined planar surfaces other than the object of interest. The planes must be defined in the driver file and be labeled Plane1, Plane2, etc. Points that project to any of these planes within the *Tolerance* value shown are not projected to model surfaces.

If the Surface Projection Filter is on, points that don't project to a model surface within the *Surface Tolerance* are not written to the resulting triangulation file.

If *Label Points by Epoch* is on, the label of each PRO-SPOT point in the triangulation file includes the epoch number. It is necessary to label points by epoch to avoid duplicate point labels when merging several triangulation files. As an example, PRO-SPOT point 1075 in epoch 30 would be labeled **_S30_1075**.
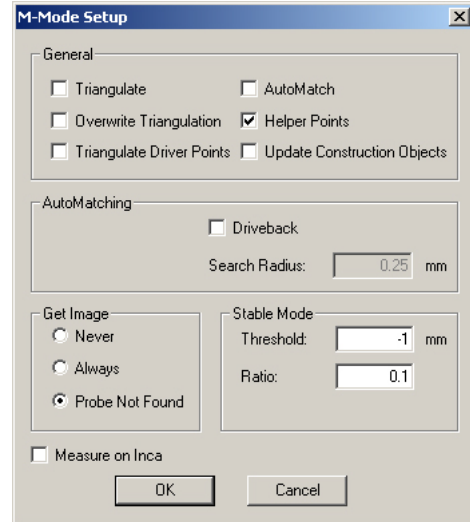
The *Create Log File* option, on by default, is used for diagnostic purposes. The log file is written to the *Projector* sub-directory of the current V-STARS project. The file name includes the epoch number. For example, the file written for epoch 30 is named *ProjectorMatchLog_Epoch30. txt*.

Figure 23: PRO-SPOT *Projector Match Setup* Dialog.

V-STARS Bug Fixes

The following bugs have been fixed in V-STARS 4.4

- Apparent instability in Unstable Camera Orientation fixed. It is important to note that the results of the procedure were always correct although the display of the residuals was incorrect. There was no detrimental impact on any subsequent measurements.
- Previously, all scale bars in a V-STARS project were written to the file Outstar.txt whether they were used or not. Now, only those scale bars that are actually used are written to the file.
- When subsampling in the bundle, scale bar points might not have been included in the adjustment. Scale bar points are now always included.
- Cameras with different filenames but identical names within the camera file could be imported into the V-STARS project causing the bundle to crash. A check has been added to prevent the import of cameras with duplicate names.
- Fixed bug in the Circle, Sphere, and Cylinder Fits that would cause the offset to be applied incorrectly.
- Fixed bug in the Save As Template Project function that would incorrectly save the project file if the name of the project was changed.
- Fixed bug in the 3D Line Follow Rename function. Previously, the function would automatically be called if two points were renamed.
- Auto Contrast bug fixed where Level 2 contrast was identical to Level 1 contrast.