WheelsBridge
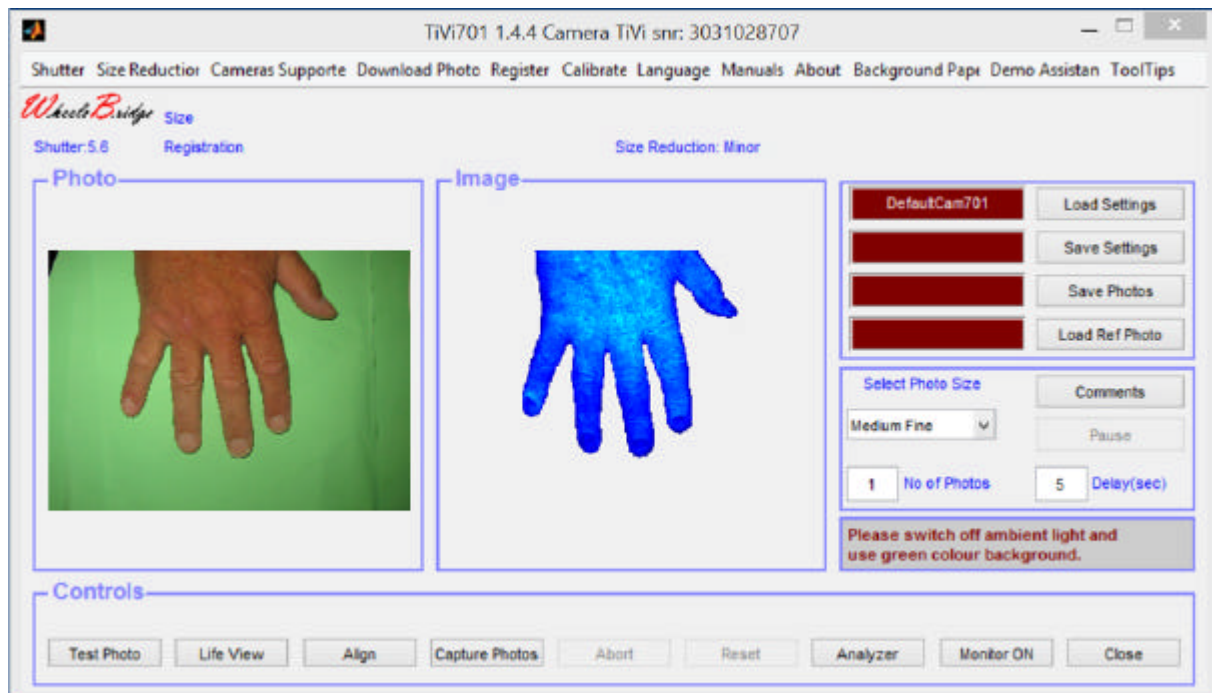

TiVi701 Camera Manual

User Manual 1.4
April 2014

TISSUE VIABILITY IMAGER

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The *TiVi700 Tissue Viability Imager* is patented and/or patents are pending in several countries.

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Part I   Setting up the camera

1. Fix the swivel end-plate to the camera.

2. Insert the battery eliminator connector (open the door at the bottom of the camera housing).

3. Attach the camera to the swivel.

Part II   Camera controls setting

1. Set the camera wheel to the "Av" position.

2. Set the Auto-Focus control to AF and the Stabilizer control to ON.

3. Set the Zoom-in by manually rotating the lens.


Part III   Attaching the Illuminator

1. Screw on the Illuminator to the camera lens (fine thread).

2. Insert the extension cable (cable with built in ON-OFF switch) connector in the Illuminator connector.

3. Connect the extension cable to the Illuminator power adapter.

4. Connect the power adapter to the mains supply.

5. Switch on the Illuminator. 96 light emitting diodes illuminate the object.
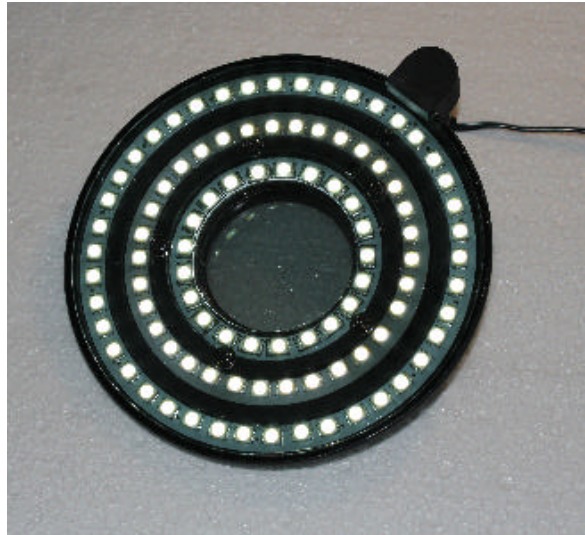
Part IV   Selecting co – or cross-polarization

1. The Illuminator is switched between the co- and cross-polarized mode by turning the Illuminator 90 degrees. When the red pin is next to the silver-colored magnet, the Illuminator is in cross-polarized mode. When the black pin is next to the silver-colored magnet, the Illuminator is in co-polarized mode.

Part V   Battery operation

1. Both the camera and the Illuminator can be operated in battery mode.

2. After charging the camera battery, remove the battery eliminator connector from the camera housing and insert the battery.

3. After charging the Illuminator battery, replace the battery-illuminator connector with the battery cable connector. When not in use switch off the Illuminator by use of the switch on the battery eliminator cable.

Part VI   Capturing photos

To capture good quality photos always

1. Switch off the ambient light in the room.

2. Place the object on a blue or green background.

To prepare the camera for capturing photos remotely and disconnected from the computer, disconnect the camera from the computer and set the Camera Dial to "Av". Click the Menu button until the information page becomes visible on the camera display (the text "Av" should be visible in the top left corner of the display). Click the "WB" button on the camera several times until the "Shade" symbol appear marked. Then click the SET button. The white balance is now set to "Shade".

Part VII   The TiVi701 Camera software

The camera must be connected to the computer before the TiVi701 Camera software is started because the unique serial number of the camera is controlled in the TiVi701 Camera software startup phase.

1. Start the **TiVi701 Camera** software from inside the **TiVi700 Analyzer** window (File ✍ Camera) or directly from Windows 7 Start (WheelsBridge ✍ TiVi700 1.1 Tissue Viability Imager ✍ Launch TiVi701Camera.exe).
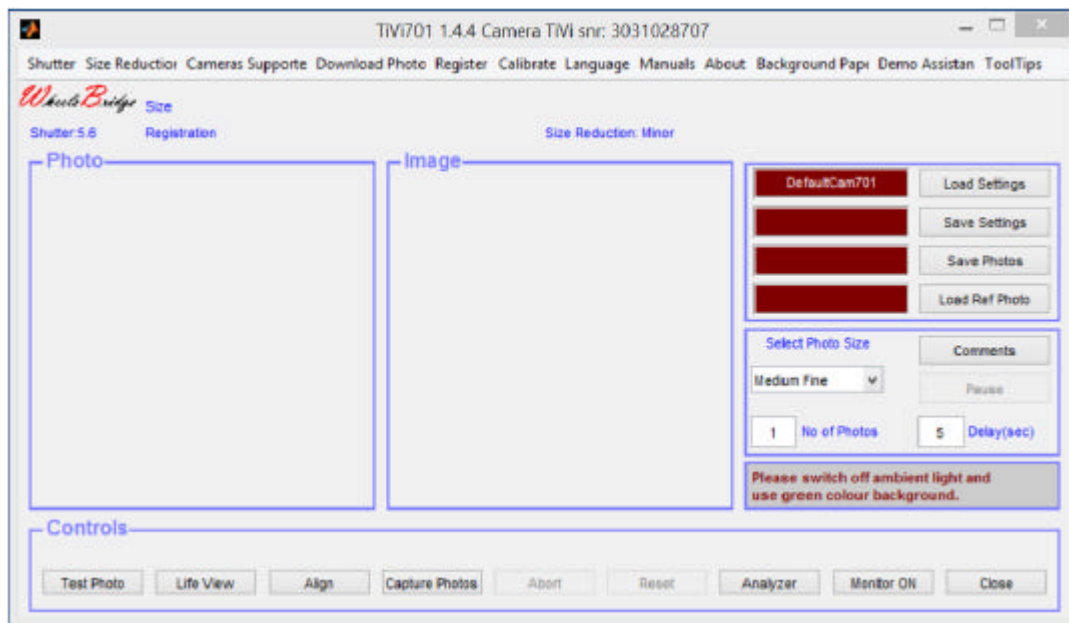
2. **Menu Panel**

   a. **Shutter** – to set the Av-value (shutter aperture) in steps of 4.5, 5.6, 8.0, 10 or 20). A low Av-value corresponds to a large shutter aperture. If a low Av-value is selected, the focal depth becomes shallow while the shutter opening time becomes short. A low Av-value is to be selected if the shutter opening time must be short (as is the case when capturing photos of moving objects and large magnification) to avoid blurring of the photo due to movement artifacts. A large Av-value is to be selected if a large focal depth is needed (at for instance investigation of sweat drop activity using the camera adapter macro lens system).

   b. **Size Reduction** – this pull-down menu contains three items (**No Size Reduction**, **Minor Size Reduction** (default), **Major Size Reduction**). In **No Size Reduction** the entire photo is utilized. In **Minor Size Reduction** (default) the 10% of the photo closest to the borders is cut off. In **Major Size Reduction** the 20% of the photo closest to the borders is cut off. Utilizing **Size Reduction** eliminates possible shadow effects along the borders of the photo caused by the limited field of view illumination by Camera Illuminator, which

may cause **image** distortion. This is achieved at the expense of a more extensive **image** field view. The optimal distance between the camera head and the object is about 30 cm or more. It is generally better to increase the number of pixels in the images (**Photo Size**), increase the camera-object distance and use **Minor** or **Major Size Reduction** to obtain a specific **image** resolution than to work with a lower number of pixels and use **No Size Reduction**.

c. **Camera Supported** – displays a window with the serial numbers of the cameras supported. The camera serial number can be found on the camera label.

d. **Download Photos** – to download photos from camera memory to file. If photos are capture with the camera disconnected from the computer the photos <u>must</u> be downloaded by clicking the **Download Photos** button and selecting a folder into which the photos are to be saved, otherwise the photos will not be tagged as TiVi-photos and cannot be analyzed by the *TiVi700 Analyzer*.

e. **Register** – to register the camera zoom-setting, polarization mode and distance to object.

    i. **Register Zoom Settings** – This feature is used to register the zoom setting. Check one of the alternatives (18, 24, 35 or 55) and manually adjust the zoom-lens accordingly. This information is saved as meta-data with the photo and displayed in the **TiVi701 Camera** window when the **Reference Photo** is uploaded or in the **TiVi700 Analyzer** window when the photo is uploaded as the **Actual Photo.**

Rotate the zoom lens to adjust the Zoom. The actual setting corresponds to the number next to the white bar on the camera housing.

    ii. **Register Polarization Mode** – This feature is used to register the setting of the polarization filter in front of the lens system by clicking either the CR or CO radio-button. The CR-setting (crossed polarized) is used for the investigation of sub-surface features such as RBC concentration. Manually turning the filter 90 degrees, sets the camera system to co-polarization mode, i.e. the polarization planes of the filter in front of the Illuminator LEDs and the lens system are in parallel.

This setting is used for the investigation of direct surface reflections. CR and CO information is saved as meta-data with the photo and displayed in the **TiVi701 Camera** window when the **Reference Photo** is uploaded or in the **TiVi700 Analyzer** window when the photo is uploaded as the **Actual Photo.**

    iii. **Register Distance** – This feature is used to register the distance from the edge of the Illuminator to the object. Measure the camera – object distance manually and insert the distance (in mm) in the edit box. The distance value is saved as meta-data with the photo and is retrieved and displayed when the photo is uploaded as a **Reference Photo** (in the **TiVi701 Camera** window) or as the **Actual Photo** in the **TiVi700 Analyzer** window**.** This information can later be used to adjust the camera – object distance.

f. **Calibrate** – to calibrate the length-scale in mm (see Part XI).

g. **Language** – to select Language.

h. **Manual** – displays the on-line *TiVi701Camera* manual.

i. **About** – to display the **About** window.

j. **Background Paper** – select this option to display and print out a suitable background paper for the object to be investigated. The green colour of the background paper implies that it will automatically be classified as "background" by the TiVi-system (negative TiVi-values). The raster pattern of the background papers makes it possible for the camera to automatically focus without any object placed on the background paper. If the camera is aimed to capture a picture from a uniformly coloured object or object background, the auto-focus feature may not work and the camera can go into a "freeze" mode locking the software from further operation. If this happens the camera can be released from the "freeze" mode by setting the switch on the camera housing to OFF and then back to ON (restarting the camera).

k. **Demo Assistant** – interactive Demo Assistant to display how to capture photos and use the Life View.

l. **ToolTips** – displays (ON) or hides (OFF) tooltips associated with the different controls.

3. **Photo / Image information**

a. Size – shows the size of the photo displayed.

b. Registration – displays the value of the registered parameters.

c. Number – display the number of the photo displayed in a sequence of photos.

    d. Size Reduction – displays the size reduction used.

   e. Name – name of the photo just captured.

4. Controls panel

    a. **Test Photo –** displays test photos successively with the actual camera parameters set until the **Abort** button is clicked. If a **Reference Photo** is loaded a new window – the **Positioner** – is opened (see below). If the camera cannot focus, because the object contrast is too low, an error message is displayed and the testing process is interrupted. Rearrange the object to increase contrast and try again.

    b. **Life View –** opens the Life View window (see below).

    c. **Align** – opens the Align window (see below).

    d. **Capture Photos –** captures a sequence of photos in accordance with the camera parameters set and displays the result in the **Photo** and **Image** panels. If the camera cannot focus, because the object contrast is too low, an error message is displayed and the capturing process is interrupted. Rearrange the object to increase contrast and try again.

    e. **Abort –** interrupts a photo capturing procedure.

    f. **Reset** – resets the system parameters.

    g. **Analyzer** – opens the **TiVi700 Analyzer** software.

    h. **Monitor** ON/OFF – to open or hide the monitor.

    i. **Close –** closes the **Camera Settings** window.

5. **Load Settings** – allows the user to load a file with user-determined camera parameter default values. The actual file name is displayed in the associated text box. At start-up the default values stored in the **DefaultCam701** file are loaded.

6. **Save Settings** – allows the user to store the actual camera parameter settings on file. The actual file name is displayed in the corresponding text box. If new parameter settings are to be evoked at the start up, store these parameters under the file name "DefaultCam701".

7. **Save Photos** – allows the user to select the folder and file name of the sequence of photos to be saved. If this edit box is left empty, the actual photo sequence is automatically stored under the name 'Data_xxx' in the DataDirectory. If the photos are stored under another prefix name and this already exists, the new photo will still be stored under this prefix name but under the next number in the same sequence of photos.

8. **Load Ref Photo** – loads a reference photo to be used in the alignment process (see below).

9. **Select Photo Size** pull-down menu – to select the size and quality of the photo(s) to be captured. Small photos are easier and quicker to analyze while larger photos allows for zoom-in without loss of resolution.

10. **No of Photos –** insert the number of photos to be recorded in the associated text box and press **Enter**.

11. **Delay (sec) –** insert the delay time in seconds between the capture of two successive photos.

12. **Pause –** allows for halting photo capturing. The **Pause**-button is now labeled **Continue**. When the button is clicked again, the photo capturing process is resumed.

13. **Comments** – Opens a word pad into which comments about the image capturing process can be inserted. This word pad is linked to the photo as meta-data and can be opened and edited in the **TiVi700 Analyzer**. All comments entered into the word pad at capturing time will be added to all photos of the sequence.

When the **Monitor** button is clicked the monitor function opens. The monitor is used for following changes in TiVi-values within regions of interest (ROIs) during the capturing procedure.
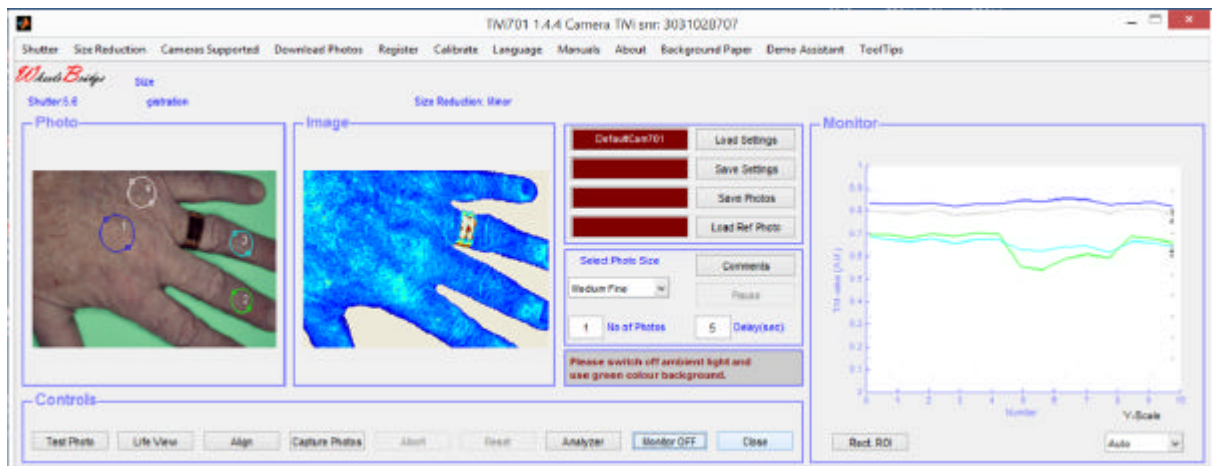
1. First capture a test photo by clicking the **Test Photo** button.

2. Click the **Abort** button to stop the capturing of test photos.

3. Draw the **ROIs** in the photo (ROIs can be moved, removed or reshaped – for further details on **ROI** operations please see the *TiVi700 Analyzer* manual.

4. When all **ROIs** have been set to the correct positions, click the **Capture Photos** button to start the photo capturing process.

5. As the photos are successively captured, the curves corresponding to the TiVi values within the **ROIs** are drawn in the monitor diagram.

Part VIII   The Positioner

When capturing photos belonging to the same sequence at different points in time, it is essential that the distance between the camera and the object and the view angle under which the object is seen from the camera are kept as identical as possible (especially if the integrated Wizards are to be used in the image analysis). By using the first photo in a sequence as the **Reference Photo** on the basis of which camera-object positioning is made before the successive photos in the sequence are captured, the analysis can readily be made using the integrated **Wizards** with possible assistance of the **Pre-Processor** features for further alignment of the photos as necessary. Proceed as follows:

1. With the *TiVi700 Camera* window open, click the **Save Photos** button and name and store the first photo in the sequence.

2. Click the **Capture Photo** button to capture and store the first photo in the sequence.

3. When the second and the successive photos in the sequence are to be captured, again open the *TiVi700 Camera* window.

4. Load the saved **Reference Photo** by clicking the **Load Ref Photo** button after having navigated to the folder in which the **Reference Photo** was saved.
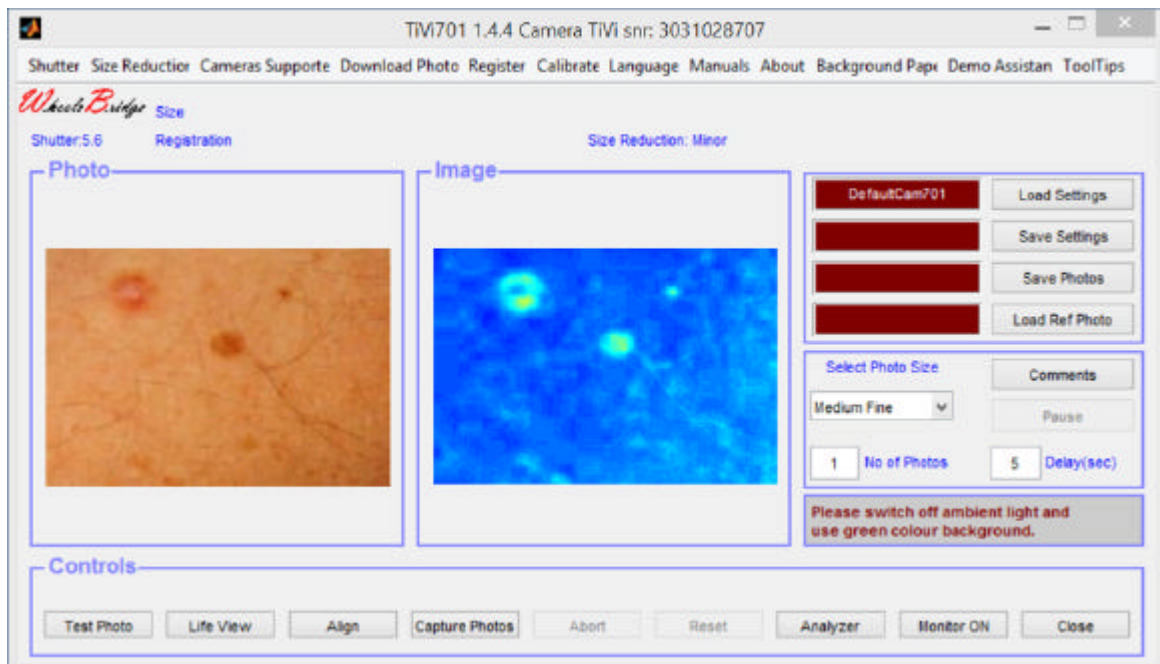
5. The **Reference Photo** is now displayed in the **Photo** panel in the *TiVi700 Camera* window. At the same time the prefix is automatically set in the **Save Photo** edit box and the actual photo size to the size of the **Reference Photo**.

6. Set the **Number of Photos** to be captured and saved.

7. Click the **Test Photo** button. A new window – the **Positioner** – is now opened.

8. The **Reference Photo** is displayed in black and white.

9. Capture a new **Test Photo** by clicking the **Test Photo** button. This photo will now be superimposed on the **Reference photo** and displayed in the **Positioner** window.
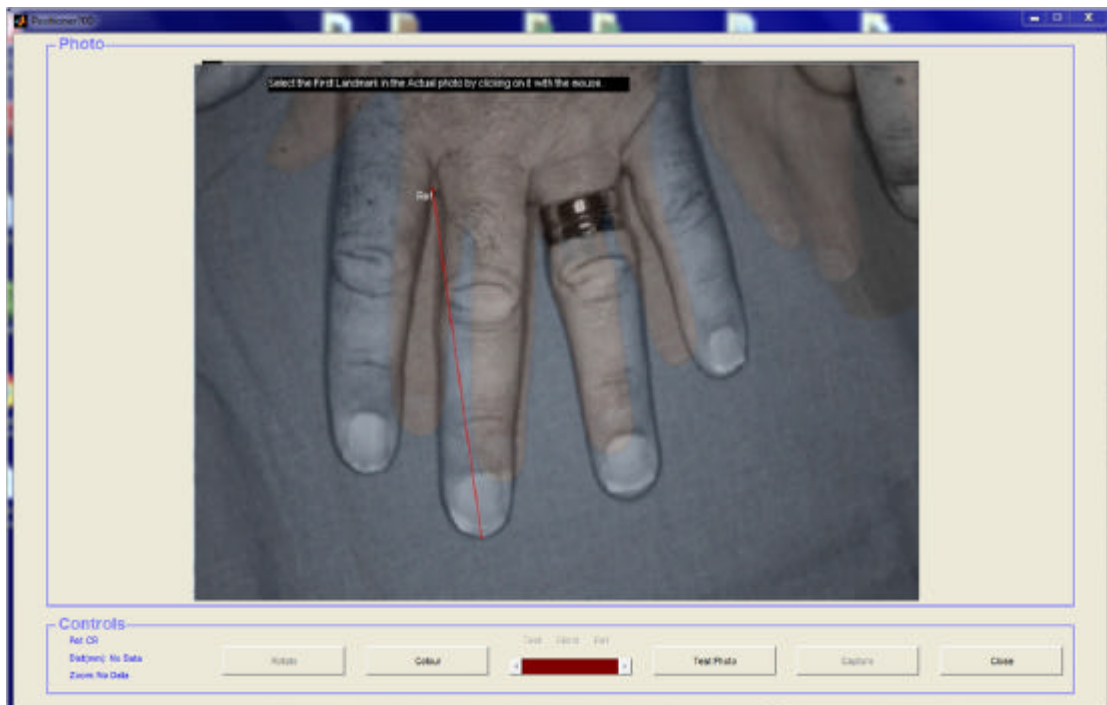

10. Drag the **Blend slider** to the right so the **Reference Photo** appears sharper.

11. To adjust for any alteration in camera – objective distance, the distance between two selected *landmarks* in the **Reference Photo** and new **Test Photo** is to be compared and a compensation adjustment of the camera –object distance calculated and displayed.

12. As the *first landmark* the tip of the third finger may be used. Move the mouse pointer to this position and click the left mouse button. A red cross-marker now appears at this point.
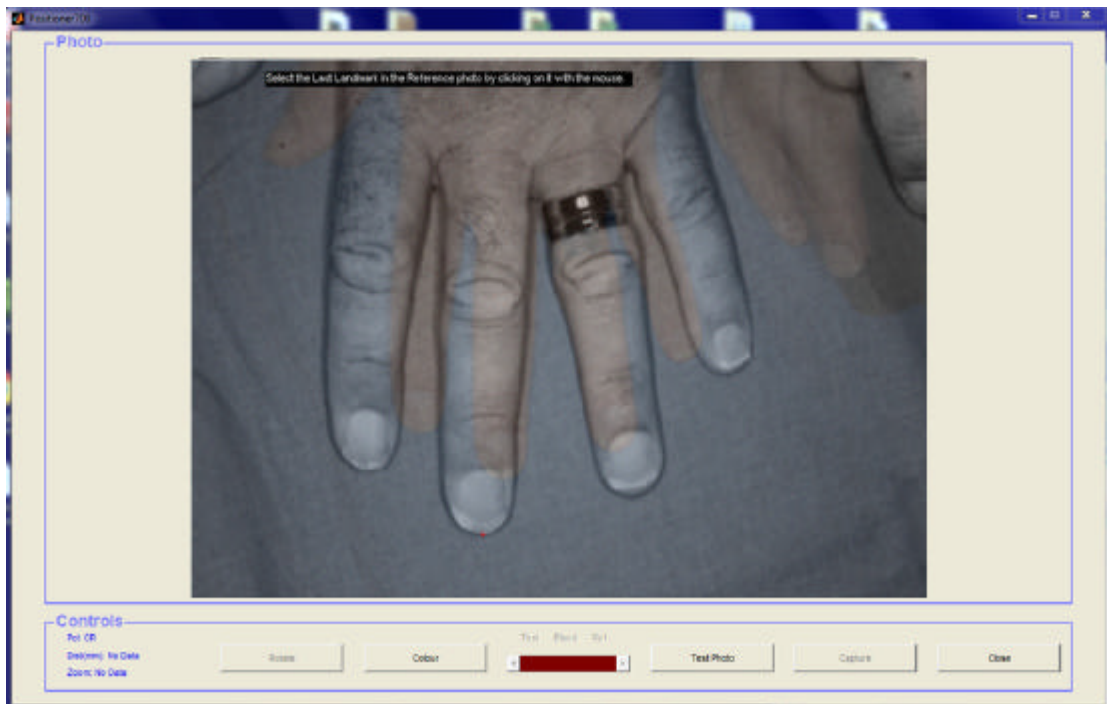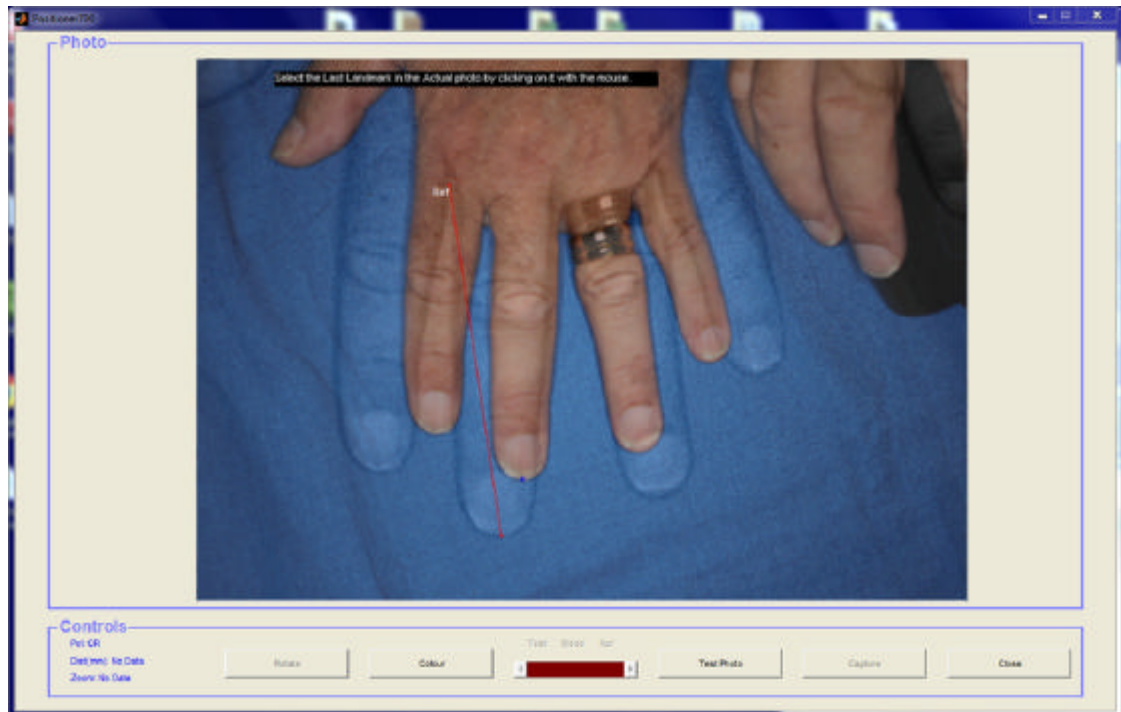
13. As the *second landmark* the base of the third finger may be used. Move the mouse pointer to this position and click the left mouse button. A red cross-marker now appears at this point and a red line is drawn between the two *landmarks*.


14. Drag the **Blend slider** to the left so the **Actual Photo** appears sharper.

15. As the *first landmark* the tip of the third in the **Actual Photo** is to be used. Move the mouse pointer to this position and click the left mouse button. A blue cross-marker now appears at this point.


16. As the *second landmark* the base of the third finger is to be used. Move the mouse pointer to this position and click the left mouse button. A blue cross-marker now appears at this point and a blue line is drawn between the two landmarks. If the camera-object distance is registered, the necessary adjustment of this distance (in mm) is displayed in the photo. If no camera-object distance is registered, the necessary adjustment of the distance is given in relative terms.
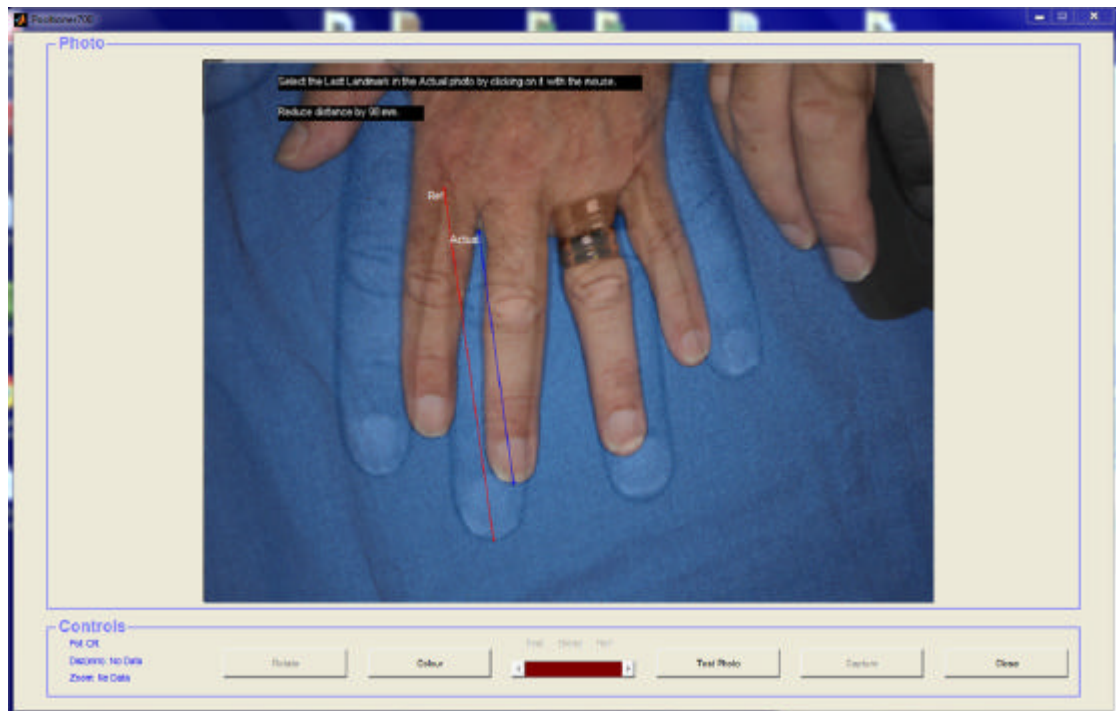
17. The relation between the lengths of the two lines is now automatically calculated and the suggested action (in this particular case: Reduce Distance by 88 mm) is displayed.

18. Repeat the procedure from step 10 if necessary.

19. Adjust the camera – object distance and view angle to approximately the same as those which were used when the **Reference Photo** was captured.

20. Click the **Test Photo** button to capture a new test photo. This photo will now be superimposed on the **Reference photo** and displayed in the **Positioner** window.

21. The photo can be rotated by clicking the **Rotate** button (each step represents a 90 degree rotation).
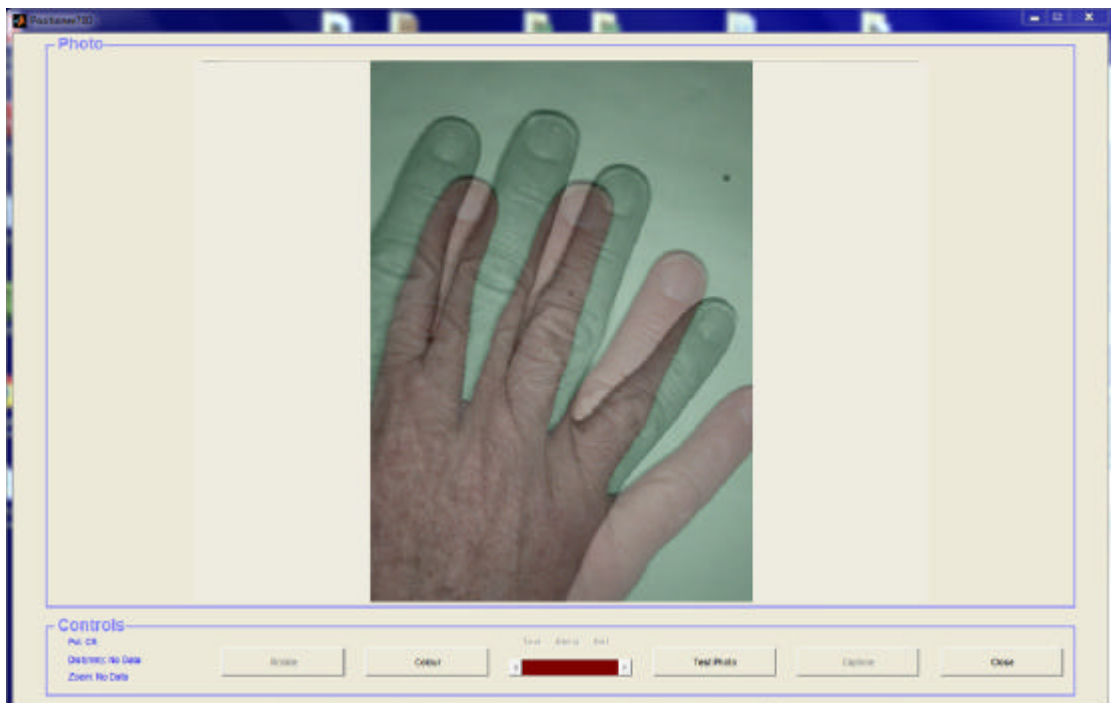
22. The degree of blending in the **Reference Photo** over the **Test Photo** can be adjusted by moving the **Blend** slider. In its leftmost position only the **Test Photo** is displayed. In its rightmost position only the **Reference Photo** is displayed. In its neutral central position the **Reference Photo** and the **Test Photo** are blended in to the same extent.

23. Readjust the lateral camera-object position by guidance of the displayed photo to reach a better overlap. Again capture a **Test Photo** to display the result.
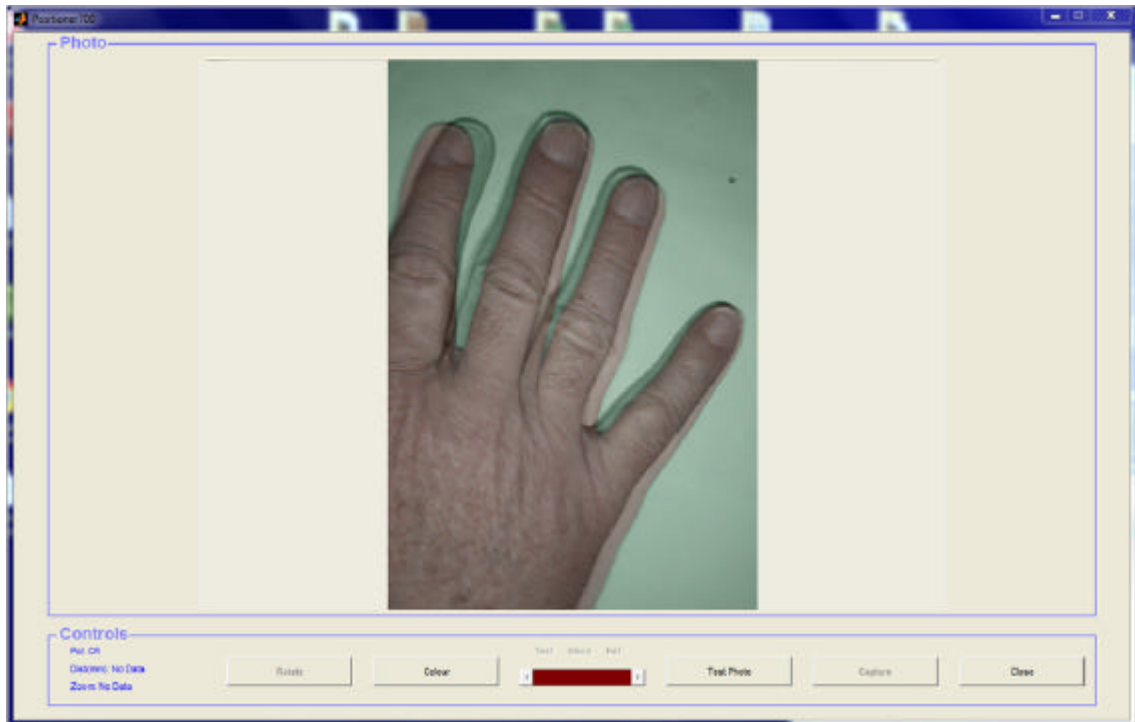
24. When the overlap is considered acceptable click the **Capture** button to start capturing new **Photos** which are saved under the same prefix as the **Reference Photo** and displayed in the **TiVi** main window.

25. If no **Photos** are to be captured and saved, click the **Close** button to close the **Positioner** window.

Part IX   Life View and TiVi Video

The **Life View** and **TiVi video** can be used for:

? Correctly positioning the object in the field of view.
? Visualizing the microcirculation maps at video rate.
? Recording and saving videos at a high resolution and frame rate.

1. *Correctly positioning the object in the field of view.*

   a) Open **TiVi Video** window by clicking the **Life View** button in the *TiVi701Camera* window.

   b) Click the **Start Button** to start the visualization process.

   c) Click the **Video** radio-button to display the moving object in video-mode.
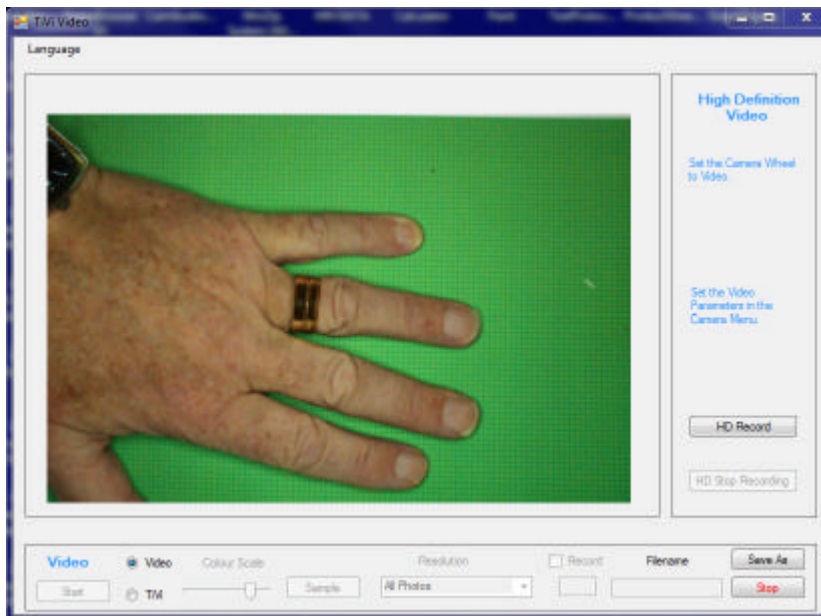

   d) Move the object (or the camera) to the correct position.

   e) Click the **Stop** button.

   f) Start capturing photos from the *TiVi701Camera* window.

2. *Visualizing the microcirculation maps at video rate.*

   a) Open **TiVi Video** window by clicking the **Life View** button in the *TiVi701Camera* window.

   b) Click the **Start Button** to start the visualization process.

c) Click the **TiVi** radio-button to display the moving object in TiVi-mode.
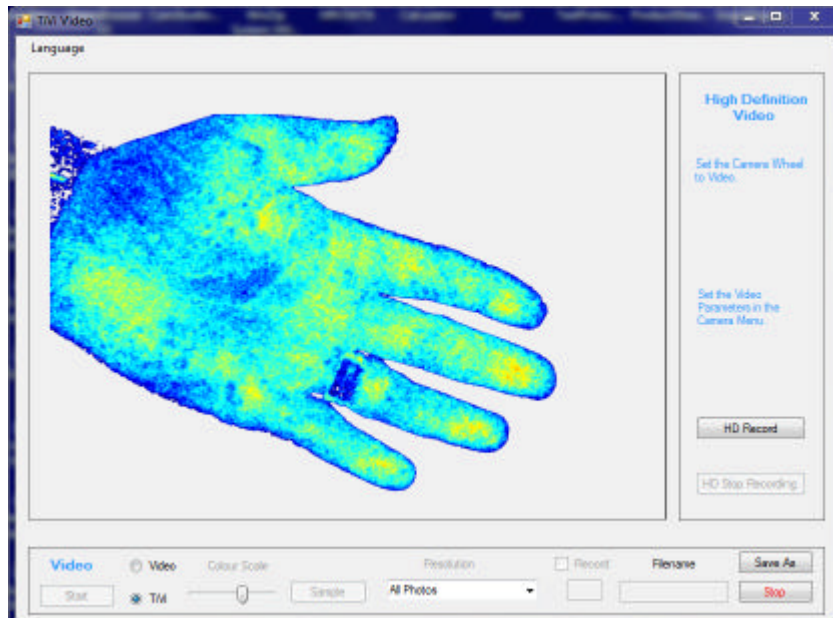
d) Set **Resolution** to **All Photos.** With the **Resolution** set to **All Photos** every photo in the stream is recorded. Depending on of the system is set to **Video** or **TiVi** the rate may be about 7 - 8 photos per second or 4 - 5 photos per second. In order to reduce the sampling rate the **Resolution** can be set to every $2^{nd}, 4^{th}, 8^{th}$ or 16th photo. For lower sampling rates the system should preferably be set to the photo capturing mode in the *TiVi701 Camera* window (the delay setting determines the photo capturing rate).

e) Set **Resolution** to **All Photos.**

f) Drag the **Colour Scale** slider to change the colour scale representation.
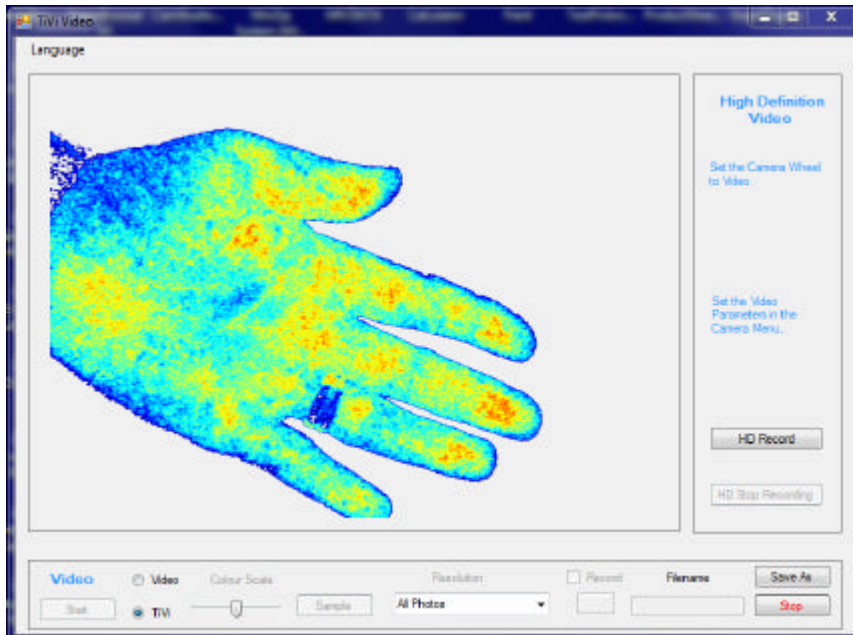
g) Click the **Save As** button, select a folder and insert a name under which the recorded sequence of photos are to be saved.

h) Check the **Record** checkbox to start saving the frames as individual photos to file. The *TiVi Video* window background colour now changes to red indicating that the system is in recording mode and large files are stored at a high rate. At the same time the number of photos saved is displayed in the textbox next to the **Record** checkbox. To halt the recording process un-check the **Record** checkbox.

The highest update rate is attained with the **Video** radio-button checked. This setting will save photos to file at an update rate of approximately 8 photos per second.

Resolution setting and corresponding update rate are as follows:

Resolution	*Update rate (photos per second)*
All Photos	8 photos per second
Every 2nd Photo	4 photos per second
Every 4^{h} Photo	2 photos per second
Every 8^{h} Photo	1 photo per second
Every 16th Photo	1 photo per two seconds

Photos that are directly and continuously saved to file are always saved at a resolution of (960 x 640 pixels). These photos can be analyzed as TiVi-photos using the *TiVi700 Analyzer* software.
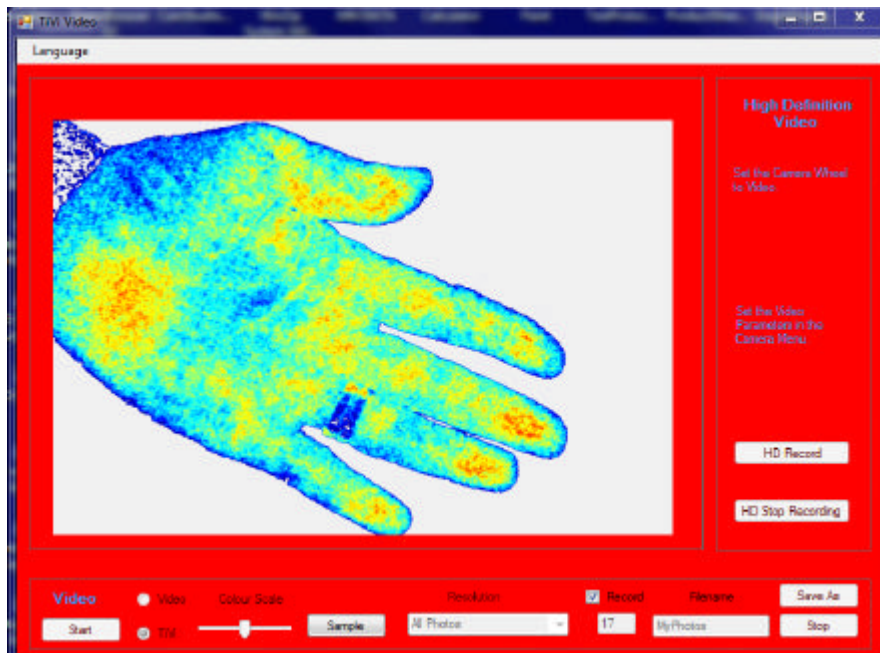
i) Uncheck the **Record** checkbox to stop recording photos.

j) To save a single photo to file click the **Sample** button. The photos will now be saved under the name selected starting with an index number of 900 in order not to interfere with sequentially saved photos.

k) Click the **Stop** button to stop the video streaming process.

3. *Recording and saving videos at a high resolution and frame rate.*

In order to save video clips at a higher frame-rate than 11 frames per second, the ***High Definition Video*** can be used. In this mode the video is temporality saved directly to the camera memory card. The video can then be downloaded and split up into individual photos in the ***TiVi701Analyzer*** software.

a) Disconnect the camera from the computer.

b) Set the camera wheel to **AF** and the switch to position **video mode**.

c) Click the **Menu** button on the camera housing and navigate to the video setting by use of the four navigation buttons on the rear side of the camera housing. The upper item should now read "*Movie rec. size.*

d) Click the **Set** button to display the different alternatives (1920x1080 25fps, 1920x1080 24 fps, 1280x720 50 fps or 640x480 25fps).

e) Select one of the alternatives by clicking the selection buttons (in this case select the 1280x 720 50 fps alternative).

f) Click the **Set** button to effectuate this alternative.

g) Again click the **Menu** button on the camera housing and re-connect the camera to the computer.

h) The camera is now set for recording video-clips at a frame resolution of 1280x720 pixels and a frame rate of 50 frames per second.

i) Place the object in the camera field of view.

j) Click the **HD Record** button to start the video recording.

k) After about 10 seconds click the **HD Stop Recording** button.

l) The *Save As* dialog window is now displayed. Insert the name under which the video is to be saved. This procedure also automatically deletes the video-clip from the camera memory card and halts the continuous video recording process.

m) The video clip is now saved to file on the target computer as indicated by the red flashing light emitting diode on the camera housing.

n) This video can be uploaded and the frames of the video saved as individual TiVi-photos in the *TiVi700Analyzer* window (movie page). For further information about this procedure please see the *TiVi700Analyzer* manual.

o) Click the **Start** button to restart the video streaming process or close the *TiVi Video* window by clicking at the x in the upper right corner of the window.

Part X   Software Installation Procedure

If another version of TiVi700Camera is already installed, this must first be de-installed. Go to the Control Panel ☞ Program (de-install a program) and select TiVi-1.1 Tissue Viability Imager (about 450 MB). Check "Yes" to de-install.

Move the **TiVi701 Camera** folder from the memory stick to the computer desktop.

1. Click the **TiVi701 Camera** software setup icon.
2. Click the **Next** button in the *Welcome to the InstallShield Wizard* for TiVi700-x.x Tissue Viability Imager.
3. Read the *License Agreement*. Check the *"I accept the terms in the License agreement"* radio-button to continue with the installation procedure.
4. Click the **Next** button.
5. Click the *"Only for me"* button to start the installation procedure (this may take several minutes).
6. In the *InstallShield Wizard Completed* window click the **Finish**-button.
7. In the *User Account* window click "*Yes*". The *WinZip SelfExtractor – MCInstaller.exe* will now be displayed and the files start to extract (will take about a minute or two).
8. In the MATLAB(R) Compiler Runtime Installer, click the **Next** button.

9. Click the "*Yes*" radio button in the *License Agreement* and then click the **Next** button to start installation of the MATLAB libraries.

10. Click the **Install** button in *Confirmation* window to start the installation (will take several minutes).

11. Click the **Finish** button to complete the installation procedure.

12. To start the TiVi701 Camera program go to All Programs --> WheelsBridge --> TiVi700-x.x Tissue Viability Image and select Launch TiVi701Camera.exe.

Part XI   Working with two cameras (optional)

In many applications a sequence of photos from e.g. the different sides of the face needs to be captured simultaneously to account for background RBC alterations when the vasoactive effect of an applied substance is to be evaluated. This can be achieved by connecting two TiVi cameras to the system.

The procedure is as follows:

1. Connect the USB cables from the cameras to the computer.

2. Start the TiVi700 Camera software.

3. If the TiVi camera is not recognized swap the connection of the USB cables (The TiVi camera to be acknowledged by its serial number has to be connected to the USB port first sampled).

4. Restart the TiVi701 camera software. The TiVi camera serial number should now appear at the top of the TiVi700 Camera window. The TiVi Camera window should look like:
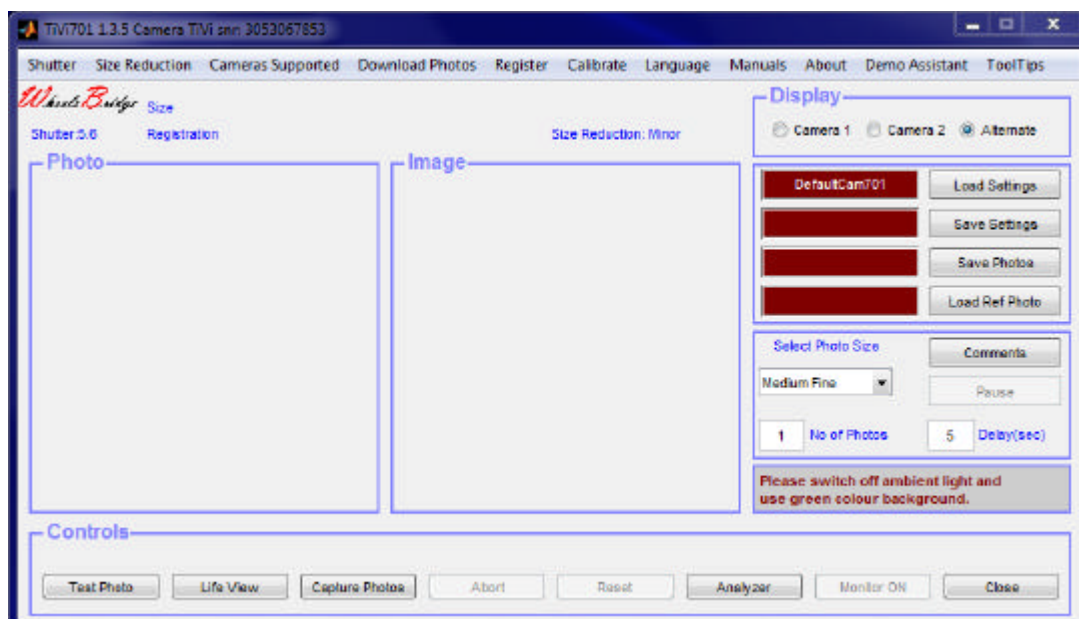
5. When the **Test Photo** or the **Capture Photo**s button is clicked the system starts capturing photos alternating between camera 1 and camera 2.

6. The photos captured by the first camera are stored under the name inserted in the **Save Photos** edit box. The photos captured by the second camera are stored under the same name with and added "s" to the prefix. By this arrangement the two sequences of photos captured can be analyzed separately.

7. When two cameras are connected to the system, the **Display** panel is visible.

8. Clicking the **Camera 1** radio-button displays only photos captured by camera number 1 (and the corresponding image).

9. Clicking the **Camera 2** radio-button displays only photos captured by camera number 2 (and the corresponding image).

10. Clicking the **Alternate** radio-button (default) displays photos from camera 1 and camera 2 as they are captured.

11. When two cameras are connected to the system the **Monitor** function is disabled.

Part XII   Calibrating the length scale in mm

To calibrate the length-scale in mm instead of pixels a white round marker of known diameter is to be placed on the object. Before capturing a photo proceed as follows.

1. Click the **Calibrate** pulldown menu and select **Show.** The **CalDia(mm)** edit box is now displayed.

2. Insert the diameter of the white marker positioned on the object in the edit box and press **Enter**.

When capturing a photo the system will automatically determine the diameter of the round marker and calculate the pixel to mm conversion factor. This conversion factor is displayed next to the **CalDia** edit box and stored as meta data with each photo. The value of the conversion factor will be displayed in the main window (in the image panel) when the photo is analyzed in the *TiVi700Analyzer*.

This procedure works best if no other white object larger than the marker is present in the photo. To store the size of the marker used in between session click the **Save Setting** button and then double click the *DefaultCam701* file. The next time the *TiVi701Camera* window is opened, the selected size of the marker is automatically uploaded. As suitable

diameter of the marker is 10 mm, but other sizes will also work. It is, however, important that the marker is <u>round</u> and <u>white</u>.

Part XII   Using a Reference photo for alignment

To be able to direct the camera at the object in the same way from day to day a Reference photo (generally the first photo in a sequence) is superimposed on the video view of the object. When the video view of the object coincides with the reference photo the camera is placed in correct position in relation to the object.

1. Click the **Align** button to open the **Align** window.
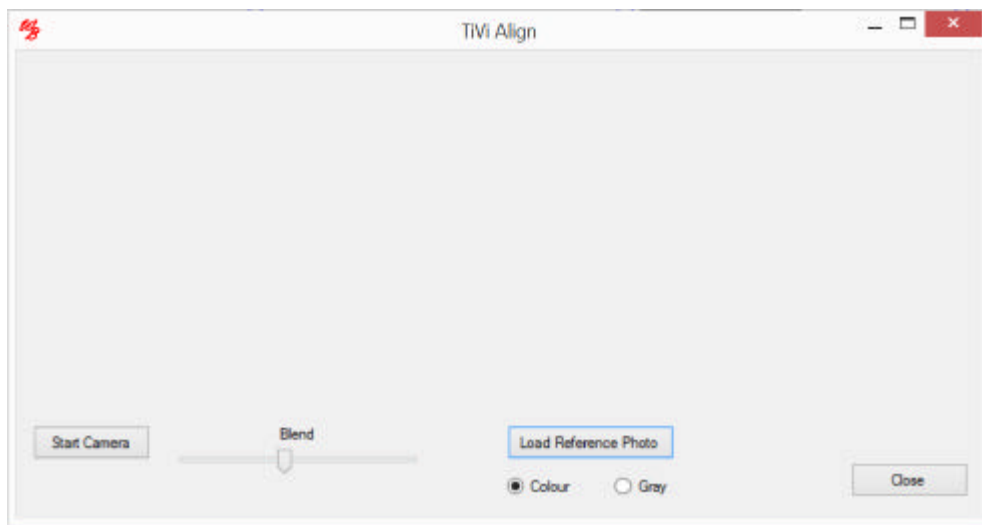
2. Click the **Load Reference Photo** button to upload a reference photo. The video will automatically start.

3. Move the **Blend** slider to select a suitable mix of video and reference photo.

4. Check the **Colour** radio-button to display the reference photo in colour.

5. Check the **Gray** radio-button to display the reference photo in gray scale.

6. The video can be started without uploading a reference photo by clicking the **Start Camera** button.

7. Click the **Close** button to close this window.