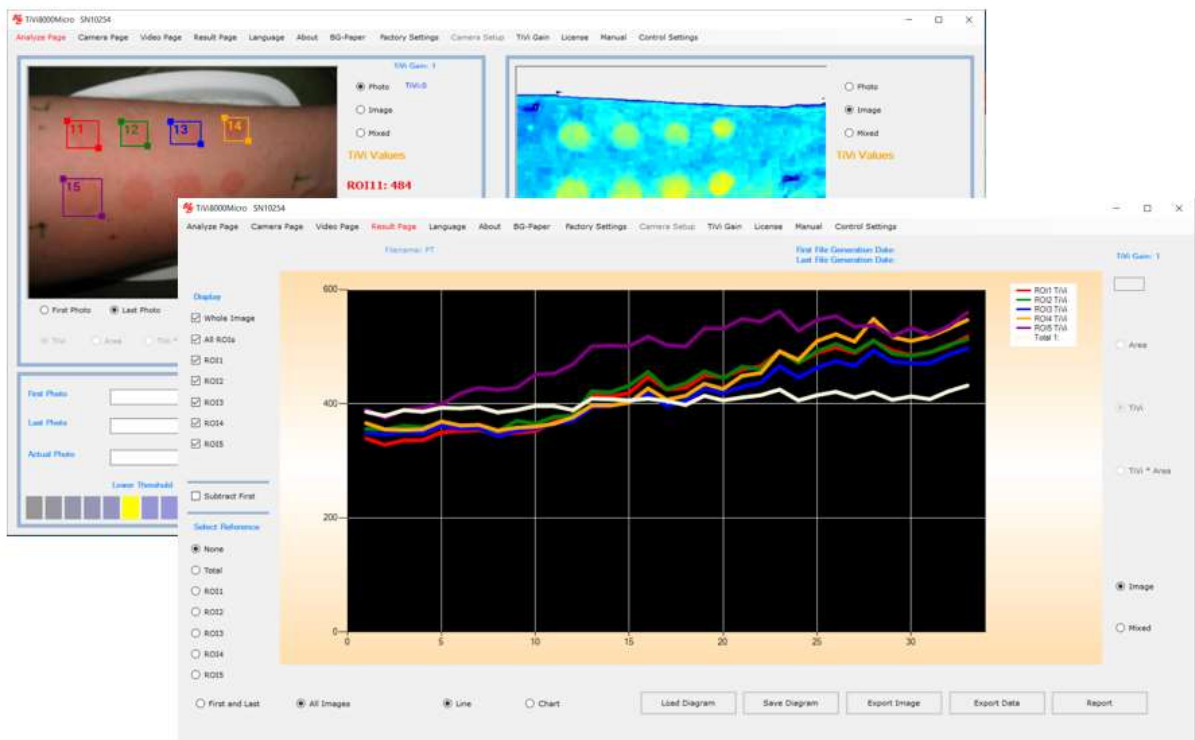




# Wheels Bridge



## TiVi8000Micro User Manual

User Manual 1.2  
January 2019

PIONEERS IN TISSUE VIABILITY IMAGING

*Dear Valued Customer!*

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*Welcome to the WheelsBridge TiVi8000Micro microcirculation analyzer intended for automatic and user-independent analysis of skin vasodilatation and vasoconstriction as well as investigation microvascular events in small animal research.*

*The Wheelsbridge TiVi8000Micro microcirculation analyzer utilizes a hand-held camera equipped with polarization filters to capture photos and video clips of tissue microcirculation which are analysed using the integrated TiVi8000Micro software.*

*Among the many useful features of the TiVi8000Micro microcirculation analyzer software the following are of particular interest:*

- *Capturing and storing photos extracted from continuously recorded video.*
- *Uploading photos for quantification of local skin erythema and blanching.*
- *Displaying in photo, image (erythema map) or mixed image (erythema map with threshold) mode.*
- *Selection of up to five ROIs (Region of Interest) in each photo/image.*
- *Displaying ROIs in zoom-in mode.*
- *Automatic calculation of erythema intensity and erythema area.*
- *Automatic calculation of ROI average erythema values (TiVi-values)*
- *Displaying a sequence of photo/images in manual or automatic mode.*
- *Comparison of average TiVi values within the ROIs using bar-graph presentation.*
- *Creating a time-compressed video from a captured sequence of photos.*
- *All results exportable to Excel document for further processing.*
- *Main results exportable in report form to Word for further editing.*

*We are convinced that the TiVi8000Micro will be a productive tool in the validation process of vaso-active reactions of the skin following application of pharmaceuticals and skin care products in general.*

*The TiVi8000Micro is intended for research applications only.*

*Thank you for choosing the WheelsBridge TiVi8000Micro Erythema Analyzer.*

*WheelsBridge AB*

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The *TiVi8000* is not registered as a Medical Device. It is intended for research applications only.

WheelsBridge is a registered trade mark.

Wheelsbridge products are covered by patents: EU pat: 1737339, Jap. pat: 5062961, US pat: 8.208.997.

## 1. INTRODUCTION

The intended use of the Tissue Viability Imager *TiVi8000Micro* microcirculation analyzer is rapid screening and quantification of erythema and blanching in skin irritation grading, assessment of microvascular effects of vaso-active substances topically applied to the skin and in the validation of skin care products and pharmaceuticals with respect to safety and efficacy. Its use is not restricted to investigation of the skin - it is useful in tissue microvascular research in general.

*TiVi8000Micro* is truly portable and can be used for point-of-sale imaging of skin microcirculation in retail shops and in the home environment as well as for rapid screening in cosmetic and personal care product studies.

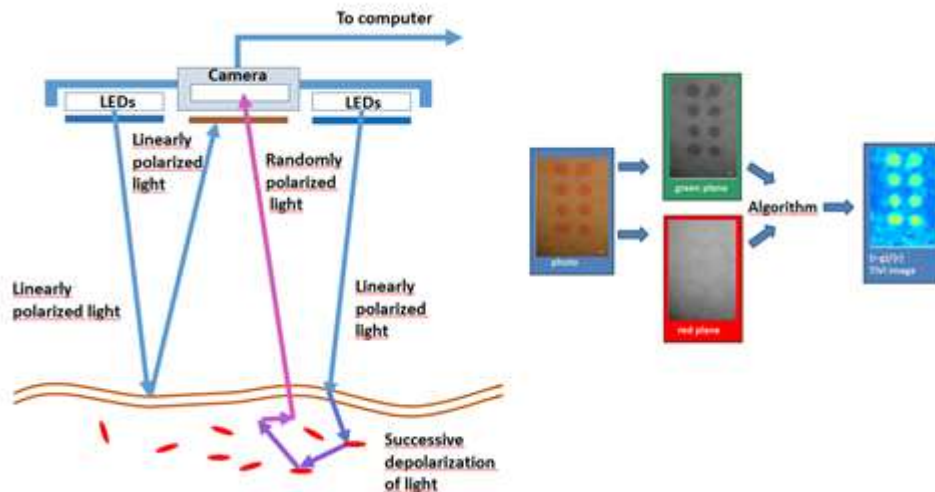
*TiVi8000Micro* is further suitable for the study of small animal tissue microcirculation, because the recorded images are not affected by movement artefacts.

Although the *TiVi8000Micro* device is not yet cleared for diagnosis and treatment of disease it may still be used in medical research applications where the use of bulky equipment is not feasible.

After having captured photos by the *TiVi8000Micro* microcirculation analyzer these can be analyzed using a PC or tablet host computer and the *TiVi8000Micro* system software or exported to the *TiVi700 Tissue Viability Imaging* system for more in-depth analysis. The *TiVi8000Micro* runs on computers with the operating systems Windows 10.

## 2. OPERATING PRINCIPLE

*TiVi8000Micro* is an emerging technology intended for mapping the tissue microcirculation [O'DOHERTY, J., HENRICSON, J., ANDERSON, C., LEAHY, M, NILSSON, G and SJOBERG, F. *Sub-epidermal Imaging using Polarized Light Spectroscopy for Assessment of Skin Microcirculation. Skin Research and Technology* 2007, 13; 472-484].



Operating Principle of the *TiVi8000Micro*.

In *TiVi8000Micro*, linearly polarized white light from a ring of white light emitting diodes (LEDs) – embedded in a hand-held probe - illuminates the tissue surface under investigation. An integrated digital camera equipped with polarizing filters captures individual photos or video clips. The light illuminating the skin is partially reflected both in the skin surface and within the upper layer of the epidermis, as well as partially scattered in a diffuse manner into the deeper dermal layers where the microvascular network resides. The light directly reflected from both the surface and near-surface layers of the skin preserves its linear polarization, while the light diffusely scattered in the deeper dermal layers quickly becomes randomly polarized. The directly reflected light approaching the camera is effectively blocked by a polarizing filter with a polarization direction in a plane perpendicular to that of the linearly polarized light produced by the LEDs Illuminator. A portion of the diffuse, randomly polarized light is backscattered from within the deeper dermal layers, passes through the filter and finally reaches the detector. The resulting “sub-epidermal” image gives the impression that the camera can “see beneath” the top layer of the skin and probe the microvascular network. The polarizing filters on the camera lens and LED light source are set in cross-polarized mode.

The green component of the backscattered randomly polarized light reaching the camera detector array is attenuated to an extent determined by the relative presence of red blood cells in the scattering volume, while the red component of the light is virtually unaffected due to its low absorption rate in red blood cells. In contrast to what is the case with the red blood cells in the skin microvascular network, the surrounding tissue absorbs both green and red light to approximately the same extent. After capturing a colour photo (or a frame in a video clip), the

*TiVi8000Micro* system software divides the image into discreet red, blue, and green matrices. A software algorithm subtracts the colour value of each picture element within the normalized green colour matrix from the colour value of the corresponding picture element within the red colour matrix. These calculations result in the generation of a pseudo-colour output matrix (*TiVi*-image) which is displayed on a PC monitor or a tablet computer screen, effectively mapping the local red blood cell concentration.

In contrast to what is the case with methods based on the detection of time-variable phase factors (*Laser Doppler Imaging* and the *Laser Speckle* devices), *TiVi8000* is not affected by movement artefacts. It is therefore also well suited for assessment of the microcirculation in moving tissues.

### 3. SYSTEM DESCRIPTION

#### TiVi8000Micro camera parts

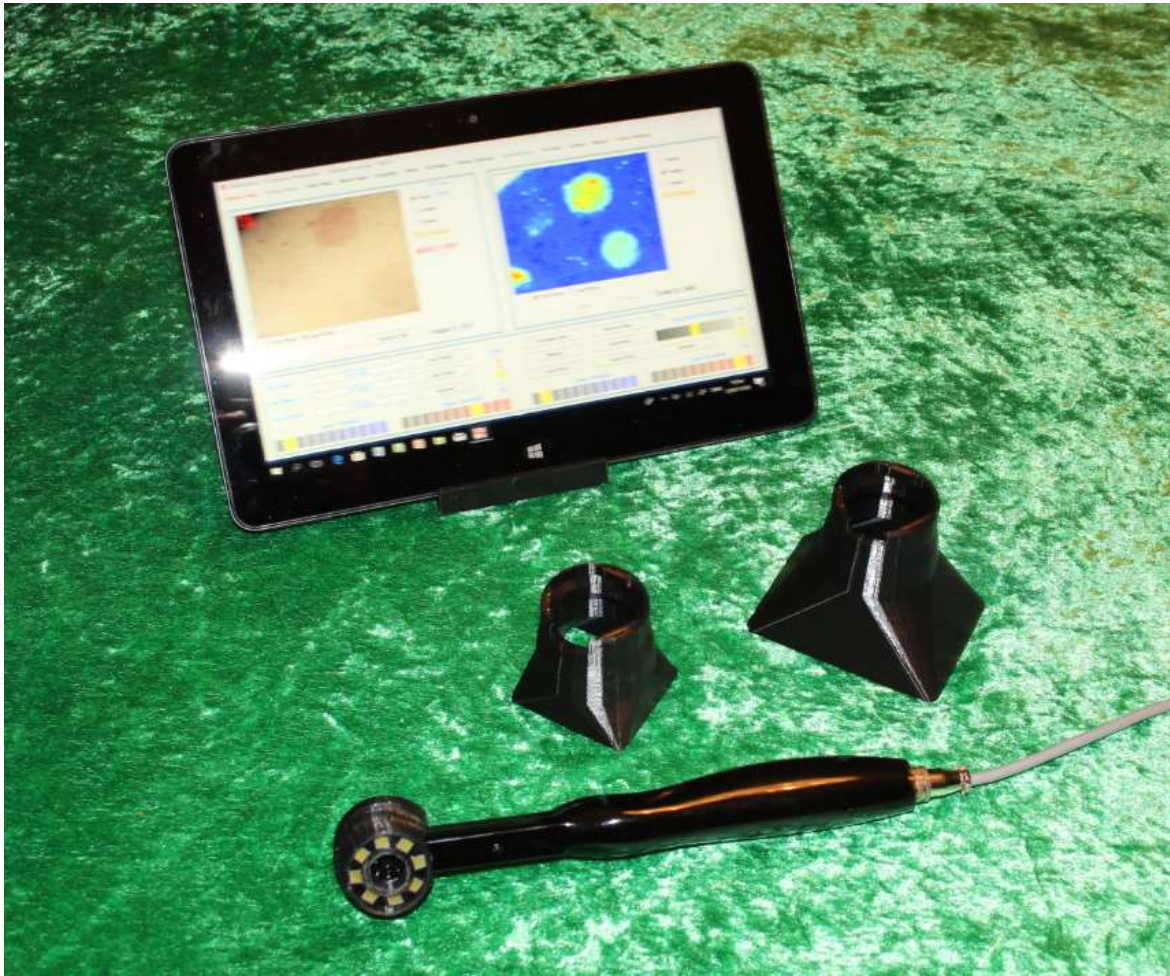
The *TiVi8000Micro* system comprises a miniature camera with integrated LEDs for illumination of the tissue. This camera probe can be held by hand or alternatively attached to a table mounted stand during operation. A set of easily exchangeable light shields can be attached to the camera probe front end to eliminate the adverse effect of ambient light. The *TiVi8000Micro* software is pre-installed in the computer (if this is ordered with the system) or stored on a memory stick for installation on a PC or tablet computer.



Camera probe with Light Shield in measurement position.

Attach the cable connector to the probe connector socket and secure the connection by pushing the cable connector inwards while rotation the front ring of the cable connector.





*TiVi8000Micro* (probe and two different Light Shields) operated from small tablet computer with touch-screen. The proximal button on the probe is used for capturing photos or videos, while the distal button is not in use.

**Always use a light shield when capturing photos with the TiVi8000 system. The light shield eliminates the adverse effect of ambient light on the photo and defines the distance to the object. When capturing photos, the light shield should be in contact with the object or positioned closed to the object.**

#### **Installing the TiVi8000Micro software.**

1. Drag the *TiVi8000 INSTALL* folder in the memory-stick to the target desktop computer.
2. Open the folder and click the setup icon to start the installation. Follow the instructions on the screen.



3. With the camera-probe connected to the computer, click the *TiVi8000Micro* icon on the desktop to start the program. If a *TiVi8000* probe is connected to the computer, the start-up page is **Camera Page**, otherwise the start-up page is **Analyze Page**.

## 4. SYSTEM SOFTWARE OVERVIEW

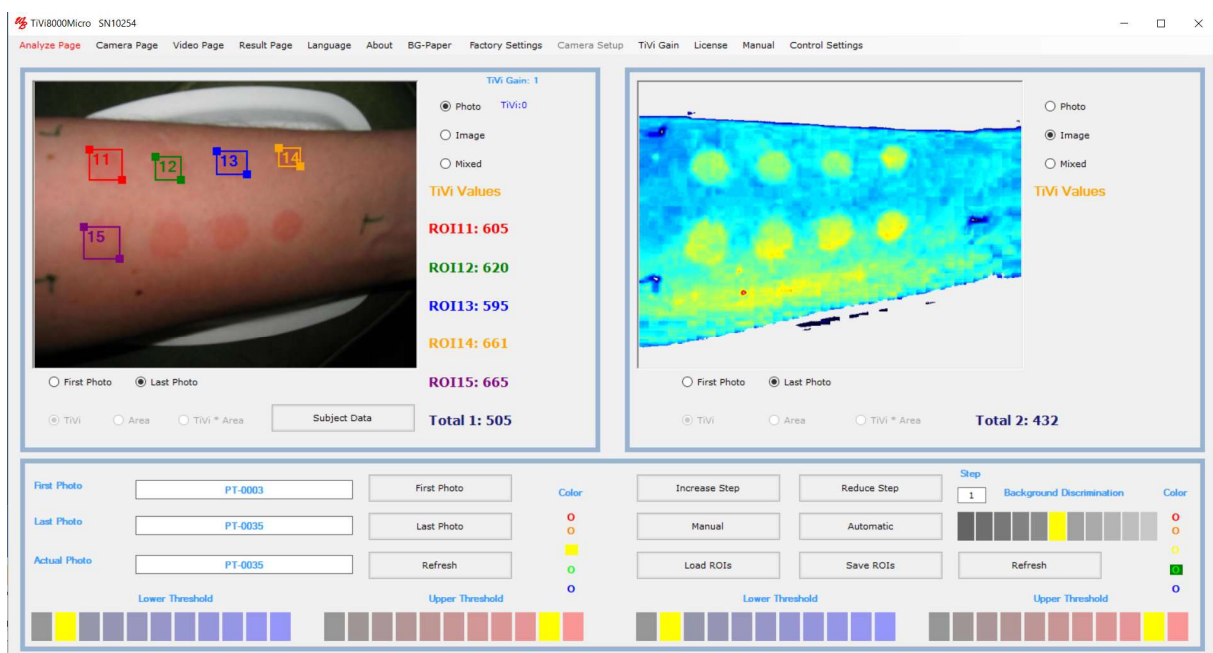
The *TiVi8000Micro* system software comprises the following four pages:

### Analyze Page:

In the *Analyze Page* captured photos are uploaded for analysis. The left picture box can for instance hold the first photo in a sequence while the right picture box holds the last. By clicking the photo, image or mixed radio-buttons, the actual photo, TiVi-image or the TiVi-image with set upper and lower thresholds is alternatively displayed. The upper and lower threshold is set by clicking an element in the *Lower Threshold* and *Upper Threshold* panels. After drawing a ROI (Region of Interest) in the actual photo, the average TiVi-value within the ROI area is displayed next to the picture box. Up to five ROIs can be utilized per photo. These ROIs can be moved, re-shaped and deleted.

By clicking the *Manual* or *Automatic* button the photos and corresponding TiVi-images can be successively displayed. The ROIs set up can be saved to file and later retrieved for further processing.

In *Mixed* mode, the TiVi-values, the areas and the product of the average TiVi-values and the areas of the individual ROIs can alternatively be displayed.

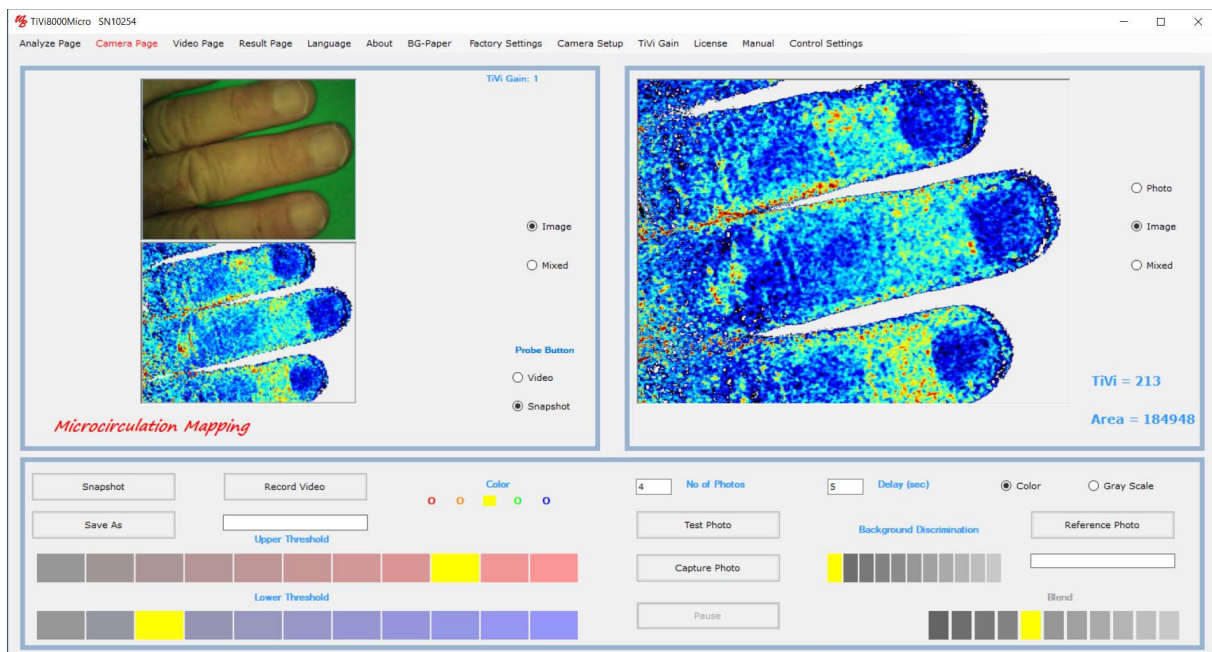


Layout of the *Analyze Page*.

### Camera Page:

In the *Camera Page* the left picture boxes continuously display video of the object in the field of view (photo mode and TiVi mode). By clicking either the *Image-* or *Mixed* radio-button the TiVi-video shows TiVi-image or the TiVi-image with upper and lower thresholds set by the *Upper Threshold* and the *Lower Threshold* panel. When the *Snapshot* button is clicked a single photo is captured and displayed in the right picture box. If a name has been inserted (using the *Save As* button), this snapshot photo is also saved to file. If the *Record Video* button is clicked, the individual frames of the video are streamed to the hard disk as TiVi photos. A sequence of test photos can be captured and displayed in the right picture box by clicking the *Test Photo* button. With a file name selected a certain number of photos with a selected delay can be captured by clicking the *Capture Photo* button.

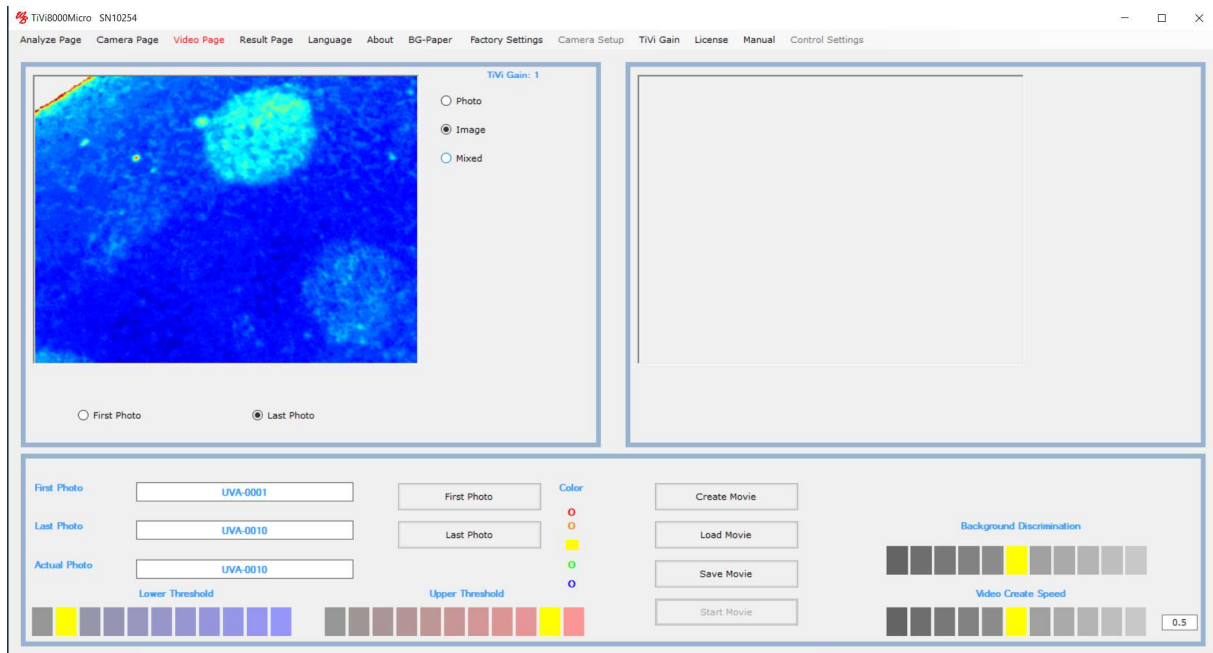
If new photos in a sequence are captured at different points in time it is important that these photos overlap in the picture boxes if ROI analysis is to be made. To facilitate this process a *Reference Photo* (generally the first photo in a sequence) can be superimposed on the continuously recorded and displayed video.



Layout of the *Camera Page*.

### Video Page:

In the *Video Page* a video can be created from a saved sequence of photos. After uploading the sequence of photos on which the video is to be based, video creation starts by clicking the *Create Video* button. When the complete video is created it can be played and stored to file. A stored video can be uploaded and played by clicking the *Load Movie* and *Start Movie* buttons. These video clips can be played also in for instance a *PowerPoint* presentation. The video clip replay rate is set by the *Video Create Speed* panel when the video is created.

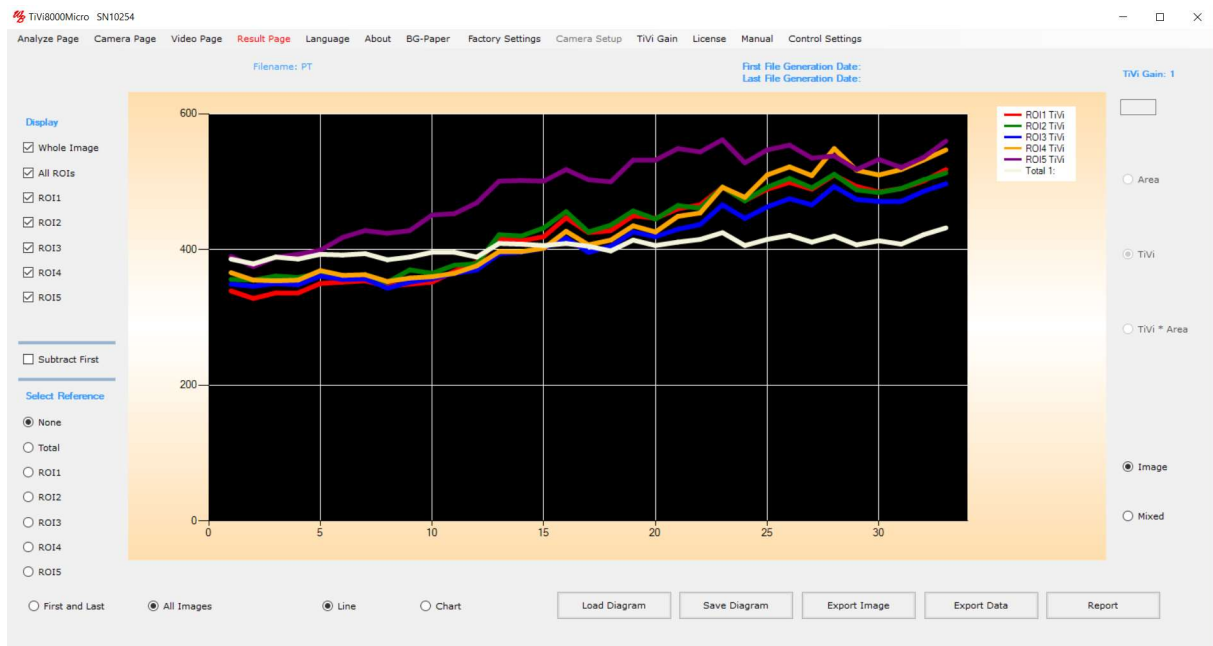


Layout of the *Video Page*.

### Result Page:

In the *Result Page*, the result of the analysis is displayed as curves or bar-graphs. After having uploaded a sequence of photos (in the *Analyze Page*) and the ROIs have been drawn,

the average TiVi-values for the ROIs in the individual photos in the sequence are displayed. By clicking the *Mixed* radio-button, average TiVi values within the ROIs are combined with the threshold setting. By clicking the *Area*, *TiVi* and *TiVi\*Area* radio-button, the areas within the threshold setting range, the associated TiVi-values and the product of these quantities can be displayed. While the areas represent the extension of an erythema area and the TiVi-values represent the intensity of an erythema area, their product (intensity multiplied by the area) is frequently the most sensitive parameter to detect erythema (or blanching).



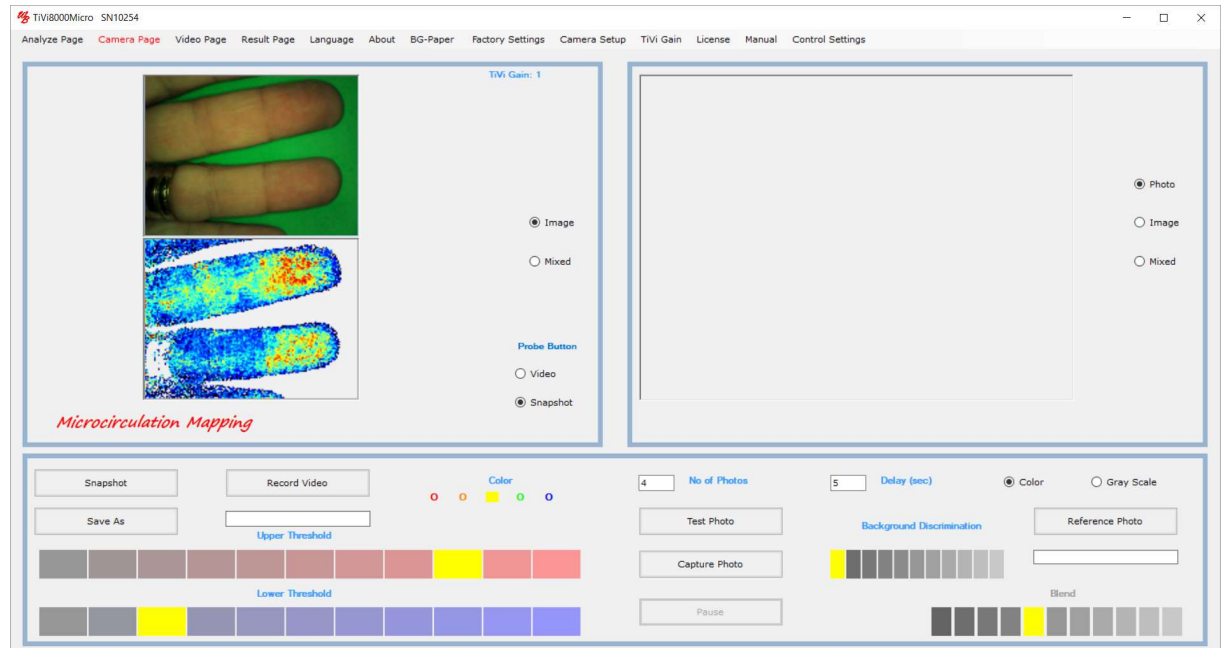
Layout of the *Result Page*.

## 5. TiVi8000 BY EXAMPLE

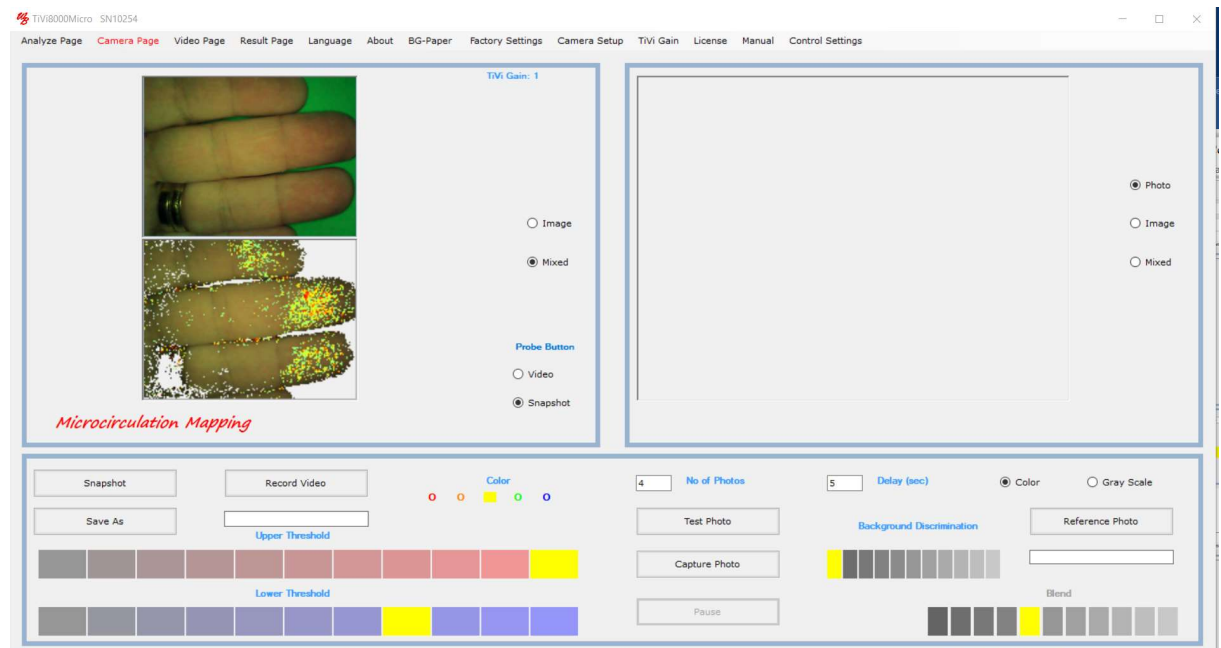
### How to record a video and capture individual photos.



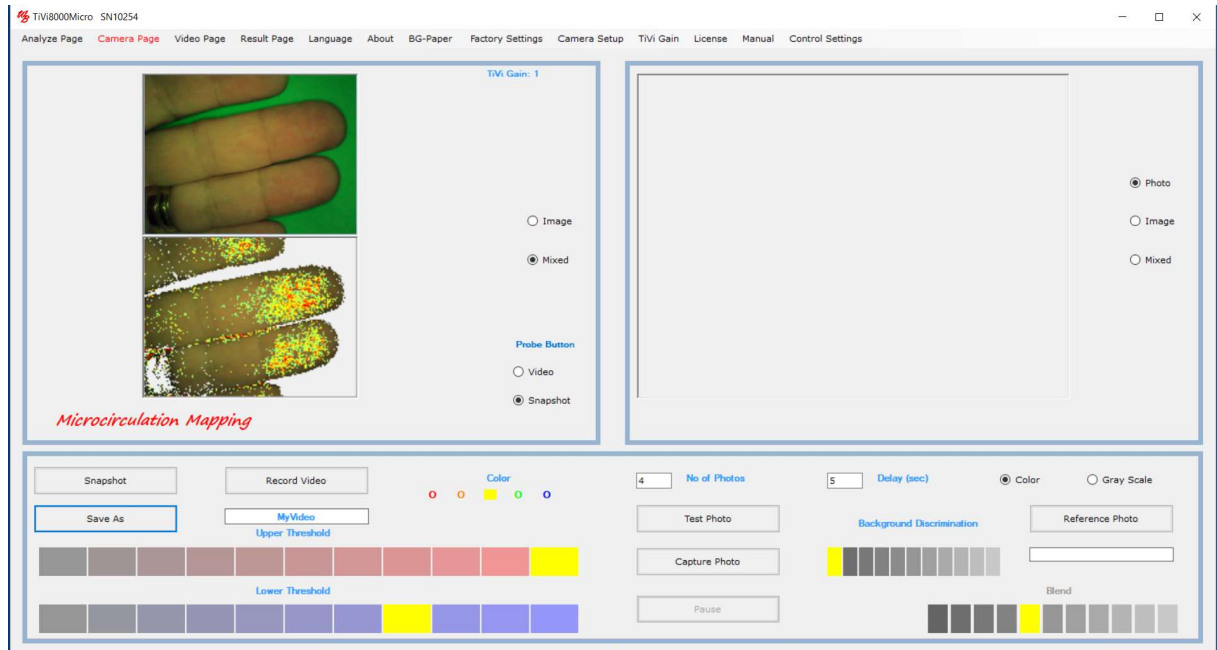
1. Select *Camera Page* in the pull-down menu to get to the *Camera Page*.
2. Place your hand on a green background paper in the field of view (this paper can be printed out by clicking the *BG-paper* button in the menu). The video should now play in the left picture box.



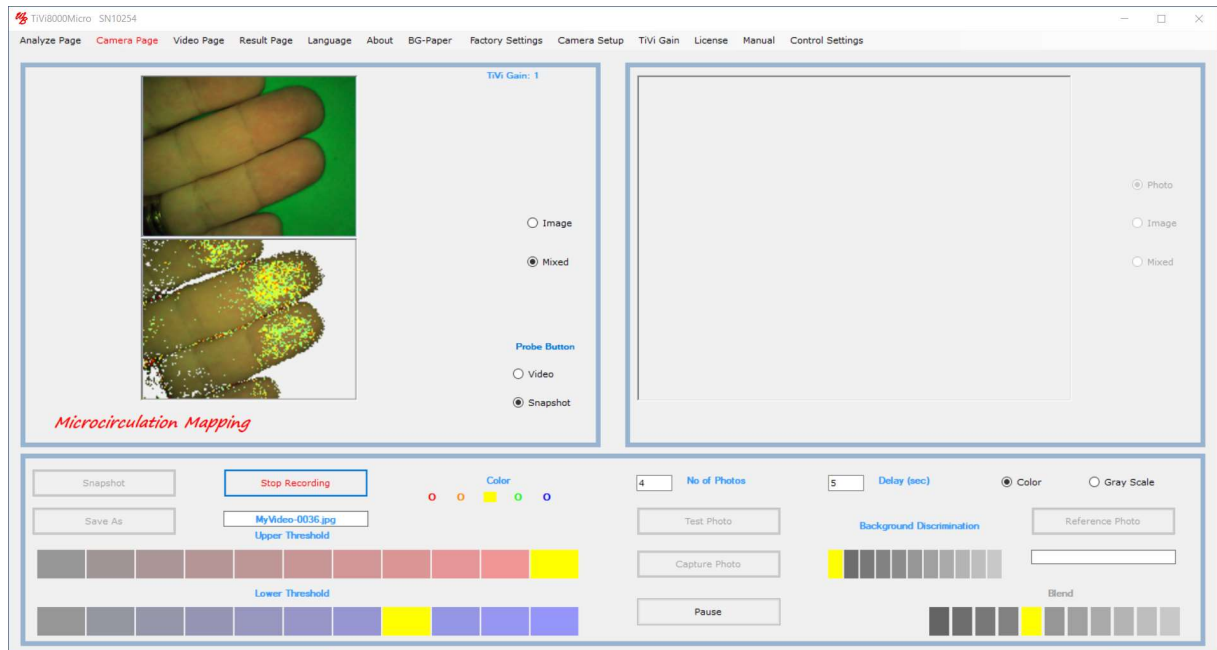
3. Click the *Mixed* radio-button and click 8<sup>th</sup> of the Lower Threshold elements.



4. Click the *Save As* button and navigate to a folder in which the individual photos extracted from the video are to be saved.

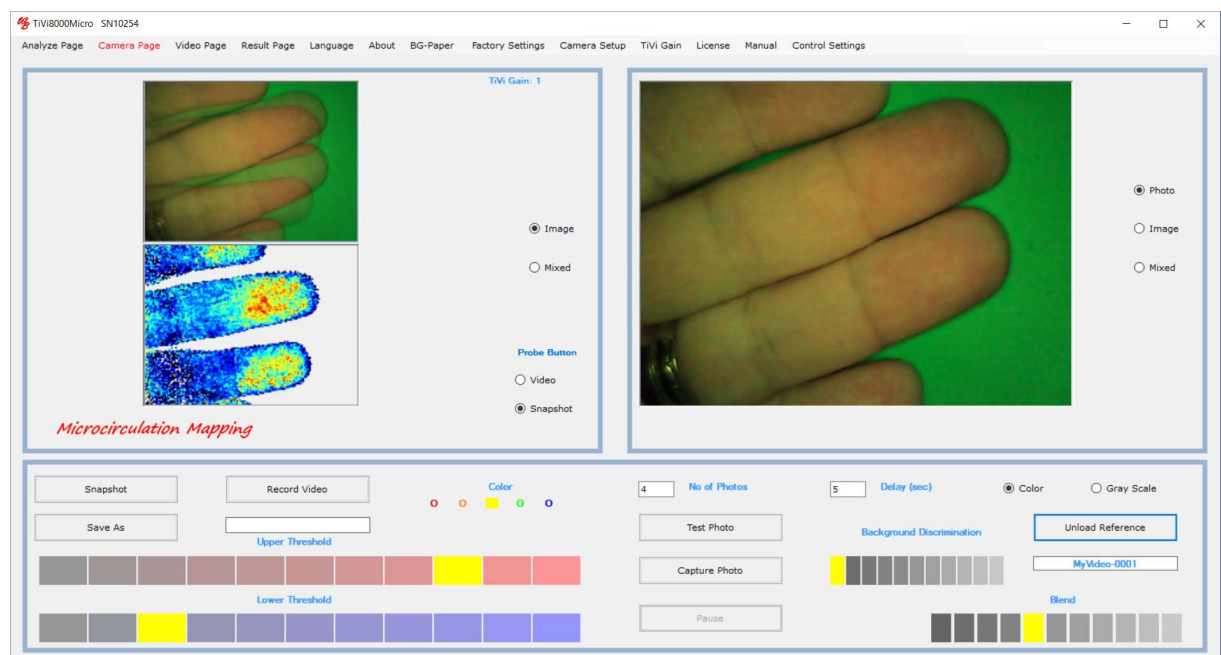


5. Click the *Record Video* button to start recording. The actual frame (photo) name (to which a number is attached) is displayed in the *Save As* textbox.



6. Click *Stop Recording* to halt the recording process. About ten frames per second have now been stored as photos named *MyVideo-xxxx*.
7. Click the *Save As* button and insert a new name. Insert "4" in the *No. of Photos* text box and "3" in the *Delay (sec)* in the *Delay* textbox to prepare for recording 4 photos with the delay between successive photos set to 5 seconds.

8. With the video running click the *Test Photo* button to capture a few test photos which are not stored to file. Click the *Stop* button to interrupt the test photo capturing procedure. If the video does not select *Analyze Page* and then again select *Camera Page*.
9. To upload a reference photo click the *Reference Photo* button and upload the file *MyVideo-0001* from the folder in which this file was stored.
10. Select the fifth element in the *Blend* panel and click the *Gray Scale Photo* button to display the reference photo in gray scale superimposed on the video.
11. Click the *Photo* radio-button to display the reference photo superimposed on the video.



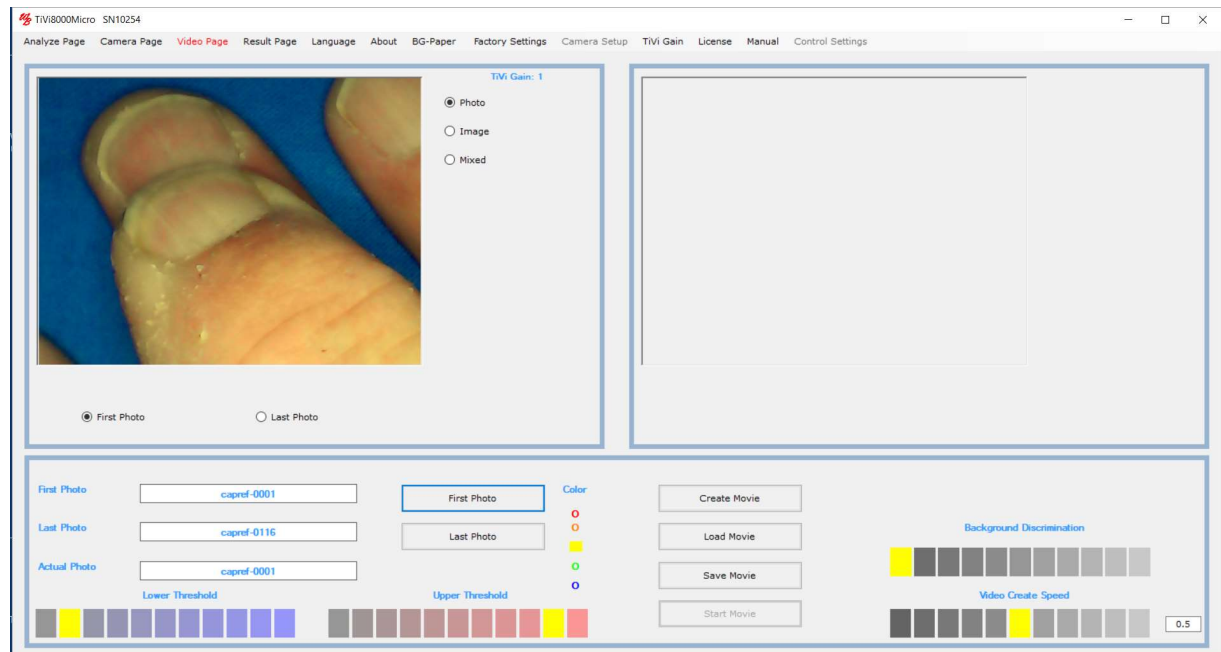
12. Click the *Capture Photo* button to capture 4 photos with 5 seconds delay.
13. Single photos can be captured at any time by clicking the *Snapshot* button. If a filename has been selected the photo will be stored to file. If no file name is selected the snapshot photo will only be displayed in the right picture box but not saved to file.
14. This completes the demonstration session on how to record a video and capture individual photos.

## How to create a movie from recorded photos.

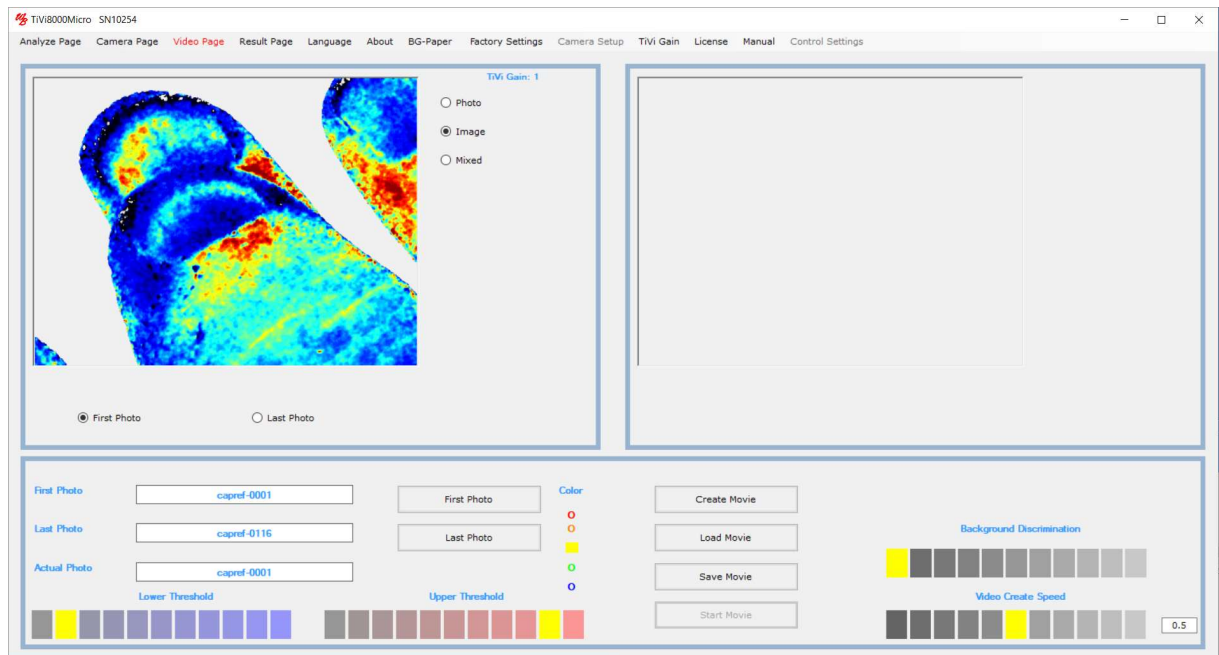
To create movies of individual photos the computer must be set so the User can read and write information to the Wheelsbridge folder. Please proceed as follows:

1. Navigate to the Program(x86) and right-click on the Wheelsbridge folder.
2. Select Properties.
3. Select Security.
4. Select Edit

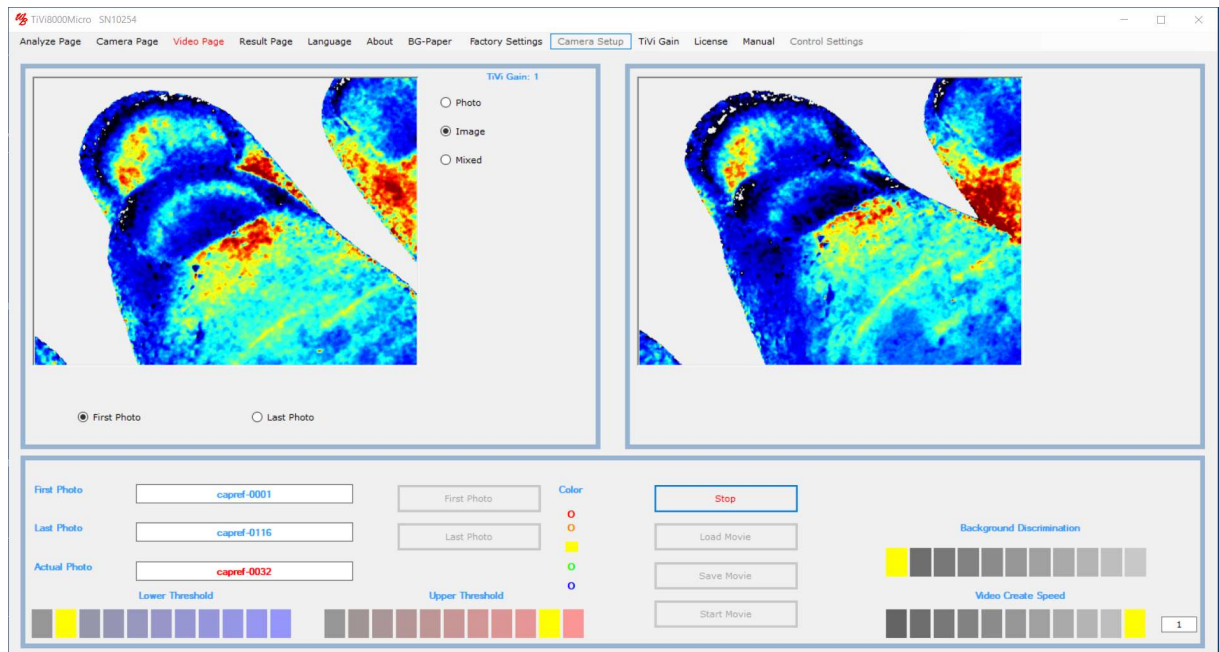
1. Select the *Video Page* from the pull-down menu to get to the *Video Page*. Click the *First Photo* button, navigate to the *Example File* folder and double-click the *capref-0001* photo file.



2. Click the *Image* radio-button.



3. Select the rightmost element in the *Video Create Speed* panel to create a movie with the highest frame rate when replayed. Click the *Create Movie* button to start the create movie process.



4. When the movie has been created click the *Start Movie* button to replay the movie.
5. Click the *Save Movie* button to save the movie as an \*.avi file. This movie can be uploaded to e.g. a *PowerPoint* presentation or played directly in the *MS Windows* environment.



- This completes the demonstration session on how to create a movie from recorded photos.

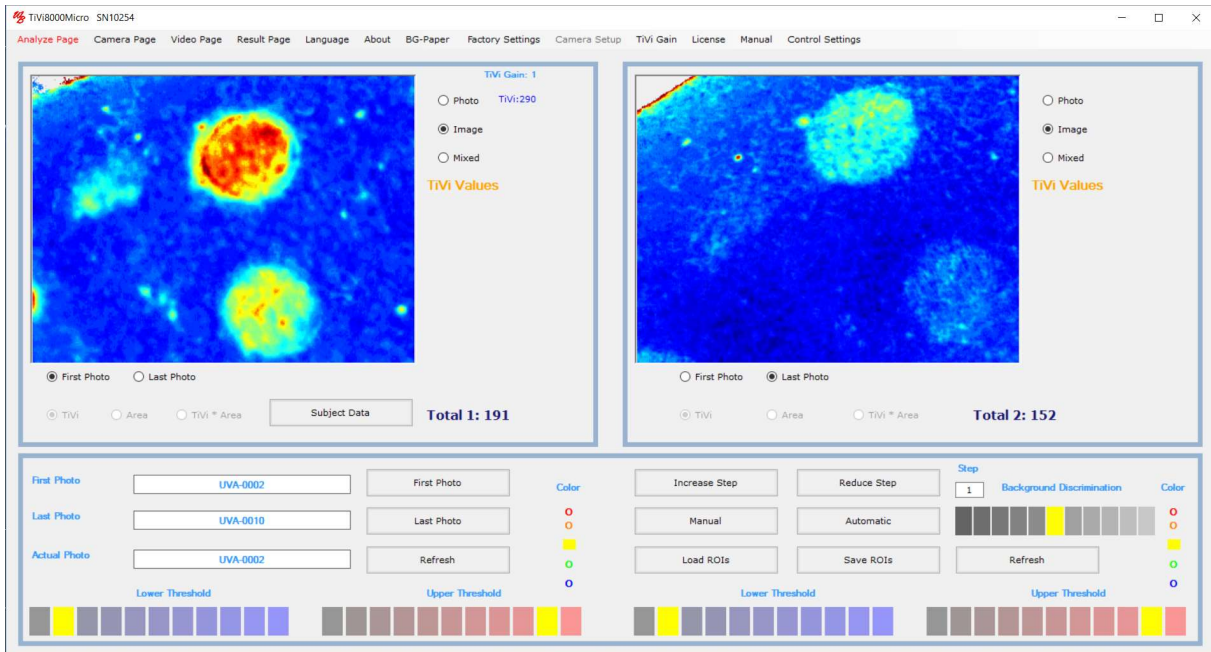
## How to analyze a sequence of captured photos.

These basic features of the *TiVi8000Micro* are probably best explained by way of an example. The example below demonstrates how a sequence of photo representing reducing erythema following the application an UVA dose at different sites protected by lotions of different protection factors (0, 10, 30 and 50). The photos are stored in the *Example Photos* folder and are named *UVA-0002* to *UVA-0010*.

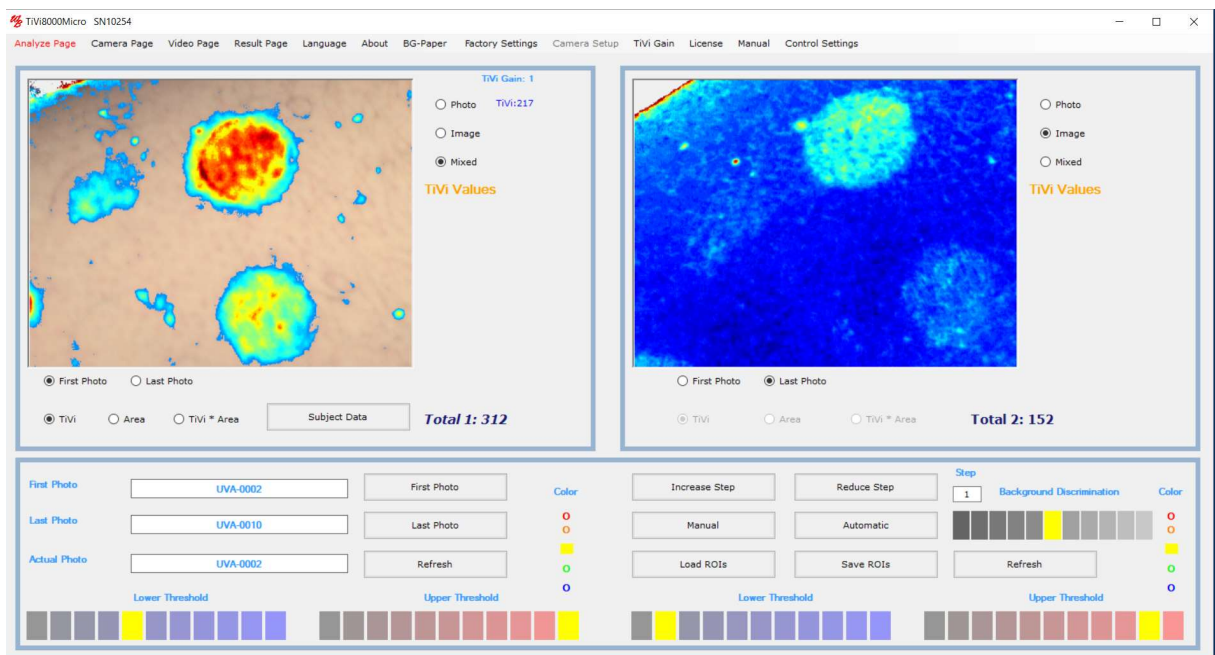
- Select *Analyze Page* in the pull-down menu to get to the *Analyze Page*.
- Click the *First Photo* button and navigate to the *Example Photos* folder. Double click on the *UVA-0002* photo file. This file will now be uploaded and displayed as will the last photo file in the actual sequence. The first photo file in the sequence is displayed in the right picture box, while the last file is displayed in the left picture box. Click the First Photo radio-button in the left photo panel and the Last Photo radio-button in the right panel.



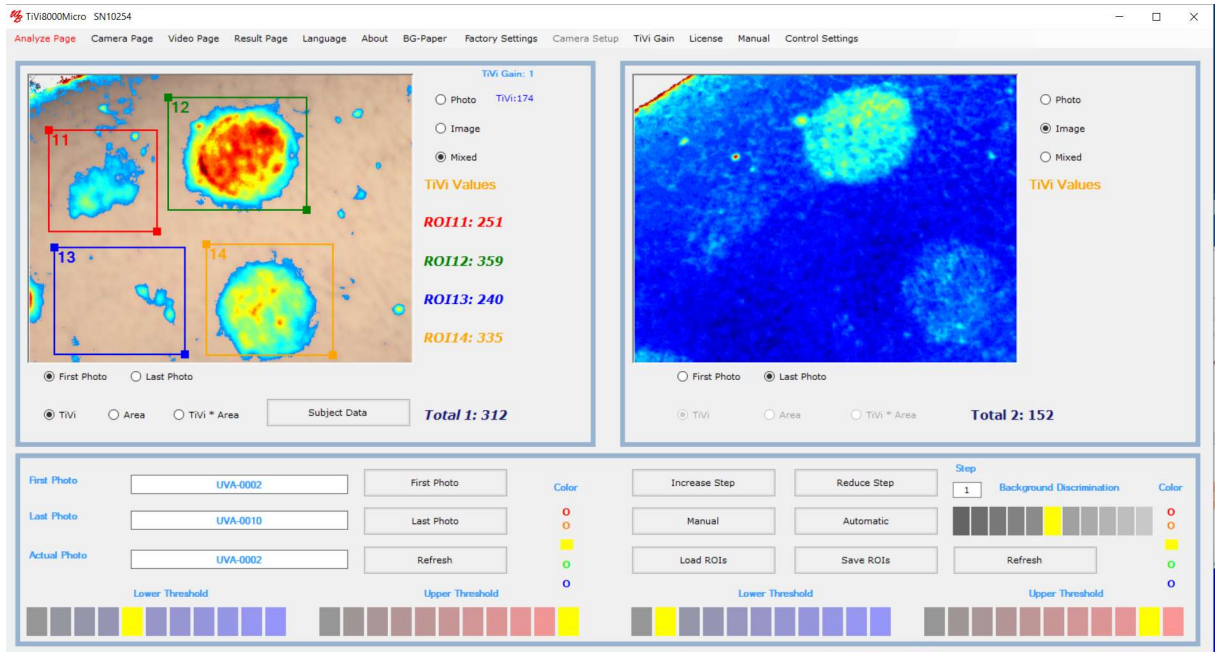
- Display the TiVi-images by clicking the *Image* radio-button associated with the left and right picture boxes.



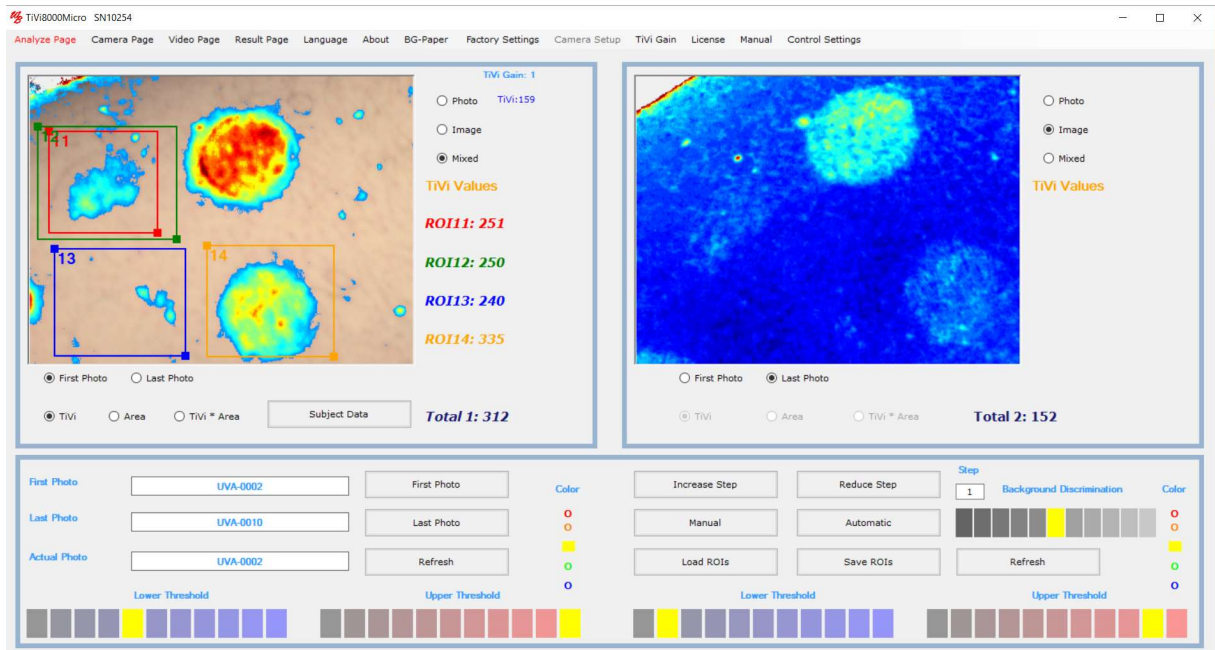
- To display only TiVi-values above a certain threshold click the fifth element in the *Lower Threshold* panel and the rightmost element in the *Upper Threshold* panel. Then click the *Mixed* radio-buttons.



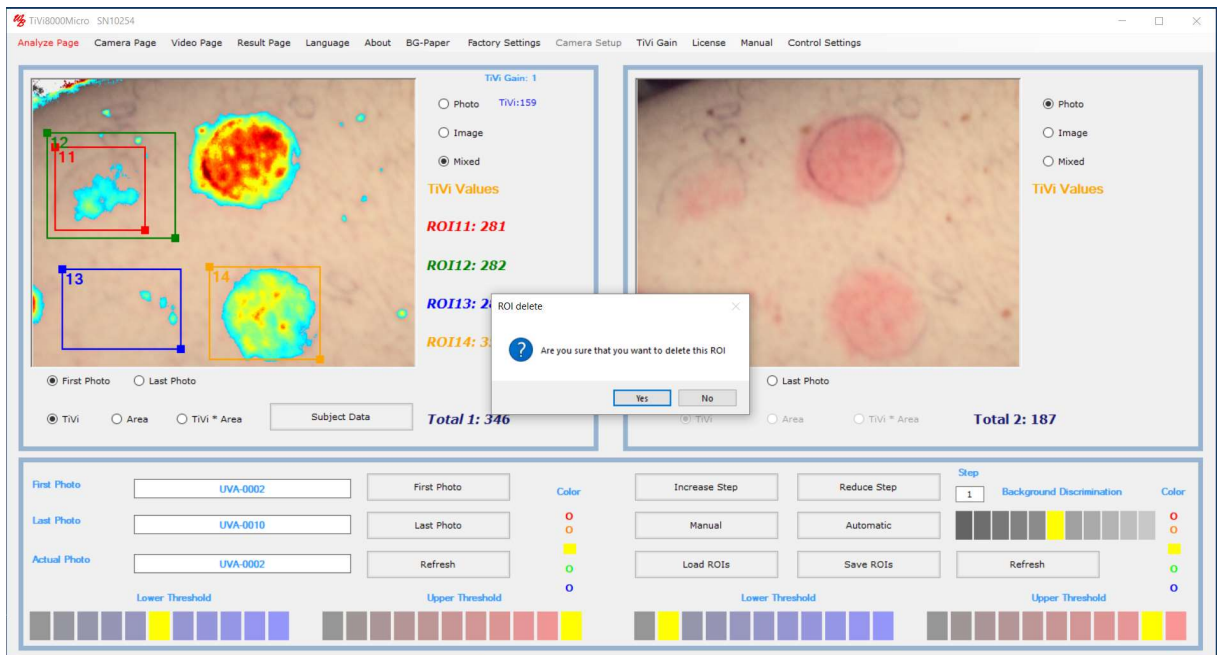
- Draw ROIs around four selected areas in the left picture box. The average values of the TiVi-values within the ROIs are now displayed next to the left picture box.



6. Move ROI12 by pointing at the centre of the ROI area in the image (the icon now turns into a finger pointing icon). With the left mouse button pressed drag the ROI to the left to enclose ROI11. Release the mouse button.



7. To delete ROI13, point at the ROI13 label and drag the mouse pointer downwards with the mouse button pressed. The *Message Box ROI Delete* now appears.



- Click the *Yes* button to delete ROI13. Observe that the other ROIs are now re-numbered and that their color representation is changed.



- Draw a new ROI around the major erythema site.





10. To zoom in on ROI14, click the ROI14 label.



11. To zoom out again, click the ROI14 label.

12. Draw a new ROI around the lower left site.

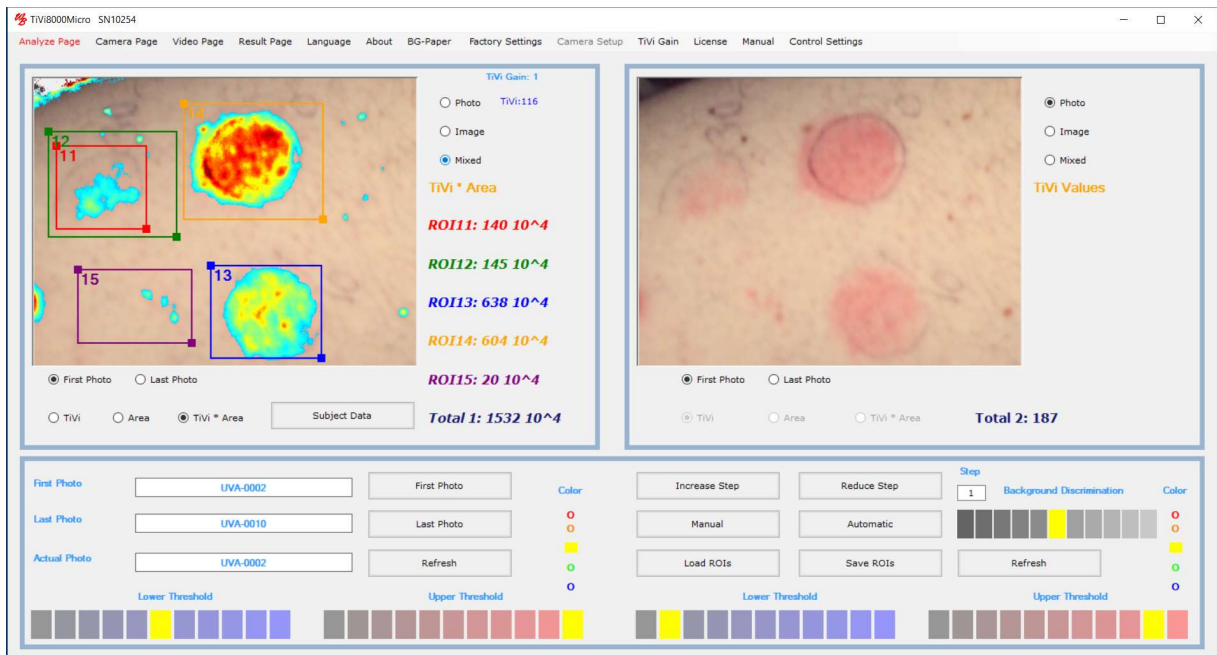




13. Click the *Area* radio button. The ROI labels now display the areas (in pixels) of the TiVi-values within set threshold limits within the ROIs.



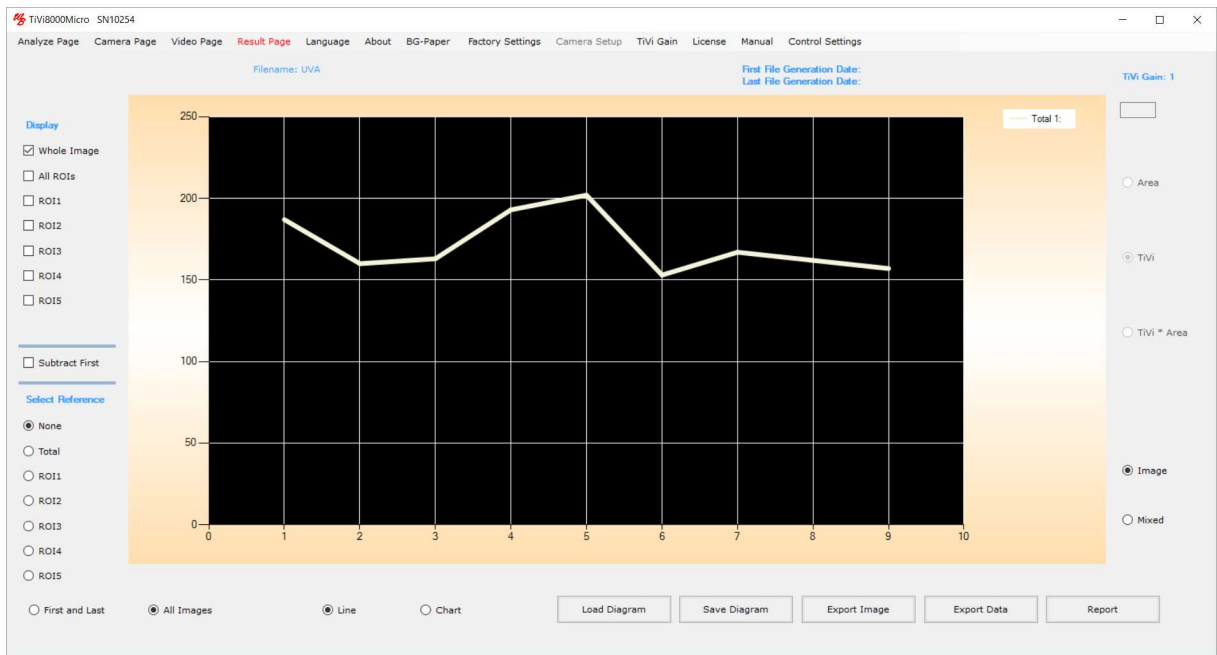
14. Click the *TiVi\*Area* button to display the product of average TiVi-value and area in the ROI labels.



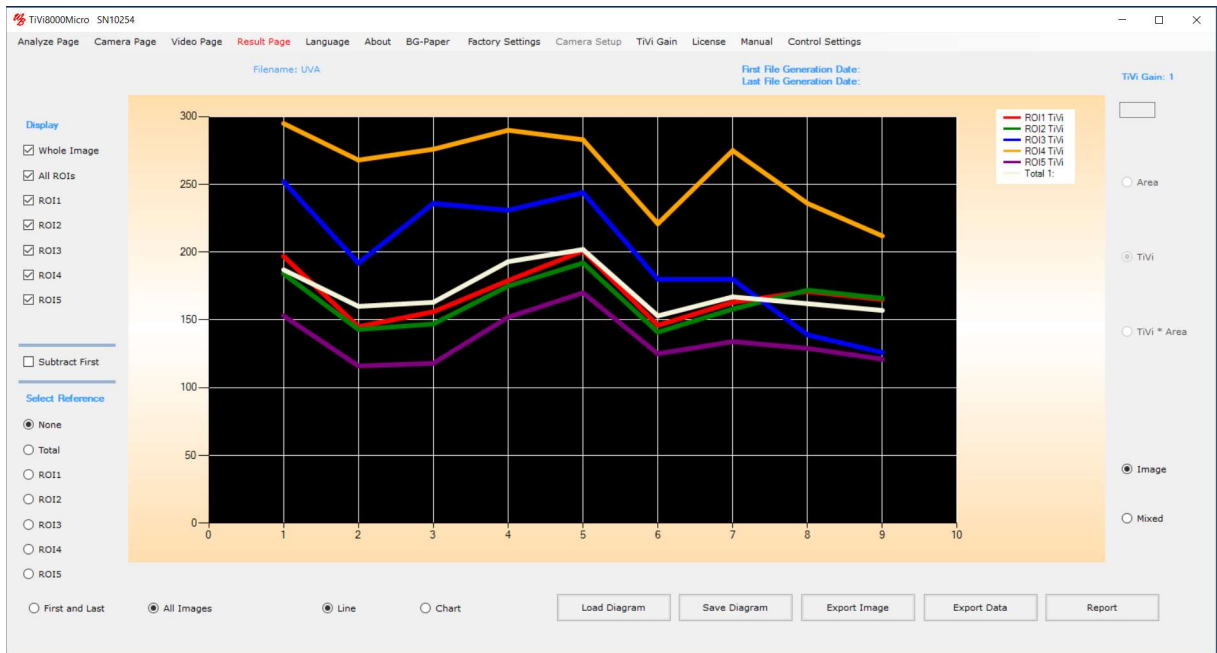
15. Click the *TiVi* radio-button and then click the *Manual* button a couple of times to manually scan through the images in the uploaded sequence of photos. The name of the photo corresponding to the actually displayed image is displayed in the *Actual Photo* textbox.



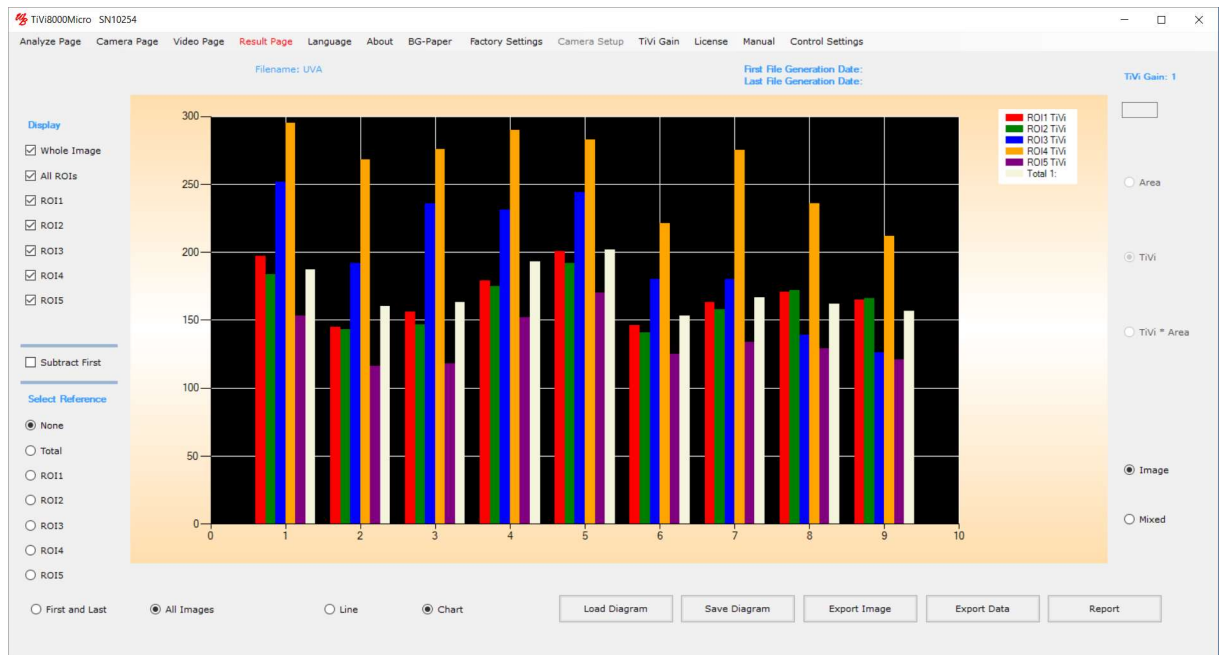
16. Click the *First Photo* radio-button and then the *Automatic* button to automatically scan through the images of the entire sequence. When all images have been displayed select the *Result Page* from the pull-down menu to display the *Result Page*.



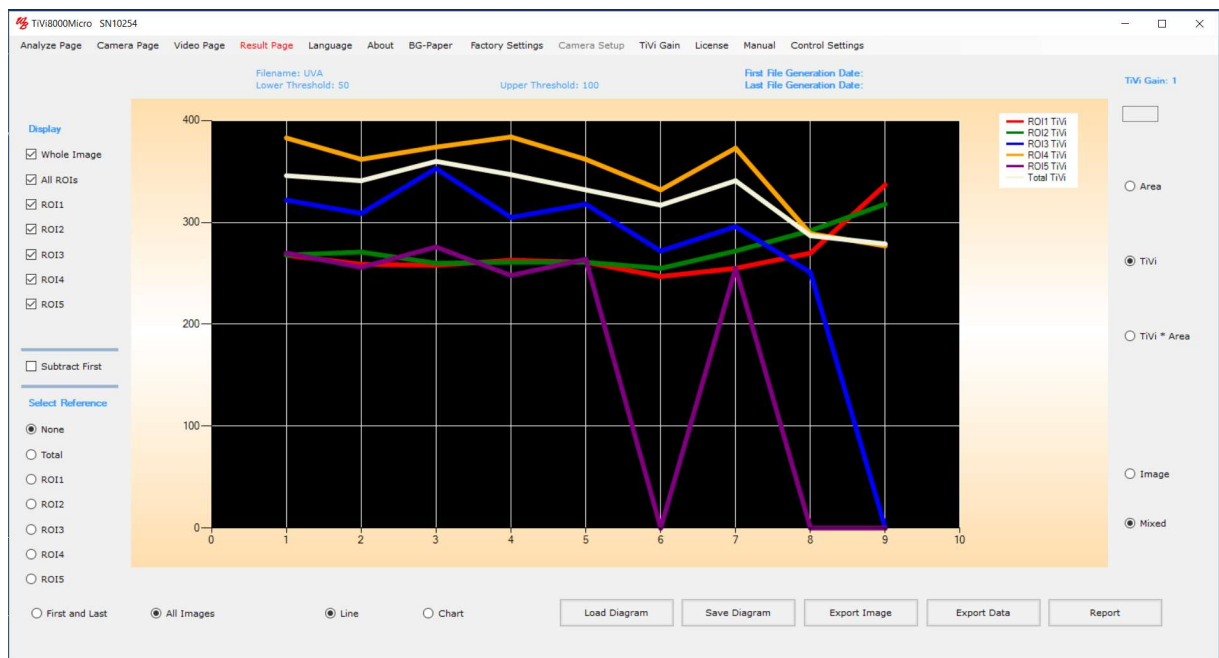
17. Check the *AllROIs* check-box to display the average TiVi-values of all five ROIs for all photos in the sequence (without any thresholds selected).



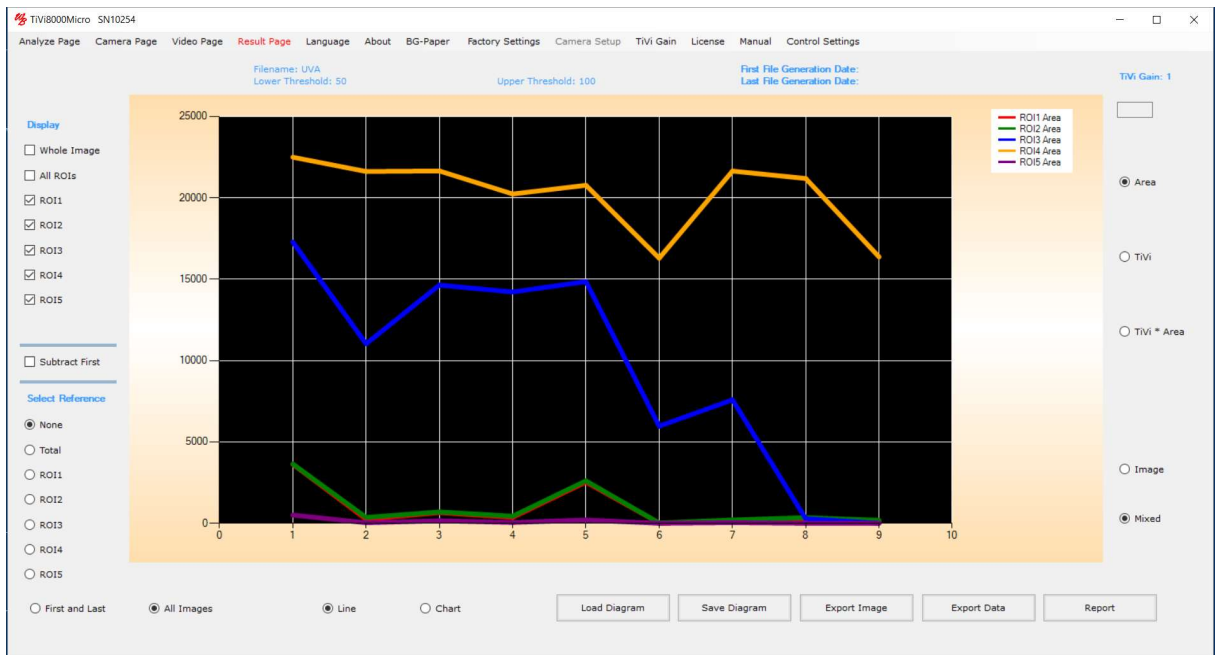
18. Click the *Chart* radio-button to display the results as a bar graph.



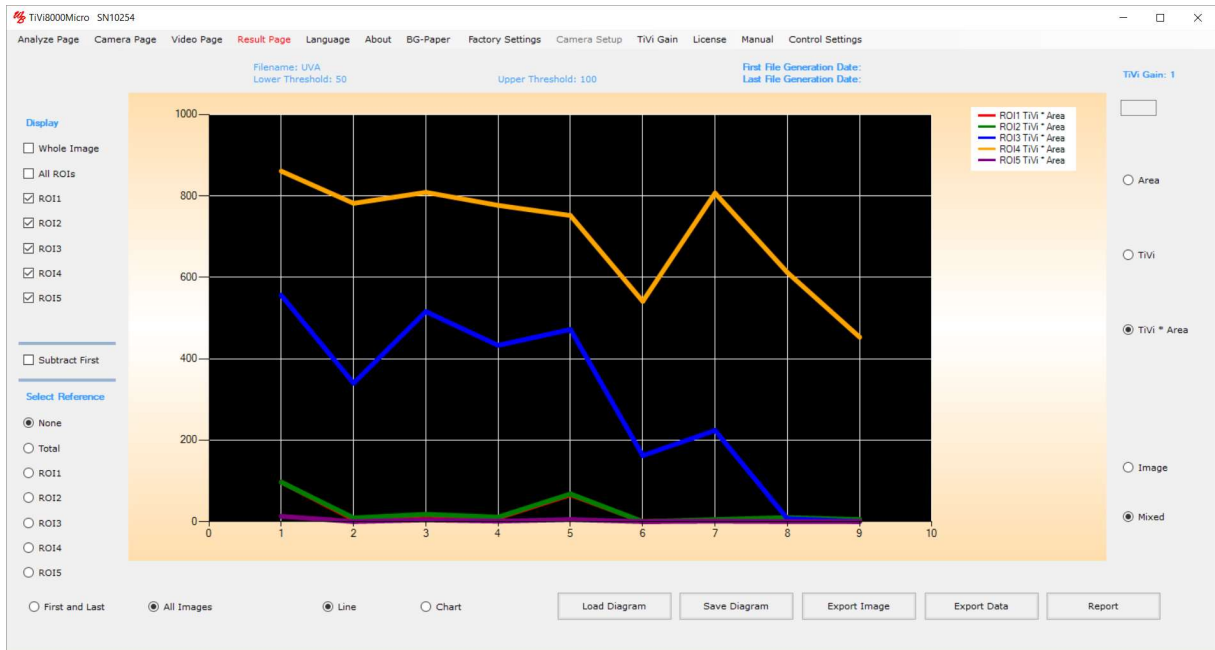
19. Click the *Line* radio-button again. Then click the *Mixed* button (to display the TiVi-values within the selected threshold limits).



20. This chart demonstrates that when there are TiVi-values within the set boundaries, these values do not change much over time (the intensity of the erythema above set threshold does not change much). Un-check the *Whole Image* check-box and then click the *Area* to display the extensions of the erythema areas within the individual ROIs. When the actual ROI area is zero, the corresponding TiVi-value defaults to zero too.

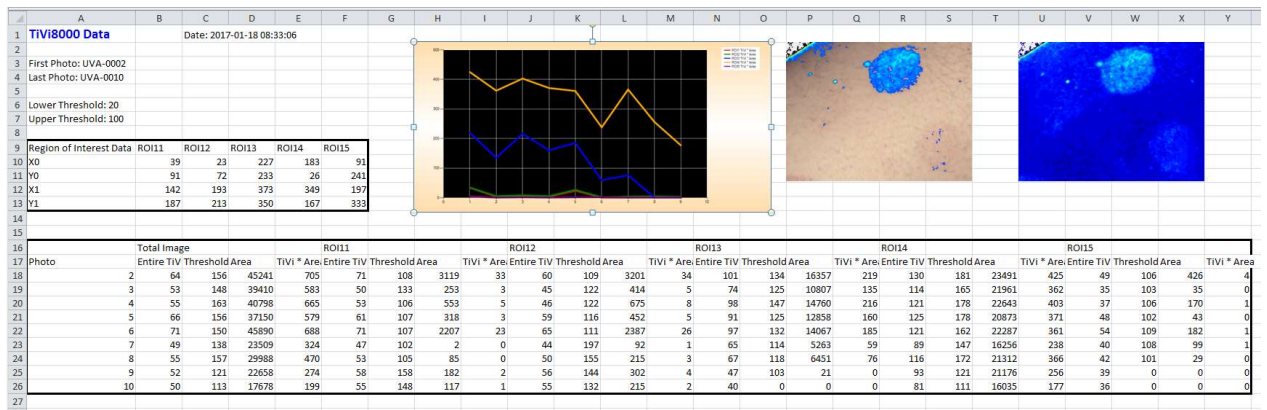


21. Click the *TiVi \* Area* radio button to display the product of TiVi-value and area within the individual ROIs.



22. Click the *Export Data* button to export the results to an *Excel*® spreadsheet (assumes the MS *Excel* is installed).





23. Click the *Report* button to generate a hard copy report in *Word*® (assuming that MS *Word* is installed).

24. This completes the demonstration session on how to use the *Analyze Page* and the *Result Page*.

## 6. DETAILED DESCRIPTION

### A. Menus

*Analyze Page* – click to select *Analyze Page*.

*Camera Page* – click to select *Camera Page*.

*Video Page* – click to select *Video Page*.

*Result Page* – click to select *Result Page*.

*Language* – click to select language (Chinese, English, French, German, Japanese or Swedish).

*About* – click to display the *TiVi8000Micro About* window.

*BG – Paper* – click to display a suitable green background paper. This background paper can be printed out as a pdf-file. A green colour background results in a negative TiVi-value which is automatically identified by the system as background.

*Factory Settings* – click to restore control factory settings

*Camera Setup: Run Setup* – click to run the probe calibration procedure (See Camera Setup Section below). This procedure is only necessary if the *TiVi8000* probe is replaced.

*Camera Setup: Restore Setup* – click to use the original calibration settings.

*TiVi Gain* – to set the amplification level to low (0.5), medium (1.0) or high (2.0). The settings will influence the numerical results.

*License* – click to display the *License Agreement*.

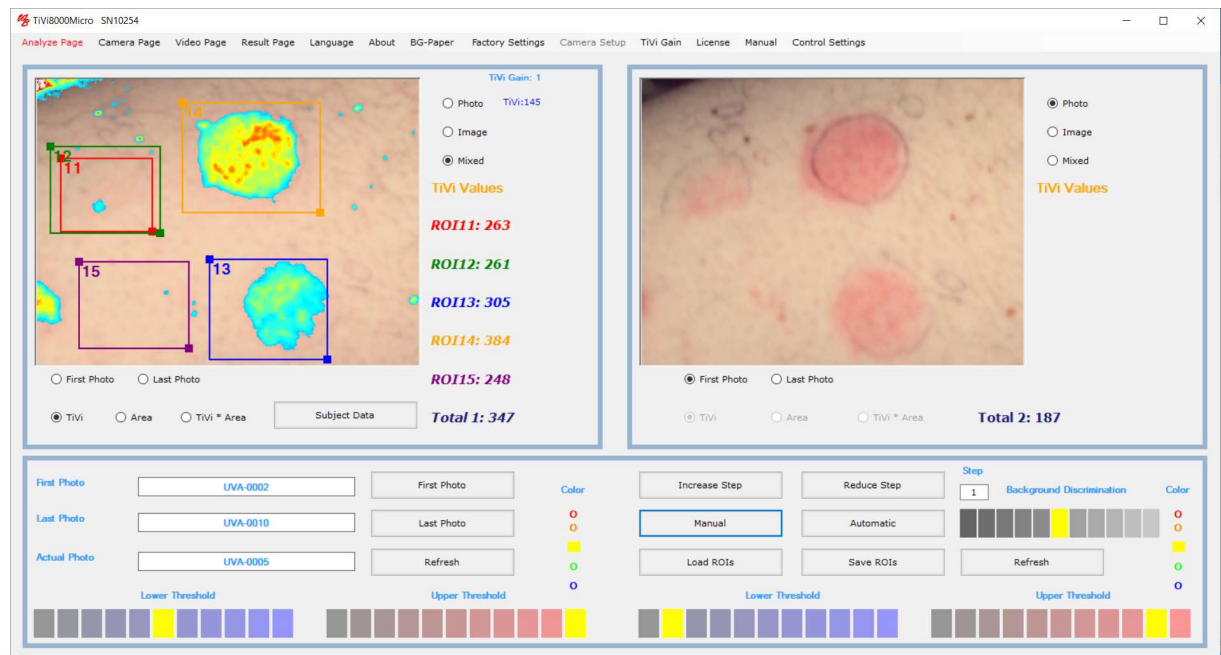
*Manual* – click to display the online *TiVi8000Micro* manual as a printable pdf-document.

*Control Settings – Advanced Settings* – includes full functionality as described above.

*Control Settings - Simplified Settings* – this mode comprises a reduced number of controls intended for capturing and analysis of single photos and images. The User can at any time switch back and forth between *Simplified* and *Advanced Settings*.

*Device ID* – to select a device ID name that will appear as part of the prefix of the photos saved.

## B. Analyze Page



### Upper Left panel:

*Left Picture box* – holds the left photo, TiVi image or mixed image.

ROIs – up to five ROIs can be drawn in the image displayed.

*ROI label values* – displays the average TiVi value, average TiVi value with threshold, area or the product of the average TiVi-value and area, depending on the radio button selection.

*Zoom in* – click on a ROI label to zoom in on the selected ROI. Click again to return to the original image.

*ROI deletion* – point on the ROI label, press the mouse button and drag the mouse down with the mouse button pressed. When the mouse button is released the *Delete Message Box* appear. Click *OK* to delete the ROI. All other ROIs are now re-calculated, re-numbered and re-colored.

*ROI reshaping* – point at one of the marked corners of a ROI, press the mouse button and move the mouse with the mouse button pressed. Release the mouse button.

*ROI moving* – point at the center of a ROI (the cursor will change to a finger pointer), press the mouse button and move the mouse to a new position with the mouse button pressed. Release the mouse button.

*Display Local TiVi-value* – move the mouse pointer over the image without pressing the mouse button.

*Photo* radio-button – click to display the photo in the picture box.

*Image* radio-button – click to display the TiVi image in the picture box.

*Mixed* radio-button – click to display the TiVi-image with upper and lower threshold limits.

*First Photo* radio-button– click to display the first photo / image in a sequence.

*Last Photo* radio-button – click to display the last photo / image in a sequence.

*TiVi* radio-button – click to display the average TiVi-values in the ROI labels with set thresholds (enabled only when the *Mixed* radio-button is selected).

*Area* radio-button – click to display areas in the ROIS labels with set thresholds (enabled only when the *Mixed* radio-button is selected).

*TiVi\*Area* radio-button – click to display the product of the average TiVi-value and the area in the ROIS labels with set thresholds (enabled only when the *Mixed* radio-button is selected).

*Total Image 1 label* – displays the total image values.

*Subject Data* Button – click to open a window into which subject data can be stored.

The screenshot shows a 'Subject Data' dialog box with the following fields and values:

- Filename : UVA
- ID: GRT45
- Gender:  Female,  Male
- First Name: Peggy
- Family Name: Anderson
- Phone: 008 895637
- Email: pa@hostmail.com
- Birthday: Year: 1956, Month: 12, Day: 13
- Address: 110 Crow Lane
- Comment: (empty)
- Save Data button

This document file can be saved under the same name as the *prefix* of the actual photo sequence by clicking the *Save Data* button. This document file can then be uploaded and edited when the same photo sequence is again uploaded.

**Upper Right panel:**

*Right Picture box* – holds the right photo, TiVi-image or mixed image.

*ROIs* – up to five ROIs can be drawn in the image displayed.

*ROI label values* – displays the average TiVi value, average TiVi value with threshold, area or the product of the average TiVi-value and area, depending on the radio button selection.

*ROI label click* – click on a ROI label to zoom in on the selected ROI. Click again to return to the original image.

*ROI deletion* – point on the ROI label, press the mouse button and drag the mouse down with the mouse button pressed. When the mouse button is released the *Delete Message Box* appear. Click *OK* to delete the ROI. All other ROIs are now recalculated and re-colored.

*ROI reshaping* – point at one of the marked corners of a ROI, press the mouse button and move the mouse with the mouse button pressed. Release the mouse button.

*ROI moving* – point at the center of a ROI (the cursor will change to a finger pointer), press the mouse button and move the mouse to a new position with the mouse button pressed. Release the mouse button.

*Photo* radio-button – click to display the photo in the picture box.

*Image* radio-button – click to display the TiVi image in the picture box.

*Mixed* radio-button – click to display the TiVi-image with upper and lower threshold boundaries.

*First Photo* radio-button – click to display the first photo / image in a sequence.

*Last Photo* radio-button – click to display the last photo / image in a sequence.

*TiVi* radio-button – click to display the average TiVi-values in the ROI labels with set thresholds (enabled only when the *Mixed* radio-button is selected).

*Area* radio-button – click to display areas in the ROIS labels with set thresholds (enabled only when the *Mixed* radio-button is selected).

*TiVi\*Area* radio-button – click to display the product of the average TiVi-value and the area in the ROIS labels with set thresholds (enabled only when the *Mixed* radio-button is selected).

*Total Image 2 label* – displays the total image values.



**Lower panel (left side):**

*First Photo* button – click to upload the first photo. The last photo in the sequence will automatically be selected.

*Last Photo* button – click to upload the last photo.

*Refresh* button – click to delete all ROIs (in the upper left panel picture box).

*Color* – click on a color circle to change the color scale of the displayed image (in the upper left panel picture box). Change the *Color* setting does not affect any numerical values.

*Lower Threshold* – click on an element to set the lower threshold of the TiVi image (in the upper left panel picture box).

*Upper Threshold* – click on an element to set the upper threshold of the TiVi image (in the upper left panel picture box).

*First Photo* text box – displays the name of the first photo.

*Last Photo* text box – displays the name of the last photo.

*Actual Photo* text box – displays the name of the actual photo.

**Lower panel (right side):**

*Increase Step* button – click to increase the step length of the image sequence displayed.

*Reduce Step* button – click to reduce the step length of the image sequence displayed.

*Step* text box – displays the actual step length.

*Manual* button – click to step through the photos / images manually.

*Automatic* button – click to step through the photos / images automatically.

*Load ROIs* button – click to load a set of saved ROIs.

*Save ROIs* button – click to save the actual set of ROIs.

*Refresh* button – click to delete all ROIs (in the upper right panel picture box).

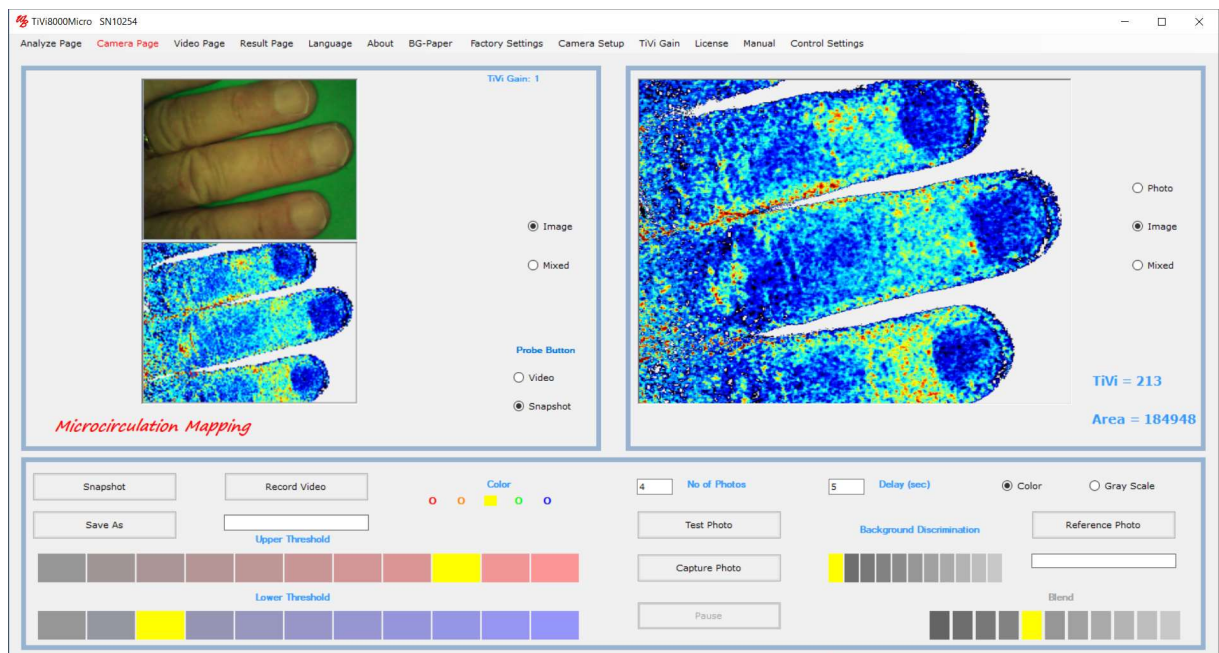
*Background Discrimination* – click on an element to change background discrimination.

*Color* – click on a color circle to change the color scale of the displayed image (in the upper right panel picture box). Change the *Color* setting does not affect any numerical values.

*Lower Threshold* – click on an element to set the lower threshold of the TiVi image (in the upper right panel picture box).

*Upper Threshold* – click on an element to set the upper threshold of the TiVi image (in the upper right panel picture box).

### C. Camera Page



When the *Camera Page* is selected, the system is automatically set to continuous video mode.

#### Upper Left panel:

*Upper Picture box* – displays the left photo video.

*Lower Picture Box* – displays the TiVi-image or mixed image video.

*Image* radio-button – click to display the TiVi image – video in the picture box.

*Mixed* radio-button – click to display the TiVi-image – video with upper and lower threshold limits.

*Probe button: Video radio-button* – click the proximal button on the probe to capture continuous frames by clicking the button on the probe.

*Probe button: SnapShot radio-button* – click to proximal button on the probe to capture a single photo.

*Using the probe button to capture photos or videos* – with the video-radio-button checked, pressing the probe button starts the video capturing process. Keep the probe button pressed for about one second until the beep-sound is heard. Then release the probe button. Pressing the probe button again stops the video recording. The system then converts all frames in the video recorded to photos.

*Using the probe button to capture a single photo* - with the *SnapShot*-radio-button checked, press the probe button to capture a single photo. Keep the probe button pressed for about one second until the beep-sound is heard. Then release the probe button. If a file name has been inserted using the *Save As* button, the photo will be saved to file and displayed in the right-side picture-box. If the *Save As* text-box is empty the photo will just be displayed in the right-side picture-box.

The *TiVi8000* unit operates on “soft docking” implying that the camera can be connected while the software is running.

In case the **Camera Page** videos stop operating, just disconnect the probe and reconnected again to continue operation.

### **Upper Right panel:**

*Right Picture box* – displays the left photo, TiVi image or Mixed image captured from video.

*Photo* radio-button – click to display the photo in the picture box.

*Image* radio-button – click to display the TiVi image in the picture box.

*Mixed* radio-button – click to display the TiVi-image upper and lower threshold boundaries.

The average TiVi-value and object area (in pixels) are displayed below the right-side picture-box.

### **Lower panel (left side):**

*SnapShot* button – click to capture a frame from the video and display it in the right picture box. If a file name is selected the captured frame will also be saved to file as a photo.

*Record Video* button – click to start recording a video to file as individual photos (assumes that a file name has been selected).

*Color* – click on a color circle to change the color scale of the displayed image.

*Lower Threshold* – click on an element to set the lower threshold of the TiVi video.

*Upper Threshold* – click on an element to set the upper threshold of the TiVi video.

*Save As* button – insert a name under which the photos are to be saved. The user selects the prefix of the name (e.g. *MyPhoto*) and the system automatically adds the photo number (e.g. *MyPhoto-0001*). When a filename is selected clicking the *Snapshot* button saves the captured photo to file. In case no file name is selected clicking the *SnapShot* button only displays the captured photo / image in the right picture box with saving the photo.

#### **Lower Panel (right side):**

*No Of Photos* textbox – fill out the textbox with the number of photos to be captured.

*Delay* textbox – fill out the textbox with the delay (in seconds) between capturing of photos (minimum settings = 5 seconds).

*Test Photo* button – click to capture up to 20 photos without saving anything to file.

*Capture Photo* button – click to start the photo capturing process.

*Pause / Continue* button – click to halt or continue the photo capturing process.

*Reference Photo* button – click to upload a photo to be used as a reference ghost photo superimposed on the video. This feature is useful when photos are captured at different points in time to ensure that the object is in the same position in the field of view.

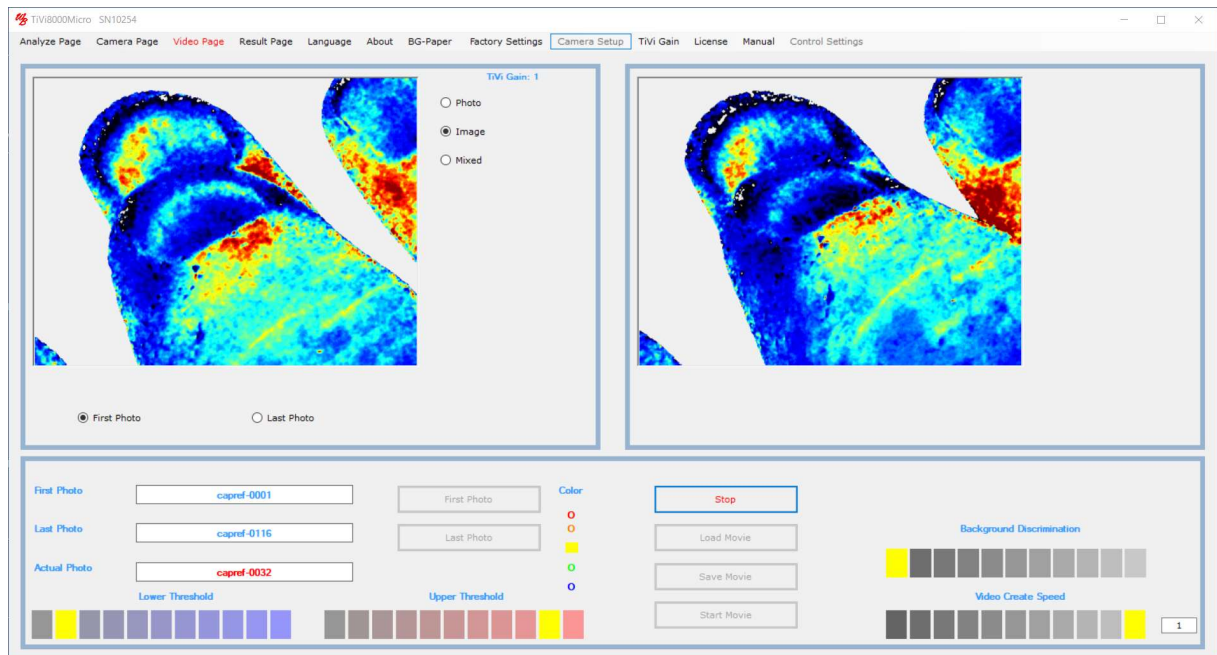
*Discrimination background* – click to change background threshold.

*Color Photo* radio-button – click if the reference photo is to be displayed in color (also used to set the background photo in Mixed mode to be displayed in color).

*Gray Scale Photo* radio-button – click if the reference photo is to be displayed in gray scale (also used to set the background photo in Mixed mode to be displayed in gray scale).

*Blend* – select an element to determine the intensity of the reference photo superimposed on the video.

## **D. Video Page**



### Upper Left panel:

The picture box displays the actual photo / image.

*Photo* radio-button – click to display the photo in the picture box.

*Image* radio-button – click to display the TiVi image in the picture box.

*Mixed* radio-button – click to display the TiVi-image upper and lower threshold limits.

*First Photo* button – click to display the first photo in the sequence from which the video is to be created.

*Last Photo* button – click to display the last photo in the sequence from which the video is to be created.

### Lower panel (left side):

*First Photo* button – click to upload the first photo. The last photo in the sequence will automatically be selected.

*Last Photo* button – click to upload the last photo.

*First photo* textbox – displays the name of the first photo.

*Last File* textbox – displays the name of the last photo.

*Actual Photo* textbox – displays the name of the actual photo.



*Color* – click on a color circle to change the color scale of the displayed image.

*Lower Threshold* – click on an element to set the lower threshold of the TiVi image.

*Upper Threshold* – click on an element to set the upper threshold of the TiVi image.

### **Upper Right panel:**

The picturebox holds the photos from which the video is created and displays the video.

### **Lower panel (right side):**

*Create Video* button – click to start creating the video. Depending on if the *Photo*, *Image* or *Mixed* radio-button is selected, a photo, image or mixed video may be created.

*Start Movie* button– click to start the created or uploaded movie.

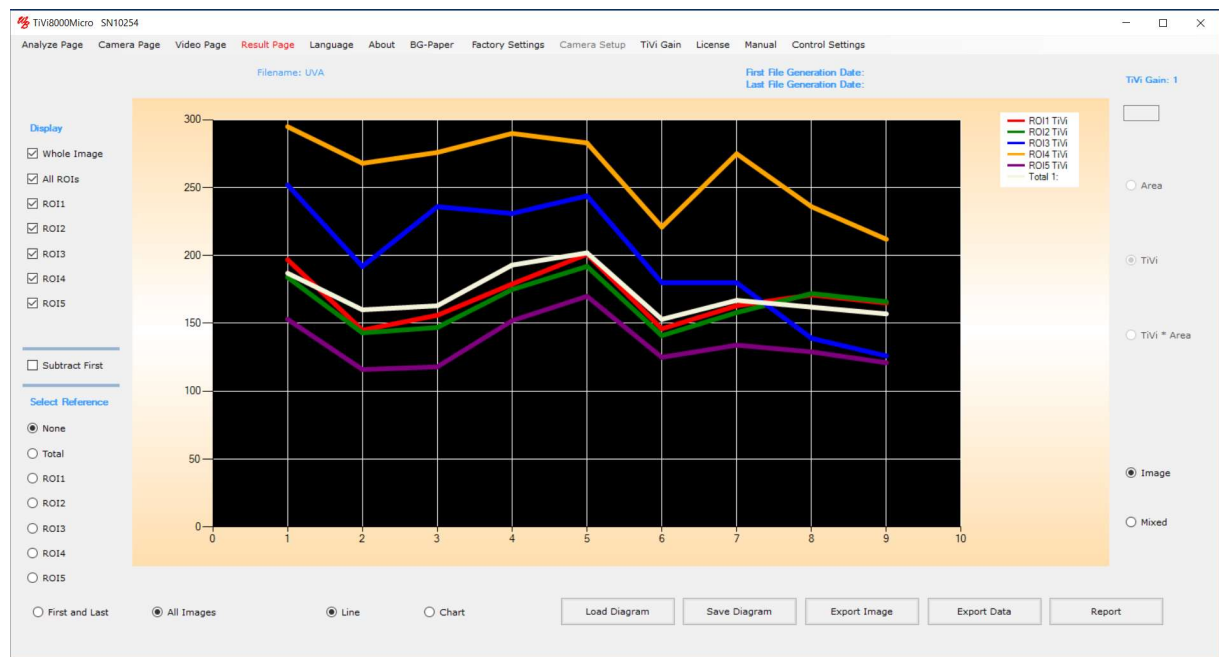
*Load Movie* button– click to upload a movie from file.

*Save Movie* button– click to save a created movie to file. This movie (.avi – format) can be replayed in e.g. a *PowerPoint* presentation.

*Background Discrimination* – click to change the background threshold.

*Video Create Speed* – click on an element to select the speed at which the created video is to be replayed.

## **E. Result Page**



*Whole image* checkbox - check to display the curve / chart corresponding to the entire image.

*All ROIs* checkbox – check to display the curves /charts corresponding to all ROIs.

*ROI11* checkbox – check to display the curve / chart corresponding to ROI11.

*ROI12* checkbox – check to display the curve / chart corresponding to ROI12.

*ROI13* checkbox – check to display the curve / chart corresponding to ROI13.

*ROI14* checkbox – check to display the curve / chart corresponding to ROI14.

*ROI15* checkbox – check to display the curve / chart corresponding to ROI15.

*Select Subtract First* checkbox – check to display only changes in ROI curves.

*Select Reference* – select one of the ROI curves below as reference.

*None* radio-button – no reference curve selected.

*Total* radio-button – subtract the curve corresponding to the entire TiVi-values from all other ROI TiVi values.

*ROI1*radio-button – subtracts the values within the ROI1 curves from all other ROIs.

*ROI2*radio-button - subtracts the values within the ROI2 curves from all other ROIs.

*ROI3*radio-button - subtracts the values within the ROI3 curves from all other ROIs.

*ROI4* radio-button - subtracts the values within the ROI4 curves from all other ROIs.

*ROI5* radio-button - subtracts the values within the ROI5 curves from all other ROIs.

*First and Last* radio-button – click to display the curves / charts corresponding to the first and last image.

*All Images* radio-button – click to display the curves / charts corresponding to all images in the sequence.

*Line* radio-button – click to display the data as curves.

*Chart* radio-button – click to display data as bar graph.

*Image* radio-button – click to display data corresponding to images without thresholds.

*Mixed* radio-button – click to display data corresponding to the images with thresholds.

If the *Mixed* radio-button is clicked:

*Area* radio-button – click to display area data.

*TiVi* radio-button – click to display TiVi-values data.

*TiVi \* Area* radio-button – click to display data corresponding to the product of TiVi-values and area values.

*Load Diagram* button – click to load a saved diagram.

*Save Diagram* button – click to save a diagram.

*Export Current Image* button – click to export detailed TiVi data of the current Image.

*Export Data* button – click to export data to an *Excel* spreadsheet (assumes MS *Excel* © is installed).

*Report* – click to generate a report in a *Word* document (assumes MS *Word* © is installed).

## 7. CAMERA SETUP

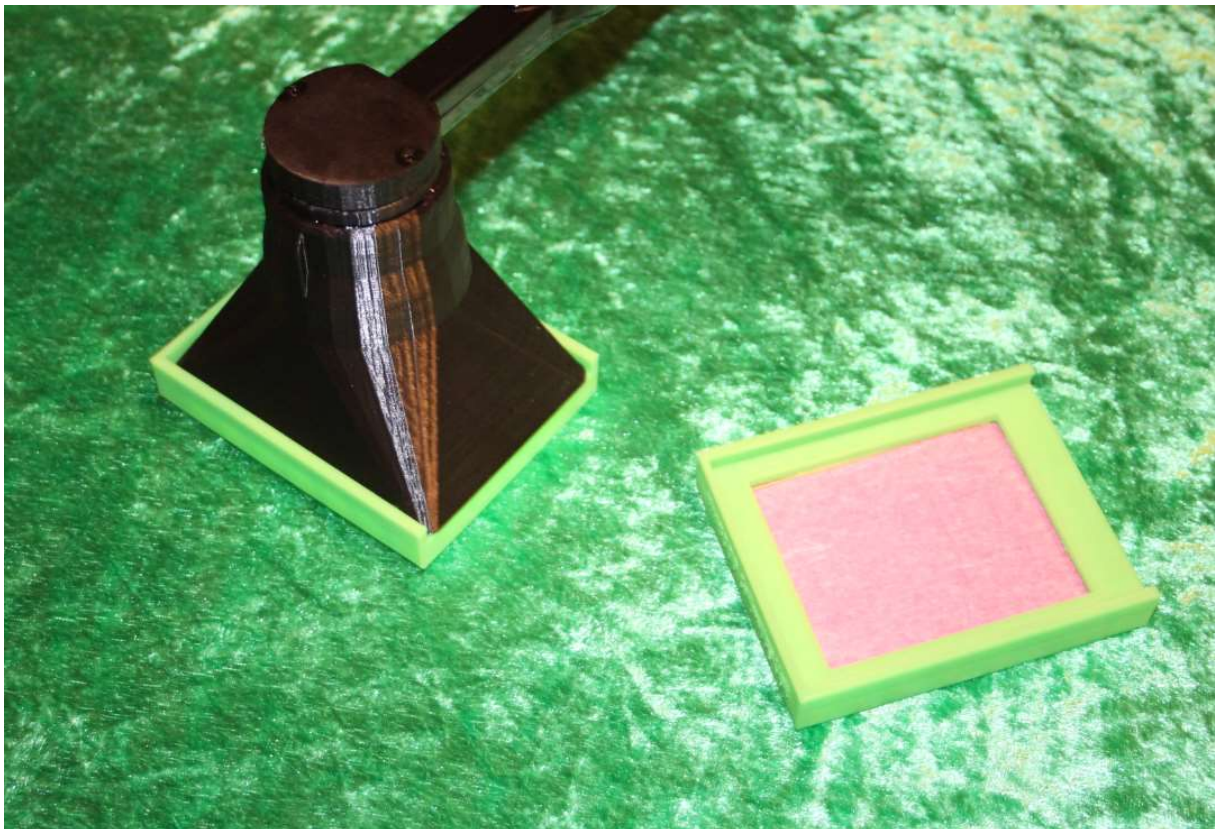
Each TiVi8000 probe is carefully calibrated for maximum performance in the manufacturing process, and generally no additional calibration is needed unless the probe is exchanged. The probe serial number (on the body of the probe) and the serial number in the top panel of the TiVi8000 software should match for optimal performance with respect to especially uniform sensitivity over the entire field image surface. If these numbers do not match proceed with the calibration procedure below.

To equalize the spatial sensitivity, the algorithm utilized is based on a compensating mechanism for the possible non-uniformity of the individual camera sensitivity. This compensation mechanism forms an integral part of the software package fine-tuned to the specific probe in use.

If the probe is replaced, correction of this compensation mechanism in the software may be necessary to preserve a uniform sensitivity over the TiVi-image surface. This correction process is performed through the following steps.

Select *Camera Setup* → *Run Setup* in the pull-down menu.

Follow the instruction on the screen. While the calibration process is in progress the **Save As** textbox flashes red and green.



## 8. SPECIFICATION

Video frame rate	10 frames per second
Image size	640 x 480 pixels
Field of View (camera-object distance 0.1 m)	About 50 x 65 mm (about 0.1 mm /pixel)
Minimal camera – object distance	About 40 mm (about 0.04 mm / pixel)
Operating temperature	+ 10 to + 40 degrees centigrade
Computer processor	Core i5 or Core i7
Operating system	Windows 10