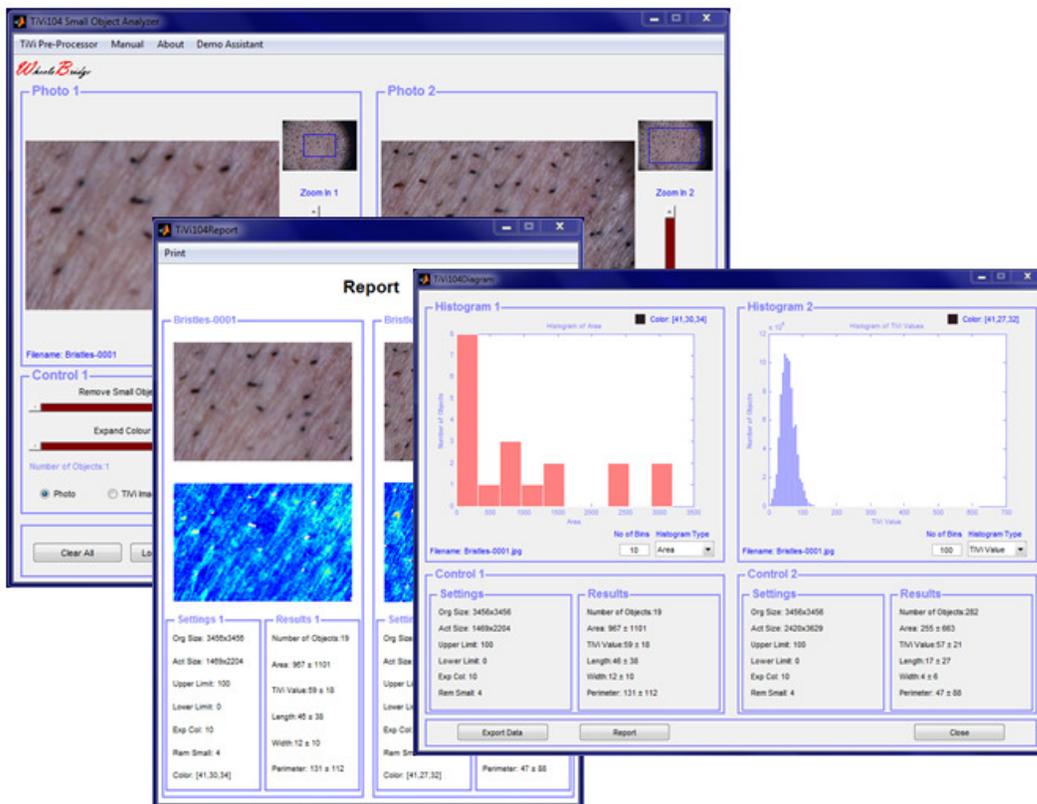




Wheels Bridge



Stubble Analyzer TiVi104 User Manual

User Manual 1.2
Version 1.2
February 2019

PIONEERS IN TISSUE VIABILITY IMAGING

TiVi104 Stubble Analyzer

Dear Valued Customer!

Welcome to the WheelsBridge TiVi104 Stubble Analyzer system intended for automatic and user-independent analysis of skin irritation and stubble elements characteristics in association with development of shaving products such as razors, electric shavers and skin care products in general.

The WheelsBridge TiVi104 Stubble Analyzer utilizes a highly sensitive digital camera equipped with a microscope adapter with polarization filters making it possible to suppress surface reflections from the skin. The versatile system software – based on the MATLAB® high performance language for technical computing – allows for rapid and easy capturing and analysis of images. Among the many useful features of the TiVi104 Stubble Analyzer software the following are of particular interest:

- *Automatic capturing of photos.*
- *Lateral resolution approximately 5 micro-meters per pixel.*
- *Parallel analysis of two photos (before –after or left-right side analysis).*
- *Quantifies skin irritation by recording local erythema maps.*
- *Automatically identifies small objects (by colour), by pointing on a representative stubble element using the mouse.*
- *Removal of small elements (noise) is possible.*
- *Generates statistical measures of stubble element data such as area, length and thickness.*
- *All data can be exported to ASCII-format spread sheets.*
- *Integrated Report Generator facilitates print out of main results.*

We are convinced that the TiVi104 Stubble Analyzer will be a productive tool in the validation process in development of razors, electric shavers and skin care products in general.

Thank you for choosing the WheelsBridge TiVi104 Stubble Analyzer.

WheelsBridge AB

TiVi104 Stubble Analyzer

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

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1. INTRODUCTION

In the development of skin care products including razors and electric shavers, product testing needs to be done with respect to effectiveness and safety. This testing procedure is best done in human skin using user-independent and non-invasive techniques. The *TiVi104 Stubble Analyzer* makes it possible to automatically record stubble element characteristics such as area, length and thickness and to quantify local skin irritation by use of erythema maps. High resolution photos are captured by use of a TiVi-camera equipped with the TiVi microscope adapter including zoom-in magnifying lenses, a ring of light emitting diodes for illumination of the skin surface and polarization filters operating in cross- or co-polarization mode. Two photos (representing before and after photos or active and control side photos) can simultaneously be analyzed in the *TiVi104 Stubble Analyzer* toolbox. The analysis delivers statistical measures of small object (stubble elements) area, length and thickness as well as erythema maps of the actual skin sites revealing possible skin irritation. All results can be exported to an *Excel* spread-sheet for further analysis or be directly transferred to a printable *Report*.

The intended use of the *TiVi104 Stubble Analyzer* is to analyse stubble and other small elements of different shapes and colour in experimental and research applications as well as potential skin irritation caused by different procedures and skin care products. It is not yet approved for the diagnosis and treatment of disease.

2. OPERATING PRINCIPLE

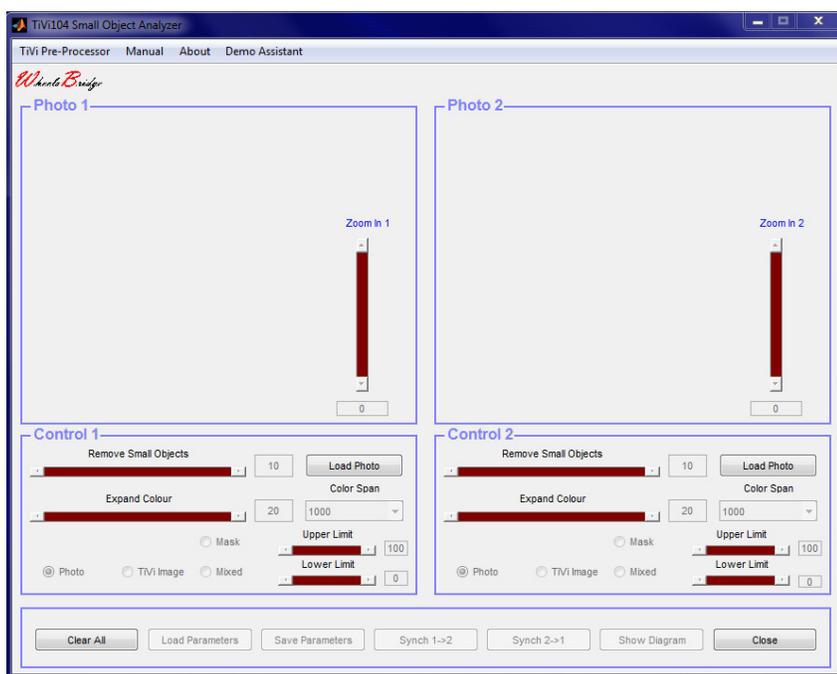
After uploading one or two photos to the *TiVi104 Stubble Analyzer* toolbox the user can zoom in on a skin area of interest. By clicking on a stubble element with the mouse pointer, the Principal Colour of the stubble element is automatically recorded and all objects of the same colour or adjacent colours are displayed. The colour space (comprised of various colours adjacent to the Principal Colour) can be expanded or diminished, and objects too small to be of interest can be removed from the object map created. The different objects of this map represent the different stubble elements and their areas, lengths, thicknesses and perimeters are automatically determined by the toolbox software. Using the object map to block out areas in the *TiVi-image*, a map of the red blood cell concentration of the skin surrounding the stubble elements can be generated and displayed demonstrating possible skin irritation. The parameter setting of one photo/image (Principal Colour of objects of interest, colour space and threshold size for removal of small objects) can be applied to the other photo/image displayed, thereby making possible the comparison of stubble characteristics and skin irritation under identical conditions in the two photos /images.

After transferring the basic data to the *TiVi 104 Chart* window, statistical distributions for stubble area, length, thickness as well as for the red blood cell concentration can be displayed from which average values of these parameters are calculated. Eventually the derived parameters can be exported to an *Excel* document or printed out from a *Report* generated in the *TiVi104 Stubble Analyzer* toolbox.

3. GETTING STARTED

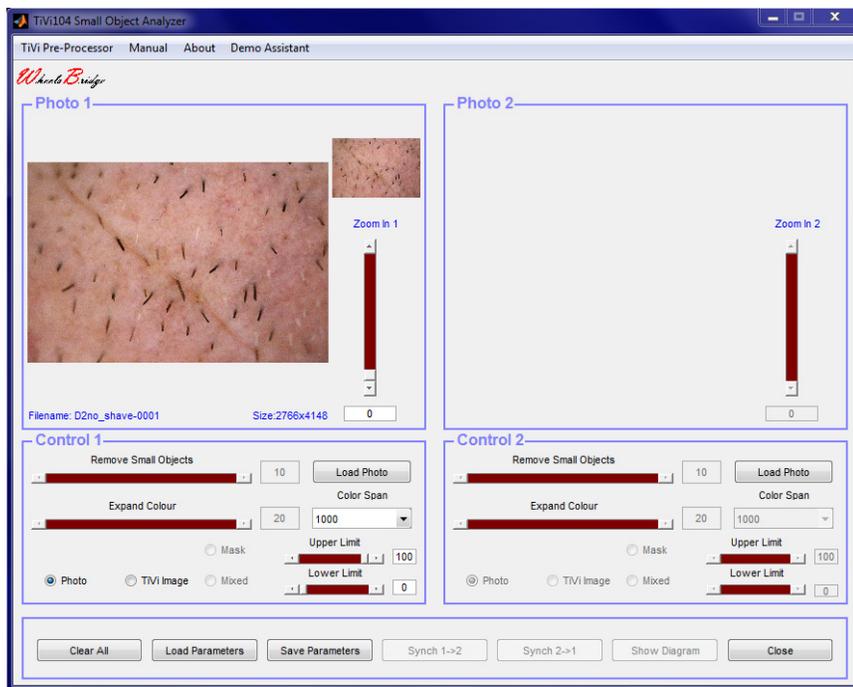
The basic features of the *TiVi104 Stubble Analyzer* are probably best explained by way of an example. In the following example it is assumed that the photos *D2no_shave-0001.jpg* and *D2after_shave-0001.jpg* have been captured by a TiVi camera system and stored in the *TiVi104 demonstration* folder. These photos display a recently shaved cheek and a cheek not shaved for 48 hours.

1. Open the *TiVi104 Stubble Analyzer* toolbox from the **Toolbox** pull-down menu in the *TiVi700 Analyzer* window.



2. Click the **Load Photo** button in the **Control 1** panel and navigate to the *TiVi104 demonstration* folder and select the *D2no_shave-0001.jpg*.

TiVi104 Stubble Analyzer

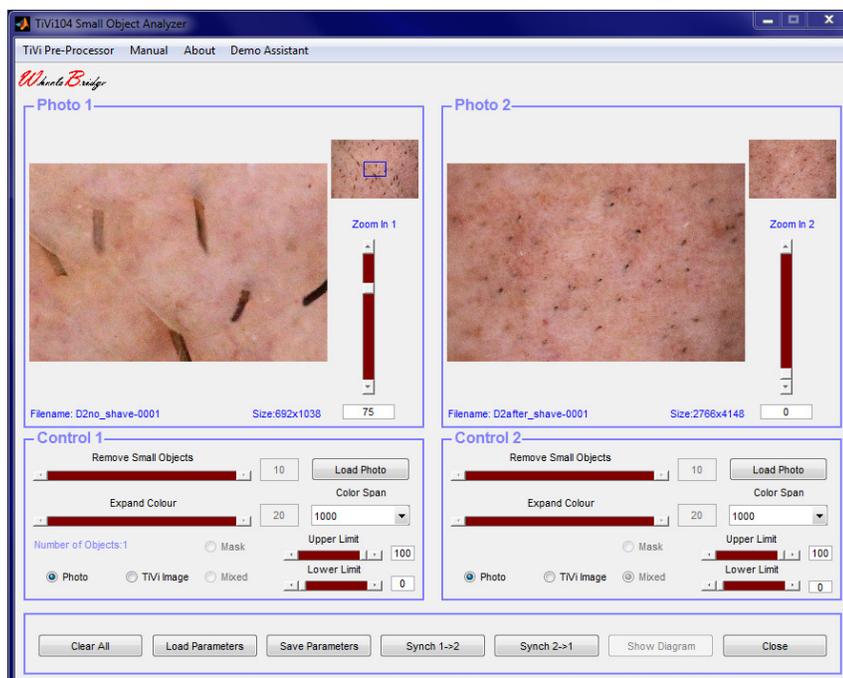


3. Click the **Load Photo** button in the **Control 2** panel and navigate to the *TiVi104* demonstration folder and select the *D2after_shave-0001.jpg*.



4. Move the **Zoom In 1** slider upwards until the associated edit box reads 75.

TiVi104 Stubble Analyzer



5. Place the mouse pointer inside photo 1, press the left mouse button and drag the mouse to a new position to move the zoomed -in **photo1** until some representative stubble elements are displayed. The position of the zoomed in area in **photo1** is indicated by the blue frame in the small version of the entire **photo1** in the upper right corner of the **Photo1** panel.

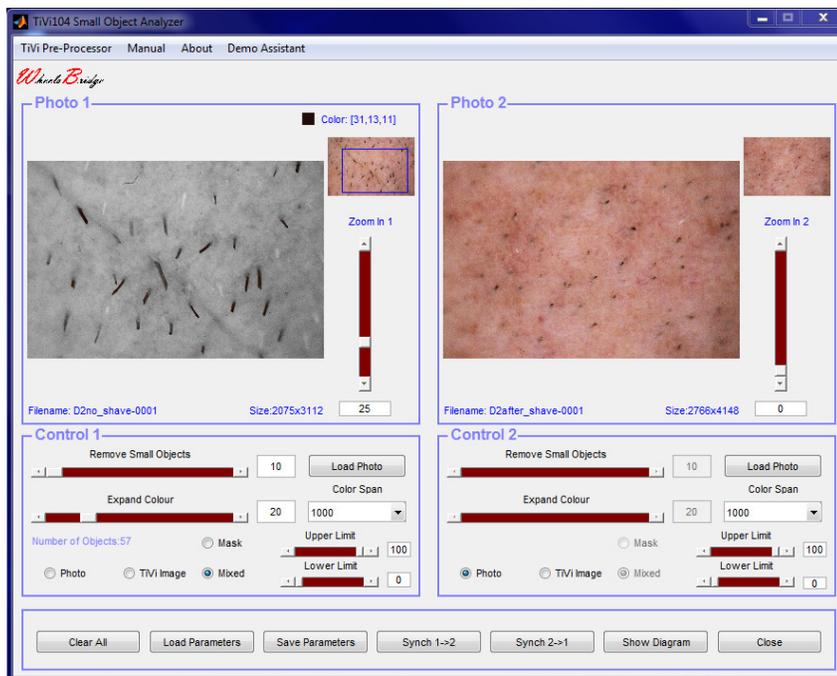


6. Use the mouse to click in the centre of the darkest stubble element to record its Principal Colour.

TiVi104 Stubble Analyzer

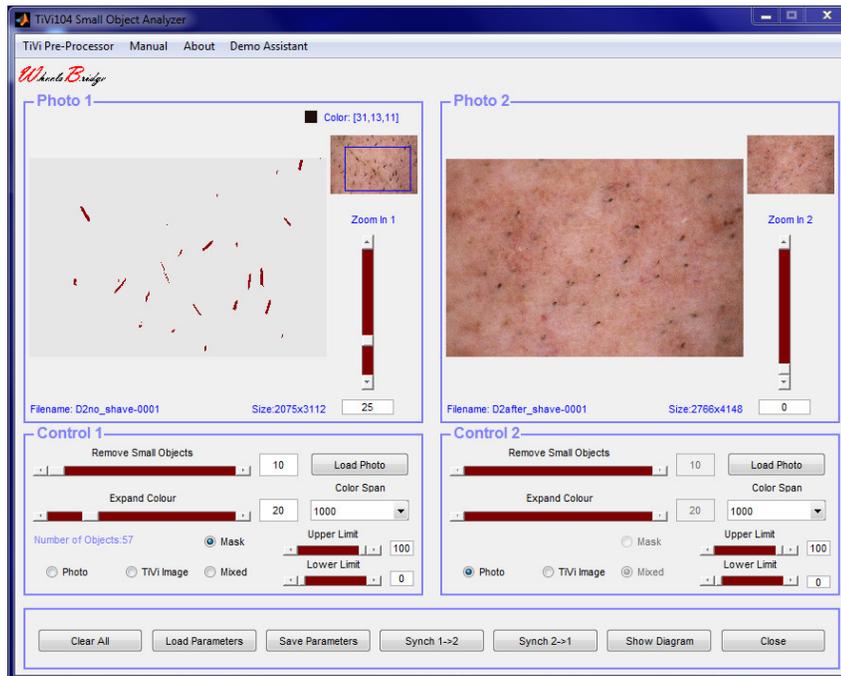


7. Stubble elements with colours within the selected colour space are now displayed in colour superimposed on a grayscale version of the photo. Print “25” in the **Zoom In 1** edit box to zoom out the actual photo displayed in the **Photo1** panel.

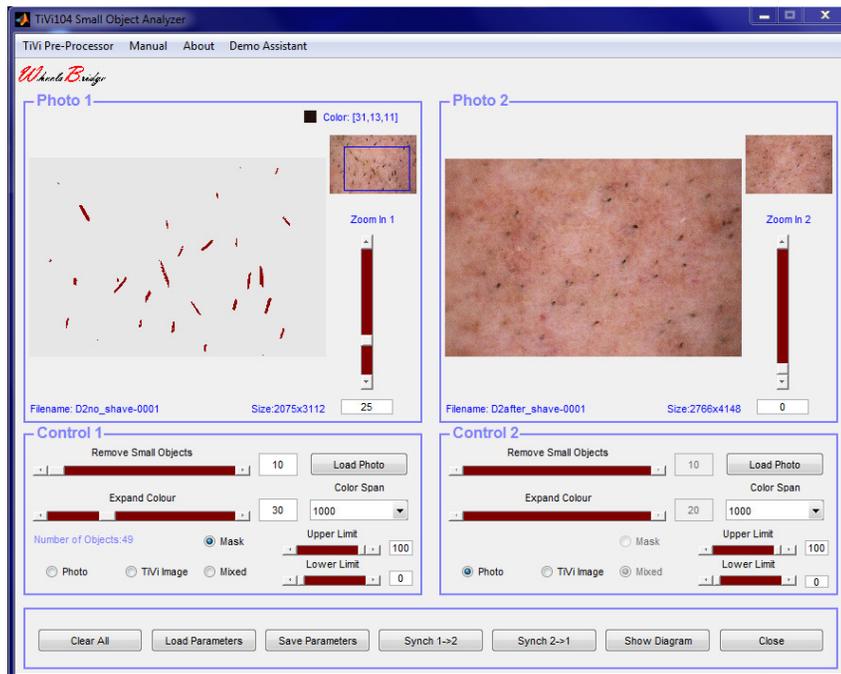


8. Click the **Mask** radio-button in the **Control 1** panel to display the mask generated.

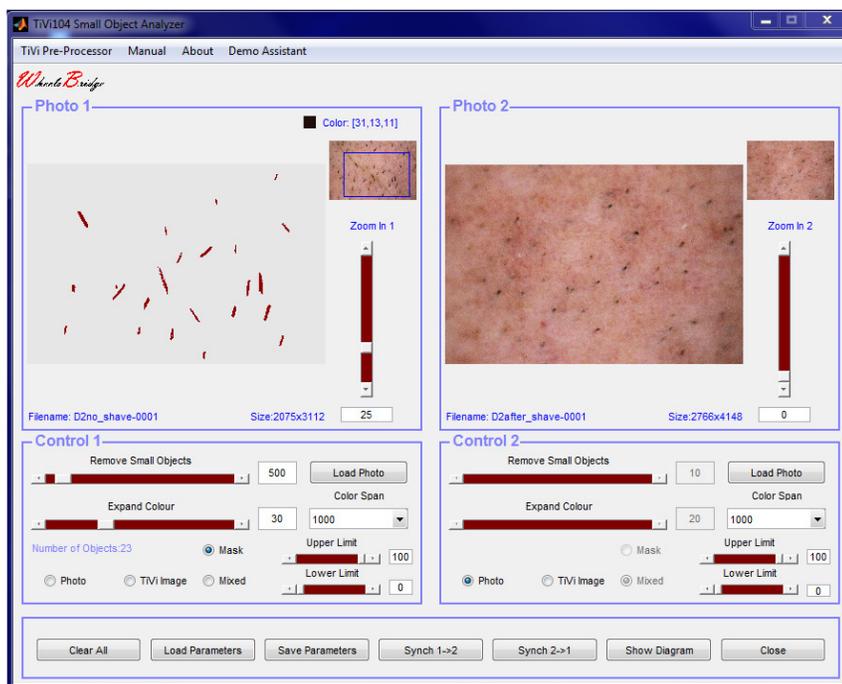
TiVi104 Stubble Analyzer



9. The **Mask** is now displayed in the **Photo 1** panel photo container. Obviously, some of the objects are not entirely filled out because the colour space (number of adjacent colours around the principal colour) is too small. Expand the colour space by moving the **Expand Colour** slider until the associated edit box reads 30 (or just insert “30” in the edit box).

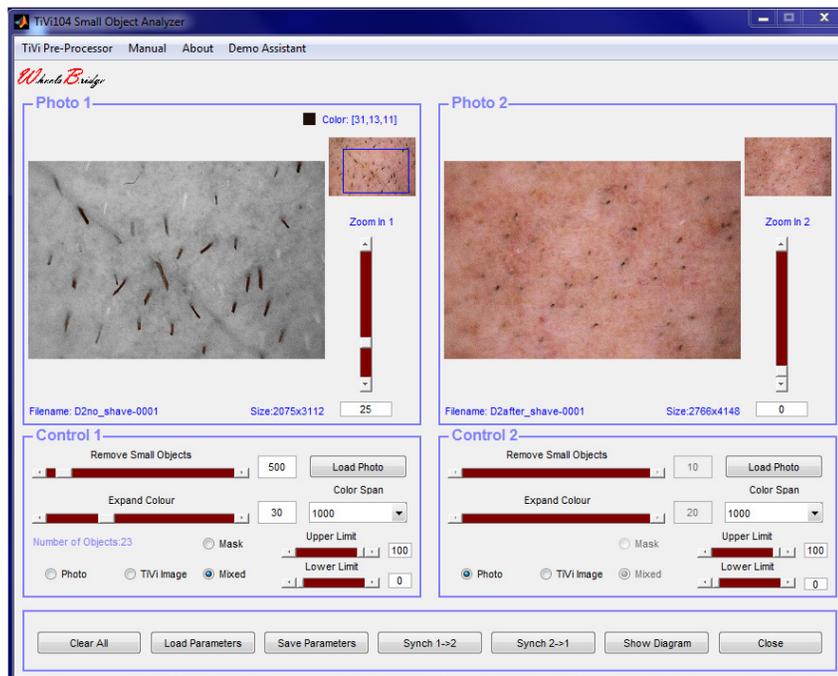


10. Remove objects too small to be stubble elements by dragging the **Remove Small Objects** slider until the associated edit box reads 500.

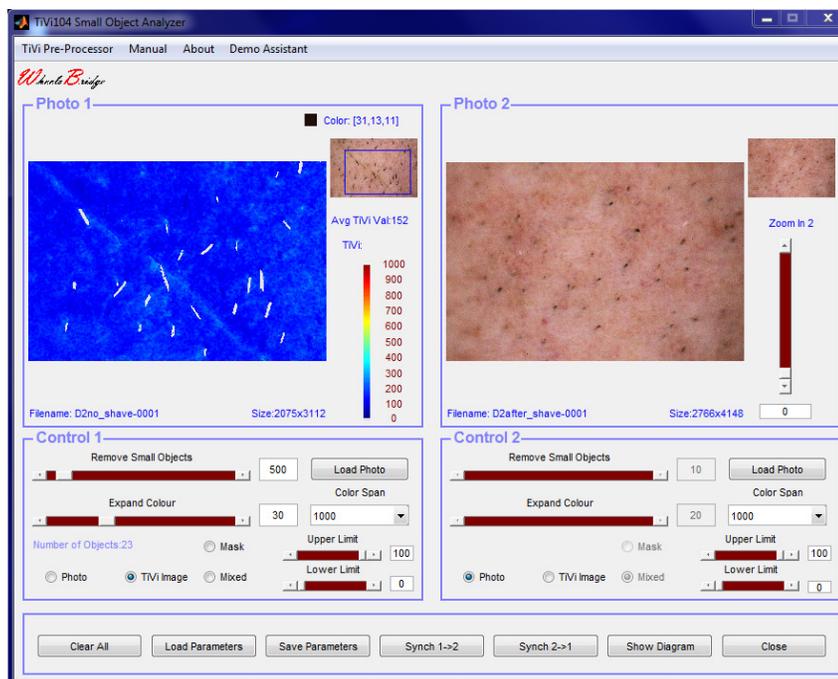


11. Setting the sliders **Remove Small Objects** and **Expand Colour** (or printing numbers in the associated edit boxes) is an iterative process and different values may be tested until the object mask is distinct and the small non-stubble objects deleted. Further, picking the most representative Principal Colour by pointing with the mouse at a representative point in a stubble element may also be subject to iterative selections.
12. Click the **Mixed** radio-button to display the selected objects against a gray-scale representation of the photo.

TiVi104 Stubble Analyzer

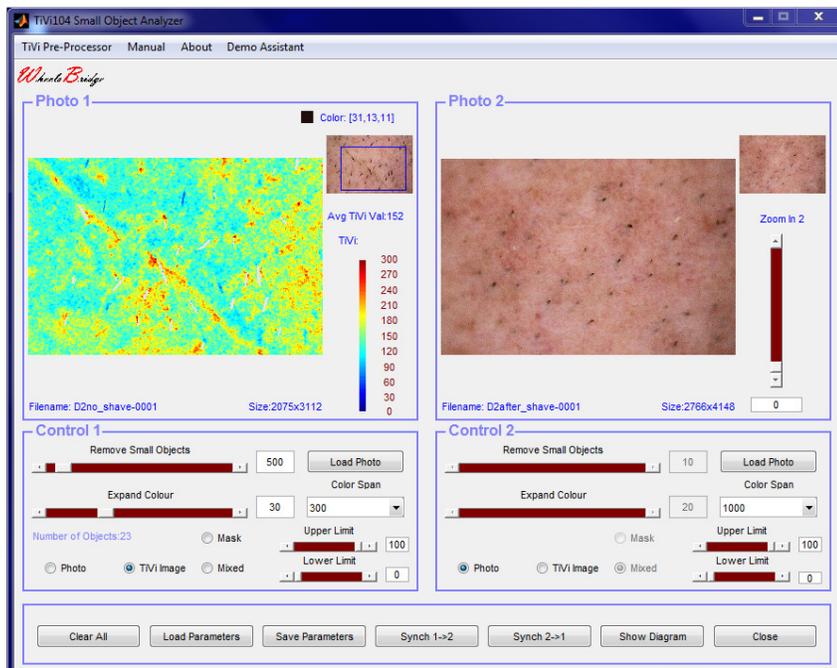


13. Click the **TiVi-Image** radio-button to display the erythema map of the actual skin region.

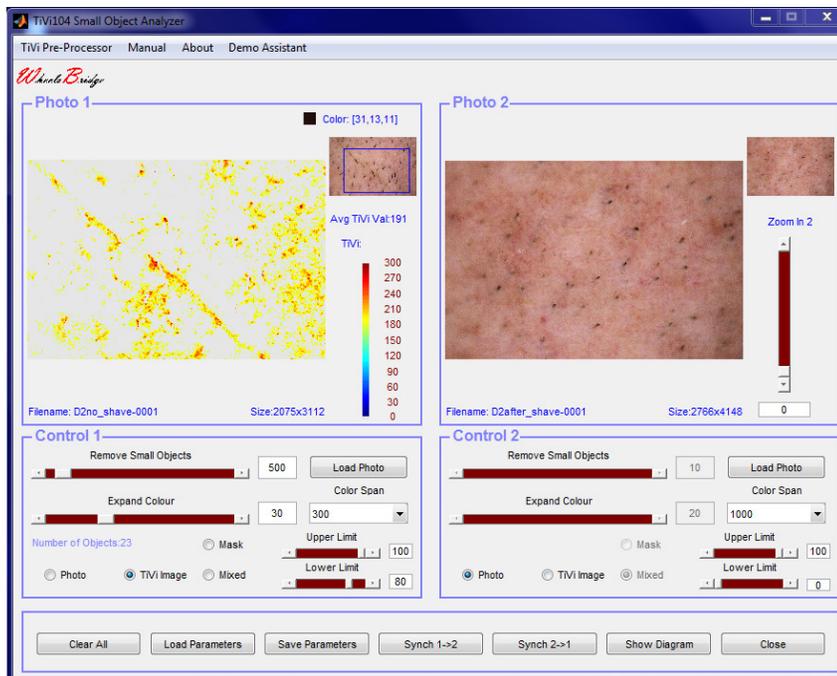


14. Set the **Color Span** pull-down menu to 300 to attain a better colour representation of the erythema map. Note that the objects defined by the mask are blocked in The **TiVi Image**.

TiVi104 Stubble Analyzer

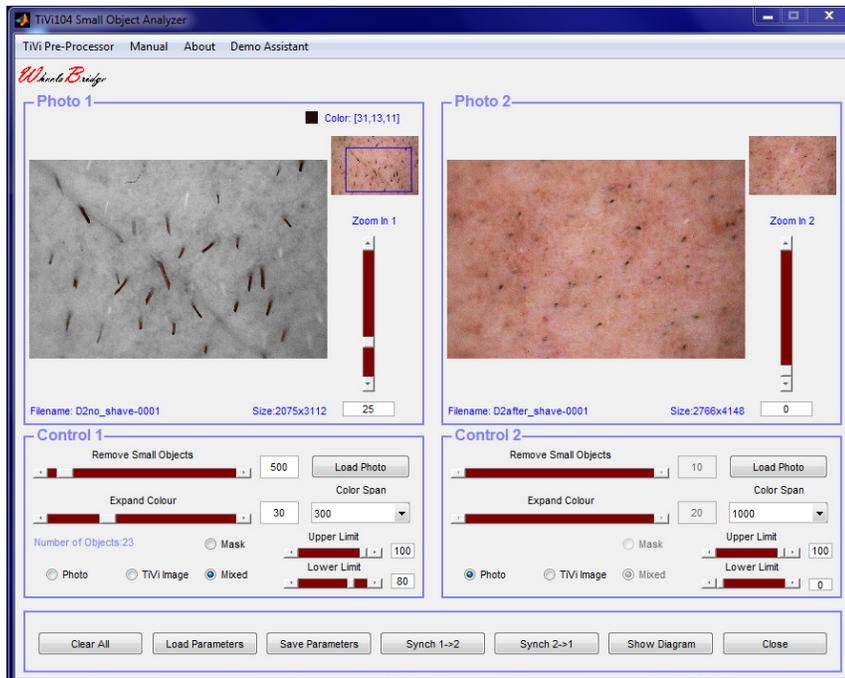


15. Move the **Lower Limit** slider in the **Photo 1** panel until the associated edit box reads “80” (or insert “80” directly in the edit box) to display only the 20% highest TiVi-values representing areas of possible skin irritation.

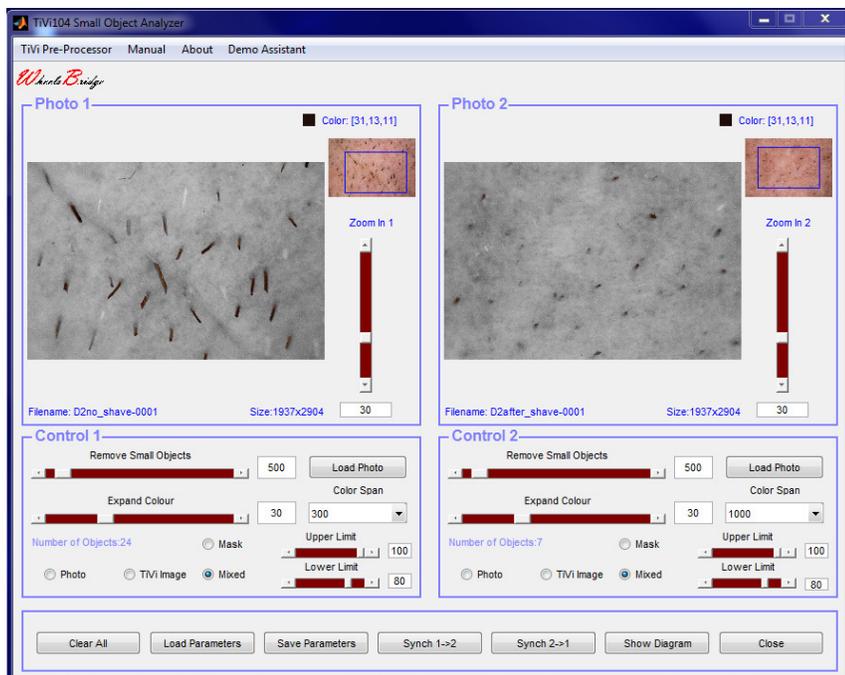


16. Click the **Mixed** radio-button in the **Control 1** panel to display the mixed photo once more.

TiVi104 Stubble Analyzer

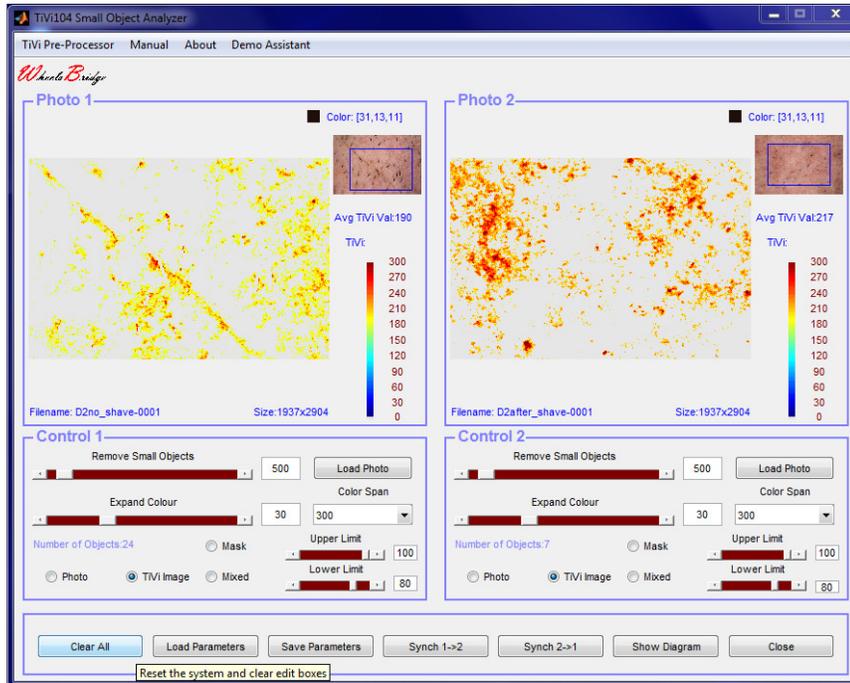


17. In order to compare the stubble elements characteristics in the two photos, click the **Synch 2→1** button. The **Remove Small Objects** and the **Expand Colour** slider in the **Control 2** panel are now both set to equal the corresponding values in **Control 1** panel, while at the same time the Principal Colour values are made equal. The **Zoom In 1** and **Zoom In 2** sliders can now be moved to expand or reduce the size of the skin areas investigated. Set both sliders to display 30 in the associated toolboxes. The number of objects in each zoomed-in photo is now 24 and 7 respectively as indicated by the **Number of Objects** text line.



TiVi104 Stubble Analyzer

18. Click the **TiVi Image** radio-buttons and set the **Color Spans** to 300 to make a comparison of the 20% highest TiVi-values (erythema level) in the two images. Note that the erythema level is considerably higher in the photo captured immediately after shave as compared to the no-shave image.



19. Click the **Show Diagram** button to open the *TiVi104 Diagram* window showing the statistical distributions for stubble area, length, width and perimeter as well as the distribution for the *TiVi-values*.



TiVi104 Stubble Analyzer

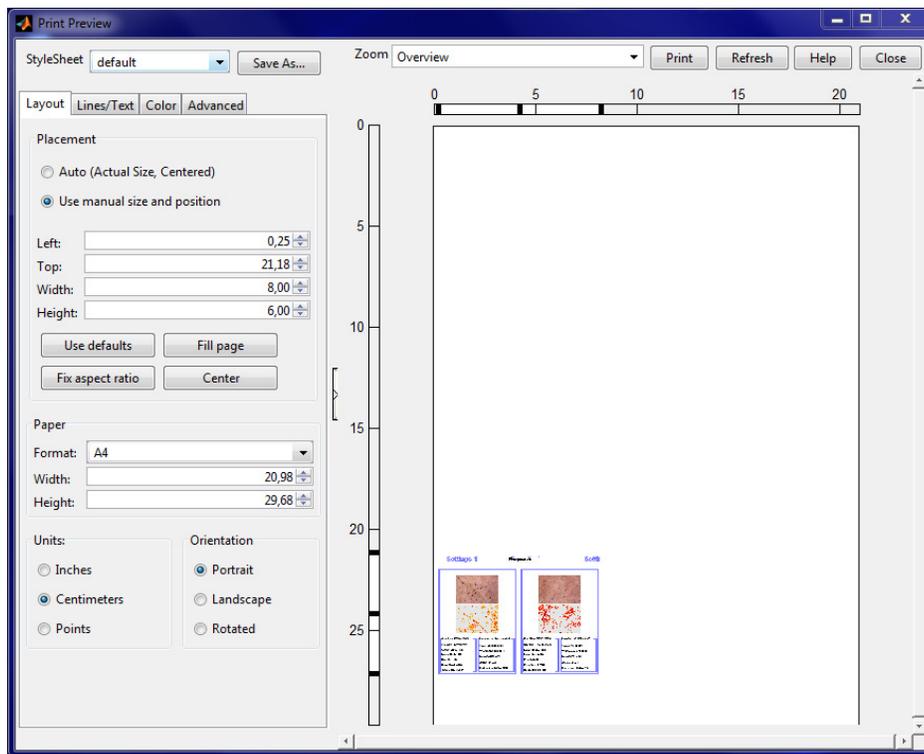
- In the **Control 1** and **Control 2** panels the average values of the parameters with standard deviations are displayed. Note for instance that the average length of the stubble elements are 137 (pixels) in the D2no_shave-0001 photo as compared to 62 in the D2after_shave-0001 photo, while the average TiVi-values are 190 and 217 TiVi units respectively.
- In the **Histogram 2** panel select *TiVi-values* in the **Histogram Type** pull-down menu and set the number of bins to 100. The lower limit threshold setting of 80 implies that no values below 200 *TiVi-units* are displayed.



- Click the **Report** button to generate a printable *Report*.

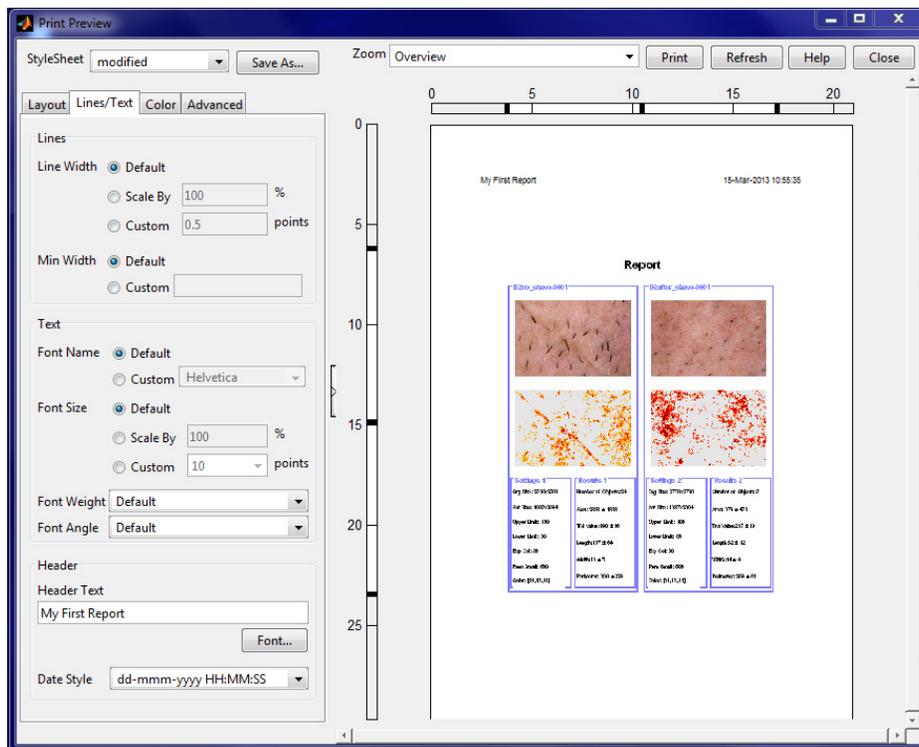


23. Click **Print** to open the **Print preview Page**.



24. Click the **Auto** radio-button to place the content in the centre of the page. Click the **Line/Text** page and insert “My First Report” in the **Header Text** edit box then select dd-mmm-yyy HH:MM:SS from the **Date Style** pull-down menu. Finally click the **Print** button to print out the report.

TiVi104 Stubble Analyzer



25. This completes the **GETTING STARTED** section.

4. DETAILED DESCRIPTION

The TiVi104 Stubble Analyzer main window

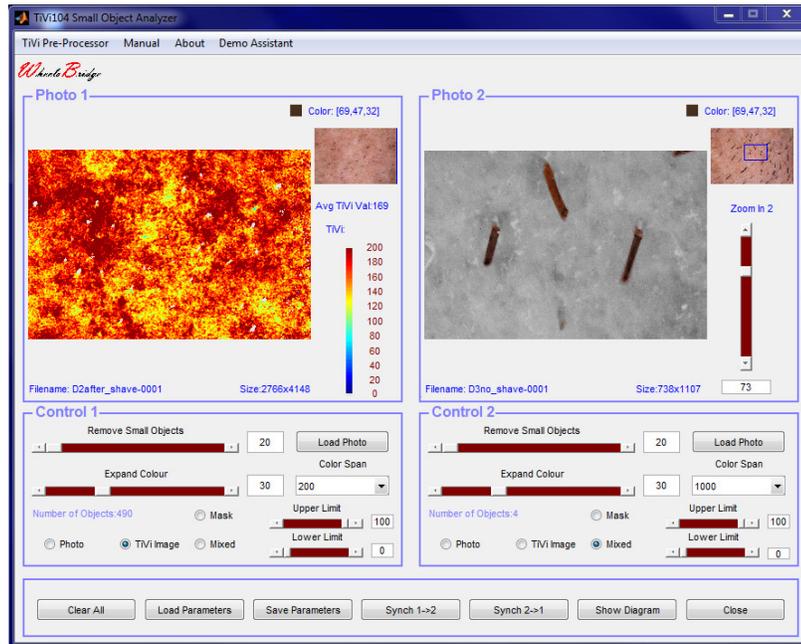


Photo Panels

1. The display area hosts the photo, mixed photo, mask or TiVi-Image depending on the setting of the radio-buttons.
2. The Principal Colour is displayed in the upper right corner of the **Photo** panel.
3. Clicking at a point in the photo, absorbs and accepts the colour at this point as the Principle colour. Colours adjacent to the Principle colour form the colour space on which the mask is built.
4. Moving the mouse pointer – with the mouse button pressed – while pointing somewhere in the photo, moves the zoomed-in photo over the original photo surface. The position of the zoomed-in photo in the original photo is indicated by the blue frame in the original photo displayed in the upper right corner of the **Photo** panel.
5. When the **TiVi-image** radion-button is checked, the **TiVi Colour Scale** is displayed in the photo panel. The average *TiVi-value* of the zoomed-in photo is displayed just below the original photo, while the local *TiVi-value* at the point at which the mouse pointer is pointing to is displayed just above the **TiVi Colour Scale**.

6. When any of the **Photo**, **Mixed** or **Mask** radio-button is checked, the **Zoom In** slider and its associated toolbox are displayed.
7. **Zoom In** slider – to zoom in or zoom out the actual photo.
8. **Zoom In** edit box -- to zoom in or zoom out the actual photo.
9. The filename of the photo is displayed in the **Photo** panel lower left corner.
10. The size of the zoomed-in photo is displayed to the right of the filename.

Control Panels

1. **Remove Small Objects** slider and edit box – to remove small objects from the actual mask.
2. **Expand Colour** slider and edit box – to expand or diminish the colour space around the Principal Colour.
3. **Load Photo** button – to reset the system and load a new photo.
4. **Colour Span** menu - to set the colour span for the *TiVi-image*.
5. **Number of Objects** text-string displays the number of objects in the zoomed-in photo.
6. **Photo** radio-button - to display the zoomed-in photo.
7. **TiVi Image** radio-button - to display the zoomed-in *TiVi image*.
8. **Mask** radio-button – to display the mask.
9. **Mixed** radio-button – to display the mixed photo.
10. **Upper Limit** slider and edit box – to set and display the upper limit threshold for *TiVi-image* displayed.
11. **Lower Limit** slider and edit box – to set and display the lower limit threshold limit for the *TiVi-image* displayed.

Lower Panel

1. **Clear All** button - to clear all displays and edit boxes and reset the system.
2. **Load Parameters** – to load system parameters saved to file.

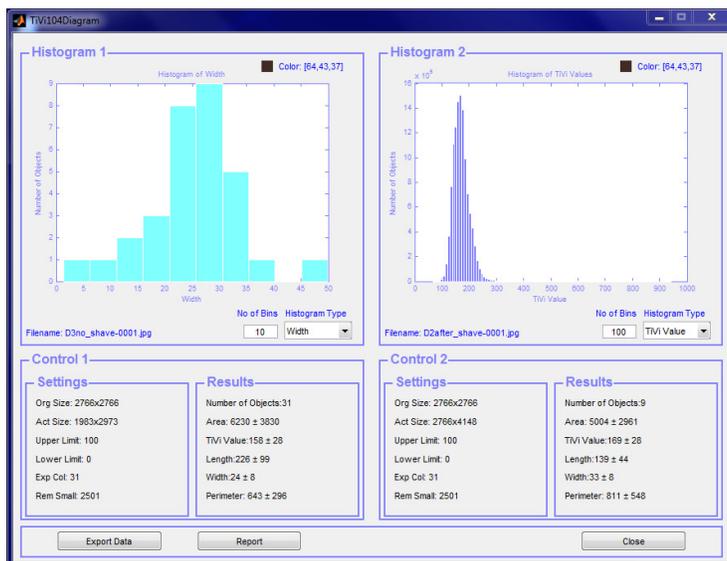
TiVi104 Stubble Analyzer

3. **Save Parameters** – to save system parameters to file.
4. **Synch 1→2** – to set the system parameters of **Photo 1** identical to those of **Photo 2**.
5. **Synch 2→1** – to set the system parameters of **Photo 2** identical to those of **Photo 1**.
6. **Show Diagram** – to open the *TiVi104 Diagram* window.
7. **Close** – to close the *TiVi 104 Stubble Analyzer* window.

Menus

1. **TiVi Pre-Processor** pull-down menu – to open the *TiVi Pre-Processor* window.
2. **Manual** pull-down menu – to display the on-line *TiVi104 Stubble Analyzer* manual.
3. **About** pull-down menu – about *TiVi104 Stubble Analyzer*.
4. **Demo Assistant** pull-down menu – interactive demo assistant for the *TiVi104 Stubble Analyzer*.

The TiVi104 Diagram window



Histogram Panels

1. The display area shows a histogram of object area, width, length, perimeter or *TiVi-value* depending on the selection made in the **Histogram Type** menu.
2. The Principal Colour is displayed in the upper right corner of the **Histogram** panel.
3. The filename is displayed in the lower left corner of the **Histogram** panel.
4. **Histogram Type** menu – to select the type of histogram to be displayed.
5. **No of Bins** edit box – to set the number of bins in the histogram displayed.

Control Panels

Settings Panels

Displays parameter settings including size of original photo, size of actual (zoomed-in) photo, Upper limit value, Lower limit value, Expand Colour value and Remove Small Objects value.

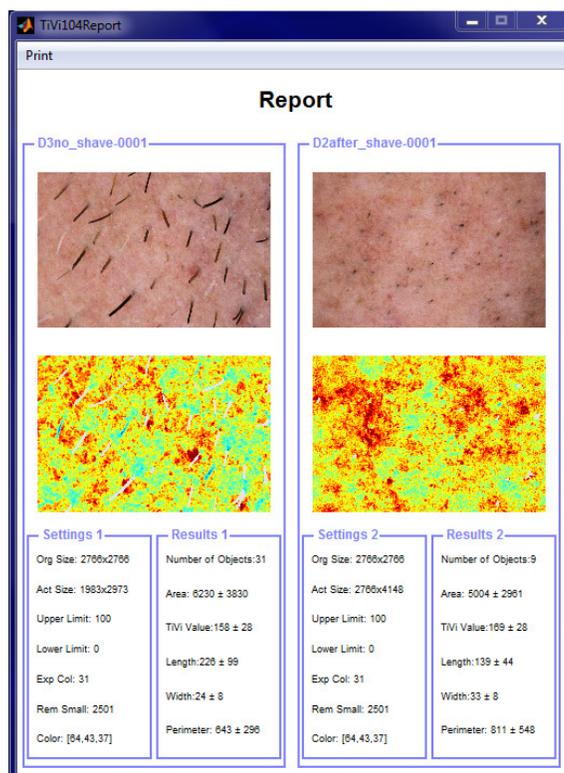
Results Panels

Displays average values with standard deviations of number of objects, object area, *TiVi*-value, object length, object width and object perimeter.

Lower Panel

1. **Export Data** button – to export results to an Excel spread-sheet.
2. **Report** button - to open a printable *Report*.
3. **Close** button - to close the *TiVi104 Diagram* window.

The TiVi104 Report window



Settings Panels

Displays parameter settings including size of original photo, size of actual (zoomed-in) photo, Upper limit value, Lower limit value, Expand Colour value and Remove Small Objects value.

Results Panels

Displays average values with standard deviations of number of objects, object area, TiVi-value, object length, object width and object perimeter.

Print

Opens the **Print Preview** window in which the text can be centred on the page (**Auto** radio- button), **Headings** and **Date** added (**Line/Text** page) and the *Report* printed out (**Print**).