



Nevus Analyzer TiVi102 User Manual

User Manual 1.2 Version 1.2 February 2019

PIONEERS IN TISSUE VIABILITY IMAGING

Dear Valued Customer!

Welcome to the WheelsBridge TiVi102 Nevus Analyzer toolbox intended for automatic analysis of naevi, moles and skin spots of different colours. The TiVi102 Nevus Analyzer was designed for observer-independent analysis of skin spots in association with evaluation of skin care products and for medical research applications.

The WheelsBridge TiVi 102 Nevus Analyzer utilizes a highly sensitive digital camera equipped 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 TiVi 102 Nevus Analyzer software the following are of particular interest:

- Automatic capturing of photos.
- Automatic tracking of skin objects by colour or intensity discrimination.
- *Removal of large and small objects from the nevus lesions map.*
- Individual display of objects (nevus lesions) by a scanning through procedure.
- Individual determination of object area, border, colour and diameter.
- Comparison of two naevi maps lesion by lesion.
- Small objects removal from plot possible.
- Automatic identification of spots with growing areas.
- All data can be exported to ASCII-format spread sheets.

We are convinced that the TiVi102 Nevus Analyzer will be a productive tool in the assessment and follow-up of human skin treatment with skin care products and in medical research.

Thank you for choosing the WheelsBridge TiVi102 nevus Analyzer.

WheelsBridge AB

Information in this document is subject to change without notice and does not represent a commitment on the part of WheelsBridge AB. No part of this manual may be reproduced or transmitted in any form or by any means, electronically or mechanically, including photocopying and recording, for any purpose without the written permission of WheelsBridge AB.

Any use of application of WheelsBridge products must be performed by properly trained and qualified personnel. WheelsBridge AB takes no responsibility for action taken on the basis of information derived from the use of the product described in this manual or from consequential damages in connection with furnishing, performance or use of this manual.

Licensee's limited rights are governed by the license agreement between WheelsBridge AB and MathWorks. Licensee may not modify or remove any license agreement file (MarthWorks or third party) that is included with the MCR Libraries ("MCR Library License"). Licensee of this Application accepts the terms of the MCR Library License.

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

WheelsBridge is a registered trade mark.

1. INTRODUCTION

Nevus (moles, birthmarks, brown spots) is the medical term for well-defined and benign lesions of the skin. Skin cancer – especially malignant melanoma – however may arise from pre-existing nevus lesions. It is therefore of interest to closely follow the development of nevus spots with respect to changes in colour, area, border and diameter over time and pay special attention to protecting sensitive skin from UV radiation and other skin damaging factors.

The *TiVi102 Nevus Analyzer* makes it possible to automatically track important nevus parameters such as area, border, colour and diameter and quantify how these parameters vary over time and over the skin surface. It is further possible to compare the change of individual naevi areas in two different photos and automatically detect spots with enlarged areas.

The intended use of the *TiVi102 Nevus Analyzer* is to analyse skin spots of different shapes and colour in experimental and research applications. It is not yet approved for the diagnosis and treatment of disease.

2. OPERATING PRINCIPLE

The basic operating principle of the *TiVi102 Nevus Analyzer* is probably best explained by a flow chart (Fig 1). After having captured a high-resolution photo (typically 18 Mpixels) of the central part of the skin of the back, this photo is uploaded to the *TiVi102 Nevus Analyzer*.



Fig 1. Basic operating principle Flow Chart.

- 1. Upload the photo to the *TiVi102 Nevus Analyzer*.
- 2. Zoom in and move the zoomed-in window over the photo until a representative nevus becomes visible.
- 3. Click on the nevus in the photo to display its colours against gray-scale background (the colour space around the centre colour can be selected by the user). Alternatively, the intensity of the nevus can be used for colour space discrimination.
- 4. Zoom out until the target size of the sub-photo is attained. All nevus lesions within the selected colour space become visible.

- 5. The individual nevus lesions are converted to individual objects. Their location can be displayed as a black and white map.
- 6. Too small and too large objects can be eliminated (the user sets the size elimination threshold).
- 7. The remaining individual objects (nevus lesions) can be displayed one-by-one. Their area, border, colour and diameter are calculated and displayed.
- 8. All calculated data can be exported to an Excel® spreadsheet.

3. PHOTO CAPTURING

When capturing photos for the *TiVi102 Nevus Analyzer*, use the highest camera resolution and place the camera about 1 m away from the object. This will give a field of view of about 430 mm x 290 mm and a resolution better than 0.1 mm per pixel. Set the filters to cross-polarized mode. Set the **AutoFocus** switch to AF and the **Stabilizer** to 'ON'. Use the zoom in feature to attain a field of view that captures a photo of the central part of the back (Fig. 2), in order to avoid shadows from the periphery and to get the highest resolution allowing also small skin objects to be included and analyzed.



Fig 2. Place the camera one meter away from the object and use the zoom in feature to attain a field of view that includes the central part of the skin of the back.

Open the *TiVi701Camera* window and set the **Size Reduction** to 'Minor' (under the **Size Reduction** pull-down menu), the **Select Photo Size** to 'Large Fine' and the **No of Photos** to '1' in accordance with Fig 3.

🚺 TiVi700 Came	ra No Camera connect	ed						_ 🗆 X
Size Reduction	Cameras Supported	Register	Language	Manuals	About	Demo Assistant		
Wheels Bridge	Size							
	Registration				Size	Reduction: Minor		
Photo—				ge——			DefaultCam701	Load Settings
								Save Settings
							Nevus	Save Photos
								Load Ref Photo
							Select Photo Size	Comments
							Large Fine 💌	Pause
							1 No of Photos	5 Delay(sec)
							Please switch off ambie use blue or green colou	ent light and Ir background.
- Controls-								
Test Photo	Life View	Capture	Photos	Abort		Reset	Analyzer Monitor ON	Close

Fig. 3. Setting Camera parameters in the *TiVi701Camera* window.

Power the **Illuminator** and switch off the ambient light in the room. Capture a photo and store it in the selected folder under the selected name in the computer.

3. GETTING STARTED

The basic features of the *TiVi102 Nevus Analyzer* are probably best explained by way of an example. In the following example it is assumed that the photo *nevus-0001.jpg* has been captured by a TiVi camera system and stored in the *TiVi102 demonstration* folder. This photo displays the central part of a back with many nevus lesions of different sizes and colours.

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

🛃 TiVi102 Nevus Analyzer		
TiVi Pre-Processor Manual About		×
Whende Breiger Photo- Point in photo to select colour of interest Zoom in I	Photo Size: Date: Time:	Colour Mode Centre
Select Photos	Show Actual Photo Show Ref Photo Load Photo Load Ref Photo Display Color Space	Select Colour Red 0.5 Green 0.2 Blue 0.1 Select Standard Colour By Mouse Pointer Int. Mode Expand Color 0.1
Clear All v0- 1547 v1- 2477	Reset	Load Settings Save Settings Close

2. Click the **Load Photo** button and navigate to the *TiVi102 demonstration* folder and select the *nevus-0001.jpg*.

V TiVi102 Nevus Analyzer			X
TiVi Pre-Processor Manual About			يد الا
Wheats Bridge			
Photo- Use Zoom in slider to create a region of interest (ROI) Zoom In	Photo Size:	Colour Mode	entre High _OW
	Date: 07-jul-2012 Time: 10:44:09		iize: 1766 1148
Select Photos		Select Colour	
Display O Photo Mixed Mask	Show Actual Photo	Green (0.	5
Actual Photo NC-0002.jpg	Load Photo	Blue 0.	1
Reference Photo	.oad Ref Photo	Select Standard Colour By Mouse Pointer Int. Mode	
Display Objects Coordinates Dis	play Color Space	Expand Color 0:	1
Clear All V0- v1-	Reset	Load Settings Save Settings Close	

3. Move the **Zoom In** slider upwards to about 90% of its maximum value. The part of the photo displayed in the **Photo** panel is outlined in the **Image** panel photo.

TiVi102 Nevus Analyzer	
TiVi Pre-Processor Manual About	د
Whenle Bridge	
Photo-	Image
Point and move mouse with the muose button pressed to move ROI 435.652	Colour Mode Centre
Zoom In	High
-	Low
and the second	
and the second second	Size:
1 Martin Bring Martin	2766
Date:	4148
07-jul-2012 Time:	and the second sec
10:44:09	
and the second	
and the second	the state of the s
C Select Photos	Select Colour
Display O Show Actual Photo Show Actual Photo	× 0.5
Show Ref Photo	Green 0.2
Actual Photo NC-0002.jpg Load Photo	Blue
Reference Photo	Select Standard Colour
Load Ref Photo	By Mouse Pointer
	Expand Color
Display Objects Display Color Space	. 0.1
Clear All v0= 1166 v1= 1600 Depat	Load Sattings Save Sattings Class
Reset	Load Solunga Sare Sellings Close

4. Place the mouse pointer on the photo displayed in the **Photo** panel. Press the left mouse button and drag the mouse over the photo. Release the mouse button. Repeat the procedure until a representative nevus lesion appears in the zoomed-in photo.

TiVi102 Nevus Analyzer			×
TiVi Pre-Processor Manual About			Ľ
Whento Bridge			
Photo- Point in photo to select colour of interest Zoom in	Photo Size: 435 652 Date: 07-Jul-2012 Time: 10:44:09	Colour Mode	Centre High Low Size: 2766 4148
Select Photos		- Select Colour-	
Display-	a stual Divisio	Red	0.5
Photo Mixed Mask Show	Ref Photo	Green	0.2
Actual Photo	Dhoto	Blue	
Defense Photo	Photo		0.1
Load R	ef Photo	By Mouse Pointer	•
Display Objects Coordinates x0- 1528 x1- 2177 Display C	olor Space	Expand Color	0.1
Clear All v0- 2004 v1- 2438 Re	eset	Load Settings Save Settings Close	

5. Click on the nevus lesion in the zoomed-in photo without moving the mouse. The selected nevus lesion will now be displayed against the surrounding skin displayed in gray colour scale.



6. Move the **Zoom In** slider downwards to zoom out the photo to a size suitable for further analysis. The zoomed-out window can be moved over the original photo by placing the mouse pointer on the photo, pressing the left mouse button and dragging the mouse pointer to a new position. The site of the zoomed-out window is outlined in the original photo displayed in the **Image** panel.

VIII TiVi102 Nevus Analyzer			u x
TiVi Pre-Processor Manual About			r
W.hento Bridge			
Photo Point in photo to select colour of interest Zoom in	Photo Size: 1303 1954 Date: 07-Jul-2012 Time: 10:44:09	Colour Mode	Centre High Low Size: 2766 4148
Select Photos Display Photo Mixed Mask Actual Photo NC-0002,pg Reference Photo Load F Display Objects 10-1176 11-3129 Display Chiperts Display Chi	Actual Photo Ref Photo I Photo Ref Photo	Select Colour Green Blue Select Standard Colour By Mouse Pointer Expand Color	1.45898 1.22588 1.17992 le 0.1
Clear All v0= 505 v1= 1807 R	eset	Load Settings Save Settings Close	e

7. Click the **Mask** radio-button to display the zoomed-out part of the photo in black and white scale.



8. Click the **Mixed** radio-button and then the **Display Objects** button to open the **Objects** window.

Objects				— — X
Objects Use remove sliders to remove too small and too large objects	Filename		Average-	
6 °	Number: Area:		Number:261 Area: 77.52	
8	Border:		Border: 20.5	9
	Colour: Diameter	-	Colour: [117 : Diameter: 4.9	57 45) 13
Control Panel Remove Small Objects	1	Display	Mixed	Mask
Remove Large Objects Size of Map: 1303 x 192	54	Small Size	Medium Size	C Large Size
Histogram Type Area Object Size: 1	54 x 132	Enumerate	nedium Distance	Export Data
Show Histogram Display Object	et Object Size	, 2	Scan Through	Close

9. This sub-photo includes 261 objects. To eliminate the smallest objects, move the **Remove Small** slider to its rightmost position. The smallest objects are now deleted and only 9 objects remain in the zoomed-in window. The average area, border, colour and diameter of these 9 objects are displayed in the **Average** panel.

Objects			_	X
┌ Objects	⊢ Data			
Click the Scan Through button to scan through the objects	Filename	: NC-0002.jpg Dbject	Average	
ø	Number:		Number:9	
o i	Area:		Area: 1492.6	6
*	Border:		Border: 255.3	8
	Colour:		Colour: [117 f	57 45]
	Diameter		Diameter: 41.	95
Control Panel		Dieplay		
Remove Small Objects 501 Number of Objects: 9		Photo	Mixed	Mask
Remove Large Objects Size of Map: 1303 x 198	54	Indicator Settings	Medium Size	🔘 Large Size
No. Bins 10 Histogram Type		Short Distance	Medium Distance	Long Distance
Area Object Size: 1	54 x 132 et Obiect Size	Enumerate	1	Export Data
Show Histogram Display Object		, 2	Scan Through	Close

10. Click the **Mixed** radio-button to display the selected nevus lesion objects against a gray scale coloured skin background.

Objects			_ <u> </u>
- Objects-	- Data Filename	: NC-0002.jpg	
	Number:	Dbject	Average
and the second	Area:		Area: 1492.66
and a state for	Border:		Border: 255.38
the and the second	Colour:		Colour: [117 57 45]
	Diameter	:	Diameter: 41.95
Control Panel			
Remove Small Objects		© Photo @) Mixed 🔘 Mask
Remove Large Objects Size of Map: 1303 x 195	i4	Indicator Settings Small Size O	Medium Size 💿 Large Size
No. Bins 10 Histogram Type		Short Distance	Medium Distance 🔘 Long Distance
Area Object Size: 11	54 x 132	Enumerate	1 Export Data
Show Histogram Display Object	et Object Size	2	Scan Through Close

11. Click the **Enumerate** button to display the object number next to the object.

Objects				×
- Objects	- Data Filename	: NC-0002.jpg		
	Actual	Object	Average	
3	Number:		Number:9	
ర్ 6 7	Area:		Area: 1492.6	6
5	Border:		Border: 255.3	18
1 2 89	Colour:		Colour: [117 5	57 45]
	Diameter		Diameter: 41.9	95
- Control Panel	L			
Demous Small Objects		Display		
Number of Objects: 9		Photo	Mixed	Mask
Remove Large Objects Size of Map: 1303 x 195	4	- Indicator Settings		
5000 Mode:Colour		🔘 Small Size 🛛 🤅	Medium Size	🔘 Large Size
No. Bins 10		🔘 Short Distance 🧕	Medium Distance	Cong Distance
Histogram Type				
Area Object Size: 15	54 x 132	No Numbers	1	Export Data
Show Histogram Display Object S	et Object Size	, 2	Scan Through	Close

12. Click the **Mixed** radio-button in the **Display** panel. Then click the **Scan Through** button to display the different objects one-by-one. The parameters for the object displayed are shown in the **Actual Object** panel.

Objects			
Objects Click the Photo, Mixed or Mask radio_button to display different views	Filename	: NC-0002.jpg Dbject	- Average
	Number: Area: 18	39	Number:9 Area: 1492.66
	Border: 2 Color: [13	240 33 71 55]	Border: 255.38 Colour: [117 57 45]
Control Danal	Diameter	: 48	Diameter: 41.95
Control Panel		Dieplay	
Remove Small Objects		O Photo O	Mixed 🔘 Mask
Remove Large Objects Size of Map: 1303 x 195	4	Indicator Settings Small Size	Medium Size 🔘 Large Size
No. Bins 10 Histogram Type		Short Distance	Medium Distance 🔘 Long Distance
Area Object Size: 15 Show Histogram Display Map	64 x 132 et Object Size	No Numbers	4 Export Data Scan Through Close

- 13. Click the **Scan Through** button repeatedly to display the different objects and the associated parameters.
- 14. Click the **Export Data** and select a name and folder to save the Excel file. Open the Excel file to display the data.

File Name	NC-0002.j	pg								
Red	Green	Blue	Expand	Mode	Rem Smal	Rem Large	Col1	Col2	Raw1	Raw2
0,45898	0,225882	0,179922	0,1	Col. Mode	501	5000	1476	3429	511	1813
Number	Avg Area	Avg Borde	Avg Colou	Avg Diame	eter					
9	1492,66	255,38	255,38	41,95						
Number	Area	Border	Diameter							
1	665	194,55	29,09							
2	1057	287,56	36,68							
3	2073	315,4	51,37							
4	1839	240,1	48,38							
5	2873	339,88	60,48							
6	2413	285,7	55,42							
7	1302	269,07	40,71							
8	685	210,24	29,53							
-	507	155.00	25.0							

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

4. COMPARISON OF NAEVI MAPS

In the following example it is explained how the areas of different naevi in two different photos can be compared and how an enlarging spot can be automatically identified.

- 1. Open the *Nevus Analyzer* toolbox from the **Toolbox** pull-down menu in the *TiVi700 Analyzer* window.
- 2. Click the **Load Photo** button, navigate to the *TiVi102demonstration* toolbox and double-click on the Act-0001 photo.



3. Click the Load Ref Photo and double-click the *Ref-0001* photo.

🛃 TVi102 Naevi Analyzer			
TiVi Pre-Processor Manual About			
Wikanta Bridge			
Photo Point and move mouse with the muose button pressed to move ROI Zoom In	Photo Size: 2213x3319	Intensity Mode Centr	e
	Date: 20-nov-2012 Time: 16:40:33	Size 2766 2766	: 33
Select Photos Display © Photo Mixed Mask Actual Photo act-0002 jpg Load Pf Reference Photo ref-0001 jpg Load Ref	tual Photo f Photo hoto Photo	Select Colour Green Blue Compare Images By Mouse Pointer Col. Mode	
Display Objects Coordinates Display Colo 30-415 x1-3733 Display Colo Clear All v0-277 v1-348 Rese	or Space	Expand Color 0.05 Load Settings Save Settings Close	

4. Place the mouse pointer on the darkest nevus click the left mouse button.

TiVi102 Naevi Analyzer			⊐ ×
TiVi Pre-Processor Manual About			
Whento Bridge			
Photo- Point and move mouse with the muose button pressed to move ROI	Photo Size:	Intensity Mode	Centre
Zoom In	2213x3319		High
	Date: 20-nov-2012 Time:		Size: 2766 4148
20	16:40:33		
C Select Photos-		Select Colour	
Display O Mixed Mask Show A	Actual Photo		0.5
Actual Photo	Ref Photo	Green	0.2
act-0002.jpg Load	Photo	Blue	0.1
Reference Photo		Select Standard Colour	
ref-0001.jpg Load R	ef Photo	Compare Images By Mouse Pointer Col. Mode	,
Display Objects Coordinates Display C	olor Space	Expand Color	0.05
Clear All v0- 277 v1- 2489 Re	set	Load Settings Save Settings Close	

5. The **Mixed photo** is now displayed.

🛃 TW1102 Naevi Analyzer			
TiVi Pre-Processor Manual About			
Wheels Bridge			
Photo Use slider to zoom out Zoom in	Photo Size: 2213x3319	Intensity Mode	Centre High Low
20	Date: 20-nov-2012 Time: 16:40:33		Size: 2766 4148
Select Photos		Select Colour	
Display O Show A O Show A	Actual Photo tef Photo	Green 0.1	3882 4196
Actual Photo act-0002.jpg Load	Photo	Blue 0.	064
Reference Photo ref-0001.jpg Load Re	ef Photo	Select Standard Colour Compare Images By Mouse Pointer Col. Mode	
Display Objects Coordinates Display Co	olor Space	Expand Color	.05
Clear All v0- 277 v1- 2489 Re	set	Load Settings Save Settings Close	

6. Click the Mask radio-button to display the black and white photo.

J TiVi102 Naevi Analyzer			- • ×
TiVi Pre-Processor Manual About			
Wheats Bridge			
Click Display Object button to open Object window Zoom In	Photo Size: 2213x3319	Intensity Mode	Centre High
	Date: 20-nov-2012 Time: 16:40:33		Low Size: 2766 4148
Select Photos Display Photo Mixed Mask Actual Photo act-0002 jpg Reference Photo ref-0001 jpg	Show Actual Photo Show Ref Photo Load Photo Load Ref Photo	Select Colour Red Green Blue Select Standard Colour Compare Images Expand Color	. 0.33882 . 0.14196 . 0.064 Col. Mode
Display Objects Continues x0-415 x1-3733 Clear Ali x0-277	Display Color Space	Load Settings Save Settings	Close

7. Drag the **Expand Color** slider somewhat to the right to expand the colour space and include more spots.

🛃 TiVi102 Naevi Analyzer		-	_ _ ×
TiVi Pre-Processor Manual About			
Wheels Bridge			
Click Display Object button to open Object window Zoom In	Photo Size: 2213x3319	Intensity Mode	Centre High
	Date: 20-nov-2012 Trme:		Low Size: 2766 4148
20	16:40:33		
Select Photos Display O Photo Actual Photo	 Show Actual Photo Show Ref Photo 	Red Green	• 0.33882 • 0.14196
act-0002.jpg	Load Photo	Blue	0.064
Reference Photo ref-0001.jpg	Load Ref Photo	Compare Images By Mouse Pointer	Col. Mode
Display Objects Coordinates	Display Color Space	Expand Color	0.097656
Clear All v0- 277 v1- 2489	Reset	Load Settings Save Settings	Close

8. Click the **Show Actual Photo** radio-button to display the black and white actual photo.

🛃 TiVi102 Naevi Analyzer			- • ×
TiVi Pre-Processor Manual About			
Wheels Bridge	1.00		
Click Display Object button to open Object window Zoom In	Photo Size: 2213x3319	age	Centre High
			Low Size: 2766
	Date: 20-nov-2012 Time: 16:40:41		4148
20			
C Select Photos	Se	lect Colour-	
Display Photo Mixed Mask	Show Actual Photo Show Ref Photo	Green	• 0.5 • 0.2
act-0002.jpg	Load Photo	Blue	0.1
Reference Photo ref-0001.jpg	Load Ref Photo	Select Standard Colour Compare Images By Mouse Pointer V	Col. Mode
Display Objects Coordinates x0- 415 x1- 3733	Display Color Space	Expand Color	, 0.05
Clear All 10- 277 11- 2459	Reset	Load Settings Save Settings	Close

9. Select Synch Actual to Ref in the Select Standard Colour pull-down menu.

TiVi102 Naevi Analyzer			- • ×
TiVi Pre-Processor Manual About			
Wheels Bridge			
Photo- Cick Display Object button to open Object window Zoom In	Photo Size: 2213x3319	Intensity Mode	Centre High
			Size: 2766 4148
	Date: 20-nov-2012 Time: 16:40:41		
20		- Select Colour-	
Display Photo Actual Photo act.c002 ino	Show Actual Photo Show Ref Photo Load Photo	Green Blue	0.33882 0.14196
Reference Photo ref-0001.jpg	Load Ref Photo	Select Standard Colour Compare Images Synch Actual to V	Col. Mode
Display Objects Coordinates 10- 415 x1- 3733 Clear All v0- 277 v1- 2459	Display Color Space Reset	Load Settings Save Settings	0.097656

10. Click the Compare Images button.

🛃 Compare 102		- • ×
Actual Photo- File Name: act-0002 jpg Number of Object	Is: 63 Reference Photo	Number of Objects: 67
Controls	Display	() Mask
Click on the Reference Spot (red square) in the Actual Photo Remove small objects or click Show Plot Click Show Plot	Remove Small Objects	. 100
	Enumerate Show Plot	Close

11. The reference spot (largest spot) is now indicated by a red square in **the Reference Photo**. Click on the corresponding spot in the **Actual** photo to synchronize the two photos.

Compare 102		
- Actual Photo		
File Name: act-0002.jpg Number of Obj	jects: 9 File Name: ref-0001.jpg	Number of Objects: 6
Controls	- Display-	
Click on the Reference Spot (red square) in the Actual Photo	O Photo O Mio	ed 💿 Mask
Remove small objects or click Show Plot	Remove Small Obje	ects
Click Show Plot	Enumerate Show	. j 100

12. Print '100' in the **Remove Small Objects** edit box to remove small objects.

		Reference Photo		
File Name: act-0002.jpg	Number of Objects: 11	File Name: ref-0001.jpg		Number of Objects: 10
, , , , ,				
ontrols				
Controls) in the Actual Photo	Display-	Mixed	le Mask
- Checkpoints - Checkpoints Click on the Reference Spot (red square) Remove small objects or click Show Plot) in the Actual Photo	Display Photo Remove Sr	Mixed nall Objects	l Mask

13. Click the Show Plot button to display the *Plot 102* window. The Diagram in the *Plot102* window displays the relationship between spot sizes in the Reference Photo and the Actual Photo. Observe that one spot has a substantially higher value in the Actual Photo than in the Reference Photo as indicated by the red dot in the Diagram.



14. Click on the red dot with the highest **Actual Area** value in the **Diagram**. The corresponding spot is now identified in the photo by circumscribing it with a red rectangle.





15. Check the Mask radio-button to display the corresponding black and white photo.

- 16. Check the **Refresh** button to hide the red rectangle circumscribing the actual spot. Check the **Actual Photo** radio-button and then the **Reference Photo** radio-button to verify that the actual spot is indeed larger in the **Actual** photo than in the **Reference** photo.
- 17. Click the **Export Data** button to export the results to an *Excel* file. Open the *Excel* file to display the data set.
- 18. This completes the **COMPARISON OF NAEVI MAPS** section.

5. DETAILED DESCRIPTION

The TiVi102 Nevus Analyzer main window

🛃 TiVi102 Naevi Analyzer				
TiVi Pre-Processor Manual About				
Whento Bridge				
Photo Point in photo to select colour of interest Zoom in	Photo Size: 282x423	Intensity Mode Centre	1	
89	Date: 20-nov-2012 Time: 16:40:41	Low Size: 2766 4148		
Select Photos Display Photo Mixed Mask Show A Show A	Actual Photo Ref Photo	Select Colour Red Green 0.51325 0.26886		
act-0002.jpg Load	Photo	Blue , 0.091608		
Reference Photo	ef Photo	Select Standard Colour Compare Images By Mouse Pointer Col. Mode		
Display Objects Coordinates Display C	olor Space	Expand Color , 0.035156		
Clear All v0- 1144 v1- 1425 Re	eset	Load Settings Save Settings Close		

Photo Panel

- 1. Photo text a text string that guides the user to the next step in the image processing process.
- 2. Zoom In slider with edit box to zoom in on a specific part of the photo. The section displayed is outlined in the Image Panel photo.
- **3.** Clicking in the photo placing the mouse pointer somwhere in the photo, pressing the left louse button and moving the mouse with the button pressed causes the zoomed in region to move over the original photo. Clicking on a spot inside the photo without moving the mouse generates a new photo with the colours representing the actual point displayed against a gray-scale background photo. The colour space the colours displayed is composed of colours around the colour of the point clicked on. The size of this colour space is determined by the setting of the Expand Color slider.
- 4. Photo size displays the size of the zoomed-in photo.

5. Date and Time – displays the date and time of photo capturing.

Select Photos Panel

- 1. Load Photo button to load a new photo from file.
- 2. Load Ref Photo button to load a new reference photo from file.
- 3. Show Actual Photo rb-button to display the actual photo.
- 4. Show Ref Photo rb-button to display the reference photo.
- 5. Display Panel: Photo, Mixed & Mask check the Photo radio-button to display the entire photo in colour. Check the Mixed radio-button to display the coloured nevus lesions against gray-scale background skin. Check the Mask radio-button to display the photos as black and white images.
- 6. Actual Photo edit-box displays the name of the actual photo.
- 7. Reference Photo edit-box displays the name of the reference photo.
- 8. Display Objects button opens the Object window and transfers image information to this window.
- 9. Clear All button deletes photos and resets the system to start mode.
- 10. Display Colour Space button opens the Colour Space window.
- 11. Reset button resets the settings but keeps the photos uploaded and displayed.
- 12. Coordinates Panel displays the coordinates of the zoomed-in photo.

Image Panel

- Image text displays the selected mode: Coulour Mode indicates that the Colour Space is selected with the centre colour widened by the settings of the Expand Colour slider. In this mode a dark nevus lesion can contain a core area outside the selected Colour Space. Intensity Mode (default) indicates that the Intensity is selected with the centre intensity increased by the setting of the Expand Color slider. In this mode all pixels of an intensity lower than the centre intensity increased by the Expand Color slider setting are included in the nevus lesions identified, i.e. a dark nevus lesion will include its centre darker colours in the mask.
- 2. Centre edit-box displays the centre colour of the Colour Space.
- 3. High edit-box displays the brightest colour included in the Colour Space.

- 4. Low edit-box displays the darkest colour included in the Colour Space.
- 5. Size displays the size of the photo in pixels.

Select Colour Panel

- 1. **Red slider & edit-box –** sets the red centre colour (automatically updated when a pixel is pointed on in the photo in the **Photo Panel**).
- 2. Green slider & edit-box sets the green centre colour (automatically updated when a pixel is pointed on in the photo in the Photo Panel).
- **3.** Blue slider & edit-box sets the blue centre colour (automatically updated when a pixel is pointed on in the photo in the Photo Panel).
- 4. Expand Colour slider & edit-box- sets the extension of the Colour Space around the centre colour (Colour Mode) or intensity threshold level above the centre intensity (Intensity Mode).
- 5. Select standard Colour pull-down menu sets predetermined centre colours and width of Colour Space (and updates the sliders and edit boxes accordingly). By Mouse Pointer the Color Space is set by pointing at a point in the photo and clicking the left mouse button. Light Nevus The RBG-values of the centre point are set to [0.5 0.3 0.2] and the Expand Color slider value to 0.1. Dark Nevus The RBG-values of the centre point are set to [0.25 0.15 0.1] and the Expand Color slider value to 0.1. Synchronize the Colors Space of the photo in focus is synchronized (made equal to that of) with the hidden photo. After having clicked on a nevus to define a colour space, two more items are added to the pull-down-menu if both the actual and the reference photo are uploaded. Synch Act to Ref synchronizes the colour space of the reference photo to that of the reference photo. After synchronizes the colour space of the reference photo to that of the reference photo. After synchronizes the colour space of the reference photo to that of the actual photo. After synchronizes the colour space of the reference photo to that of the actual photo. After synchronizes the colour space of the reference photo to that of the actual photo. After synchronizes the colour space of the reference photo to that of the actual photo. After synchronizes the colour space of the reference photo to that of the actual photo. After synchronizes the colour space of the reference photo to that of the actual photo. After synchronizes the colour space of the two photos the Compare Images button is enabled.
- 6. Compare Images button to open the *Compare 102* window.
- 7. Int Mode button this toggle button sets the system to operate in Colour Mode or Intensity Mode.
- 8. Load Settings loads saved parameter settings from file.
- 9. Save Settings saves parameters to file.
- **10.** Close closes the *TiVi102 Nevus Analyzer Toolbox*.



The Colour Space window

Limits Panel

- 1. Red Low Limit displays the low red limit of the Colour Space.
- 2. Red High Limit displays the high red limit of the Colour Space.
- 3. Green Low Limit displays the low green limit of the Colour Space.
- 4. Green High Limit displays the high green limit of the Colour Space.
- 5. Blue Low Limit displays the low blue limit of the Colour Space.
- 6. Blue High Limit displays the high blue limit of the Colour Space.

Select Colour Space Panel

- 1. ROI rb-button displays the results in the RGB Colour Space.
- 2. HSV rb-button displays the results in the HSV Colour Space.
- 3. Close-button closes the Colour Space window.
- **4. Diagram rotation** to rotate the diagram by pointing on it with the mouse pointer and pressing the left mouse button while moving the mouse.

The Object window

🛃 Objects		
Use remove sliders to remove too small and too large objects	- Data Filename: NC-0002.jpg Actual Object	Average
	Number: Area:	Number:109 Area: 95.34
	Border: Colour:	Border: 22.03 Colour: [118 58 41]
- Control Panel	Diameter:	Diameter: 5.17
	Display-	
Remove Small Objects 4 Number of Objects: 109	Photo	Mixed
Remove Large Objects Size of Map: 980 x 1470	Small Size	Medium Size 💿 Large Size
No. Bins 10 Histogram Type	Short Distance	Medium Distance 💿 Long Distance
Area Object Size: 172	x 204 Enumerate	1 Export Data
Show Histogram Display Object Set	Object Size	ican Through Close

Object Panel

- 1. Photo text a text string that guides the user to the next step in the image processing process.
- **2. Photo** displays the zoomed-in-photo imported from the *TiVi102 Nevus Analyzer* main window.

Data Panel

- 1. File Name displays the filename.
- 2. Actual Object Panel displays number, area, border, colour and diameter of the object (nevus lesion) selected.
- **3.** Average Panel displays number of nevus lesions and average area, border, colour and diameter of the nevus lesions in the zoomed in photo.

Control Panel

- 1. Remove Small Object slider & edit-box removes small objects from the zoomedin photo.
- 2. **Remove Large Object slider & edit-box –** removes large objects from the zoomed-in photo.
- 3. No.Bin edit-box to set the number of bins in the histogram.
- **4. Histogram Type pull-down menu** to select the type of histogram to be displayed (area, border or diameter).
- 5. Show Histogram button toggles between Show histogram / Show Image to display histogram or image.
- 6. Display Object button toggles between Display Object / Display Map to display individual objects (single nevus lesions) or image map.
- 7. Number of Objects text displays the number of objects in the zoomed-in photo.
- 8. Size of Map text size of map diplayed.
- 9. Mode text –indicates mode of operation Intensity Mode or Colour Mode.
- 10. **Display Panel: Photo, Mixed & Mask –** displays the zoomed-in photo as pure colour photo, coloured nevus lesions against gray background skin or black and white object mask.
- **11. Indicator Settings Panel** to set the size of numbers and their distance to the objects in the black and white image.
- **12. Enumerate button** toggles between **Enumerate / No Numbers** to display or hide object numbers in the black and white image.
- 13. Export Data button to export data to Excel® file.
- 14. **Set Object Size slider and edit-box** to set the size of the individual object photo. With the slider set to zero the boundaries of the largest object fills the entire photo.
- **15. Scan Through button and edit box** scans through and displays the individual objects while updating the **Actual Object** panel parameters accordingly.
- 16. Close button to close the Object window.

Objects				×
- Objects	Data			
Click the Photo, Mixed or Mask radio_button to display different views	Filename	: NC-0002.jpg		
The second s	- Actual	Object	Average	
	Number:	5	Number:6	
Sec. Pro	Area: 47	03	Area: 1317.	83
Contraction of	Border:	440	Border: 222	.72
C AND S	Color: [1	26 68 50]	Colour: [118	58 41]
	Diameter	. 77	Diameter: 36	5.2
Control Panel				
Domesia Small Objecto		Display		
Number of Object	ts: 6	Photo	Mixed	Mask
Remove Large Objects Size of Map: 980 x	: 1470	- Indicator Settings		
5000 Mode:Colour		🔘 Small Size	Medium Size	Large Size
No. Bins 10		Short Distance	Medium Distanc	e 💿 Long Distance
Histogram Type				
Area Object Si	ize: 121 x 144	Enumerate	5	Export Data
Show Histogram Display Map	Set Object Size	. 1.41	Scan Through	Close

Object window with a single object (nevus lesion) displayed.

The Compare 102 window

		☐ Reference Photo-		
File Name: act-0002.jpg	Number of Objects: 73	File Name: ref-0001.jpg		Number of Objects: 121
Controls		Display	Mixed	Mask
Controls Checkpoints Click on the Reference Spot (red squa	re) in the Actual Photo	Display-	Mixed	@ Mask
Controls Checkpoints Click on the Reference Spot (red squa Remove small objects or click Show P	re) in the Actual Photo ot	Display Photo	Mixed	@ Mask

Actual Photo Panel

1. Displays File Name and Number of Objects in Actual Photo .

Reference Photo Panel

1. Displays File Name and Number of Objects in Reference Photo .

Controls Panel

- 1. Remove Small Objects slider to remove small objects from the photos .
- 2. Remove Small Objects edit to remove small objects from the photos .
- 3. Enumerate to display number of the objects in the reference photo.
- 4. Show Plot to open the *Plot102* window.
- 5. Close to close the Compare 102 window.

Display Panel

- 1. Photo radio-button to display the full colour photos.
- 2. Mixed radio-button to display the spots in colour space colours superimposed on the full photo displayed in gray-scale colour.
- 3. Mask radio-button to display the spots in white colour on black background.



The Plot 102 window

Diagram Panel

1. Displays areas of spots in the actual photo versus the corresponding areas of the spots in the reference photo. Actual photo spot sizes are displayed as red dots if the corresponding actual spot – reference spot areas ratio exceeds the warning limit as set by the **Warning slider**. Spots along the y-axes (spots existing only in the actual photo) are indicated by yellow dots while spots along the x-axis (spots existing only in the reference photo) are indicated by green dots. The remaining spots are indicated by blue dots.

2. Any dot in the **Diagram** clicked on by the mouse pointer automatiaclly identified the corrsponding spot in the reference photo by circumventing it by a red square in the photo.

Photo Panel

1. Displays the photo, mixed photo or the spots (white on black background). A red square is automatically drawn around the spot corresponding to the dot clicked on by the mouse in the **Diagram.**

Display Panel

- 1. Displays filename of the actual and reference photo displayed as well as the number of objects in the corresponding photos.
- 2. **Photo radio-button** to display the full colour photos.
- 3. **Mixed radio-button** to display the spots of selected colour space colours against a gray-scale version of the photo.
- 4. **Mask radio-button** to display the spots in the actual or reference photo in white colour against a black background.
- 5. Actual photo to display the Actual Photo.
- 6. **Reference photo** to display the **Reference Photo**.
- 7. **Export Data** to export data to an *Excel* spread-sheet.
- 8. **Refresh** to remove the red square circumventiung the selected spot from the photo.
- 9. **Close** to close the *Plot 102* window.