

RUMBA

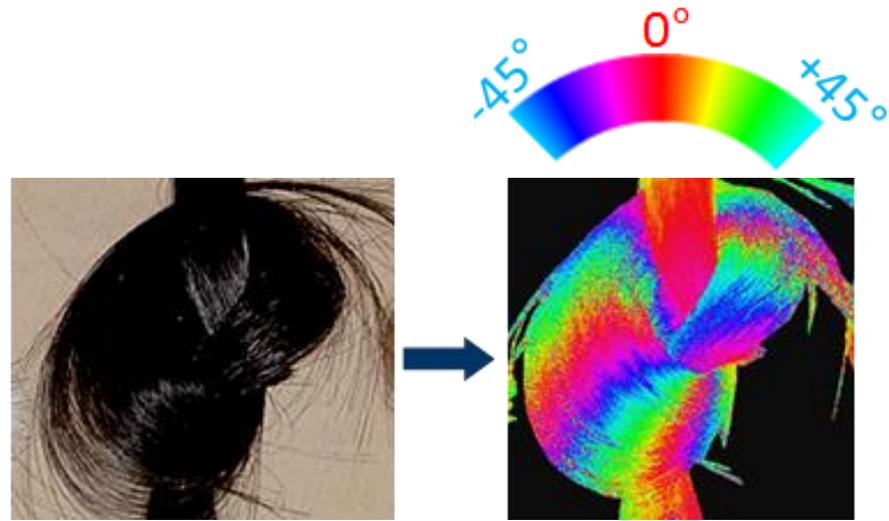
Polarization imaging for fiber orientation measurement



RUMBA Sensor



Laptop PC with pre-loaded software + Controller



Fiber orientation extraction/display

RUMBA

In-vivo/In-vitro

Rumba in-vivo



**Tripod (included)
for in-vivo measurement**

Rumba Laboratory set-up



**Lab Setup (included) for
measurement on hair tresses**

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Shape/Alignment

Spatial distribution of the hair fibers
(straight to curly + styling)



Existing technique: Fiber/Hair Orientation Measurement
→ conventional imaging + image analysis/image processing

New technique: Measurement of physical parameter related to the orientation of the fiber using polarization analysis/imaging

RUMBA

Example of in-vivo measurement (panelist)

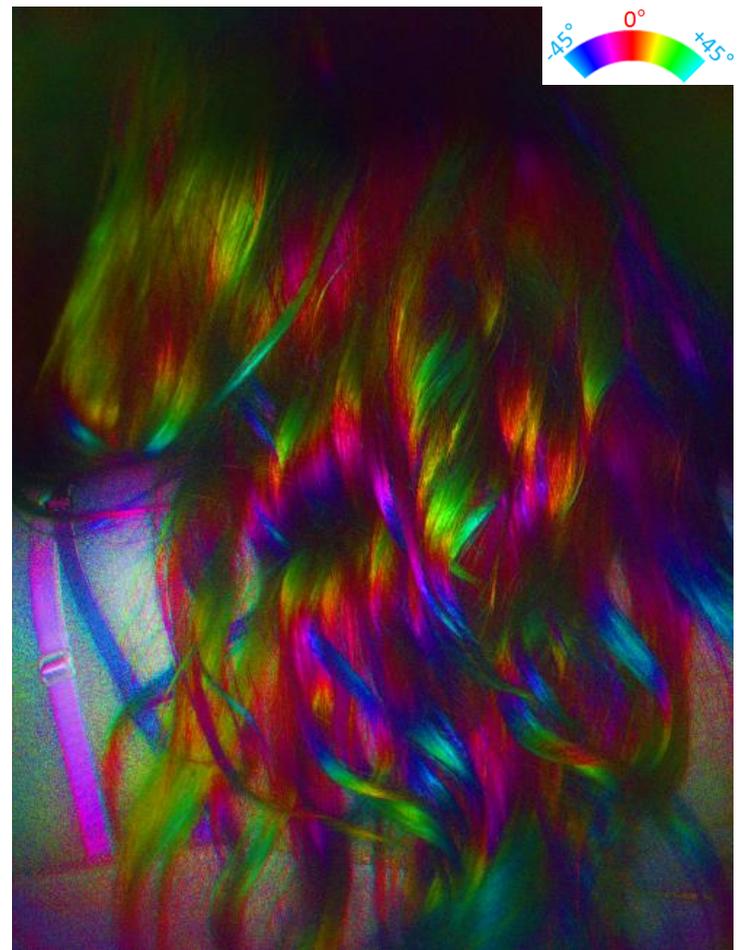
Intensity (Visible)
Conventional Image



Intensity image (NIR)



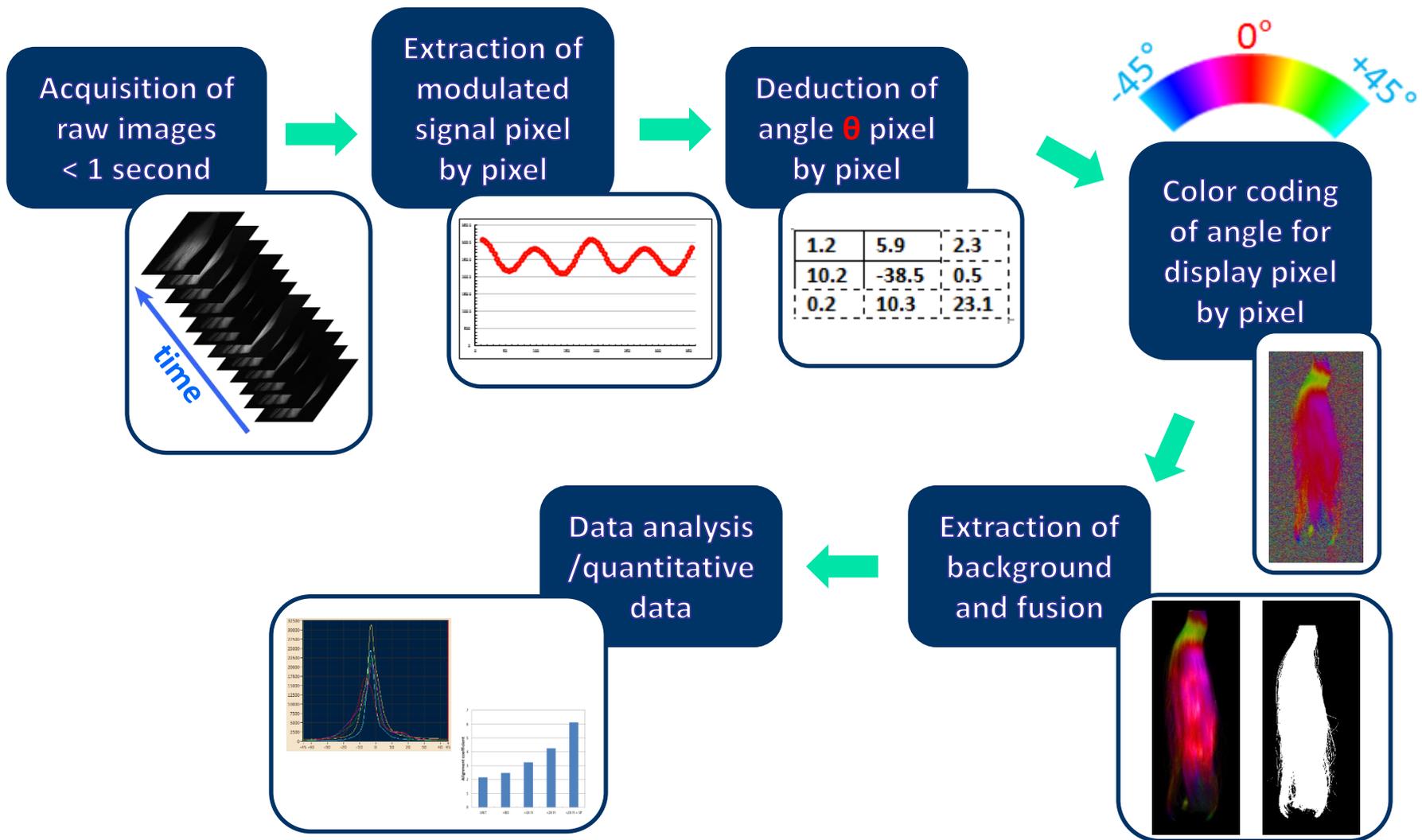
Color coded Orientation image



RUMBA Uses NIR LEDs => Even dark hair are transparent and can be measured

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Measurement process



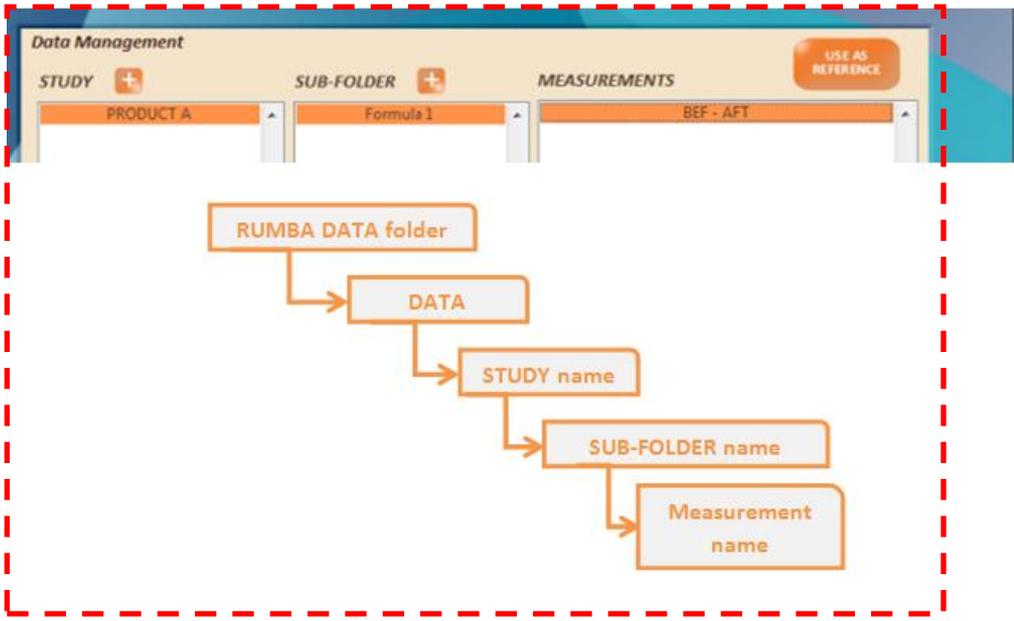
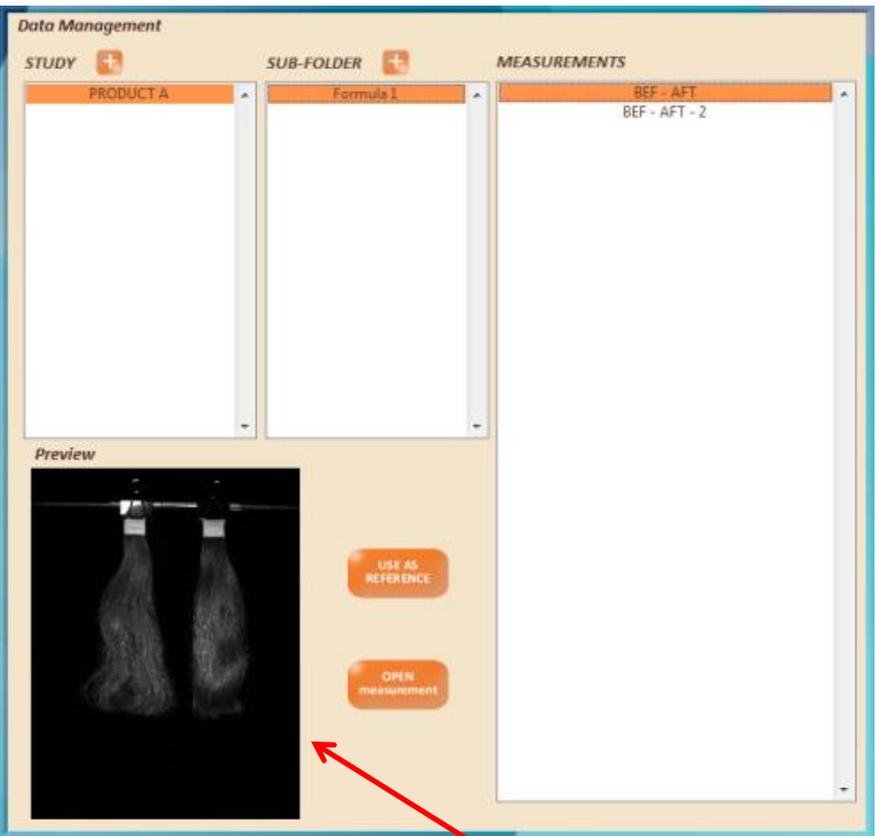
RUMBA

Live Image – Auto Exposure

The screenshot displays the RUMBA software interface. On the left, a 'Live image' shows two hair samples with a white 'ROI toolbar' overlaid. The main area features a 'Histogram in ROI' graph with a 'Mean Value' of 427.8. Below the histogram are 'Camera adjustments (gain/exposure time)' sliders for 'Gain' (0-200) and 'Exposure time (ms)' (0-1000), with an 'Auto adjustment (in ROI)' checkbox checked. Further down is an 'Overlay reference on live image' section with a 'Mixing intensity' slider. On the right, a 'Push-Acquisition' panel includes a 'STOP Live Adjustment' button, a 'Measurement name' field containing 'BEF - AFT', and an 'ACQUIRE measurement' button. A 'Tools' panel is visible in the bottom right corner. Yellow arrows point from text labels to these specific interface elements.

RUMBA

Data Management

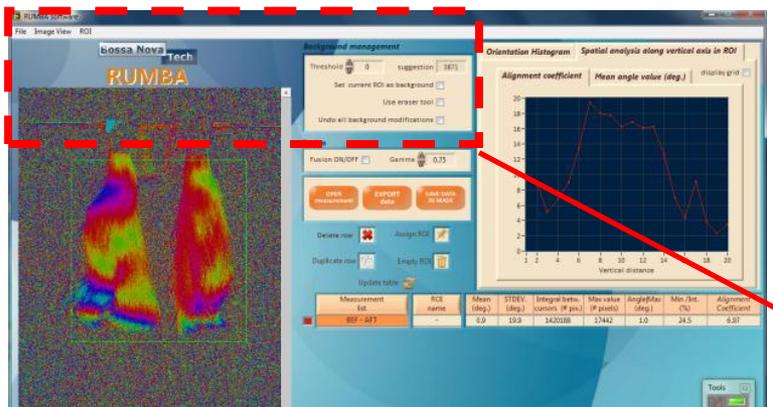


All previous measurements are easily accessible

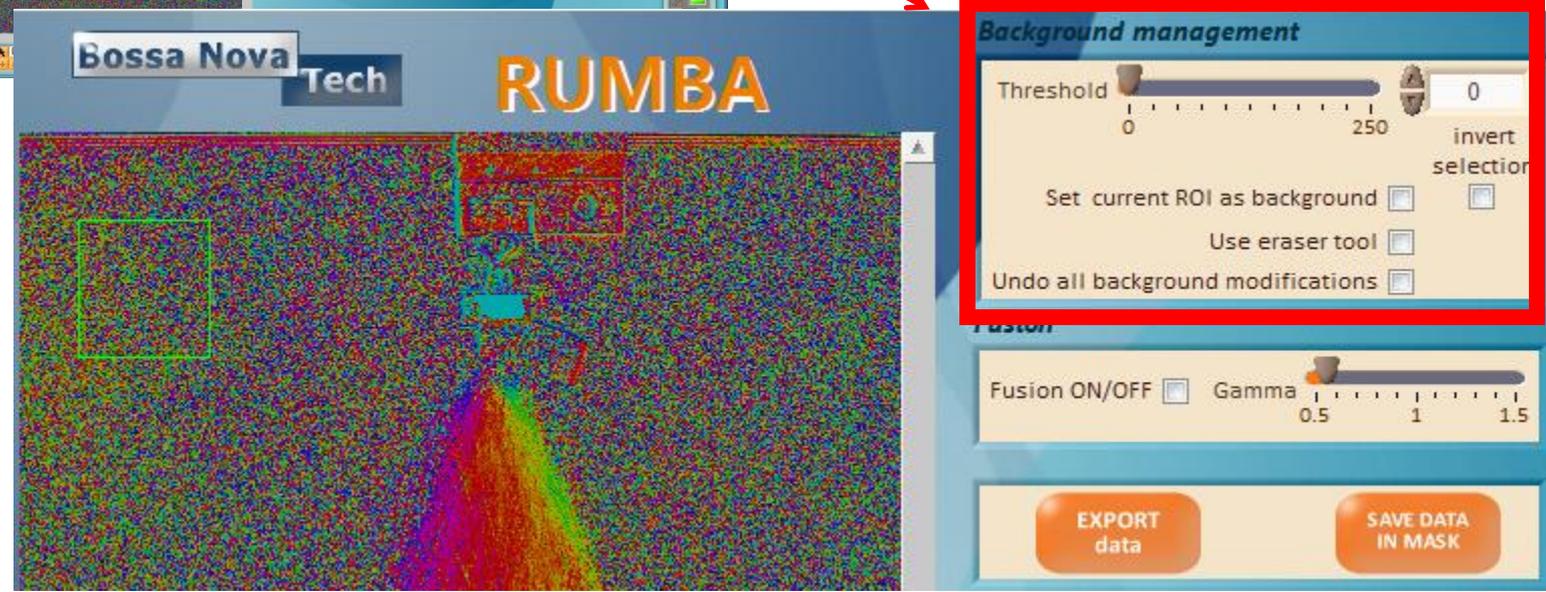
Preview

RUMBA

Background extraction using the software



Detachable background panel and the threshold tool included in the software allows for easy background extraction



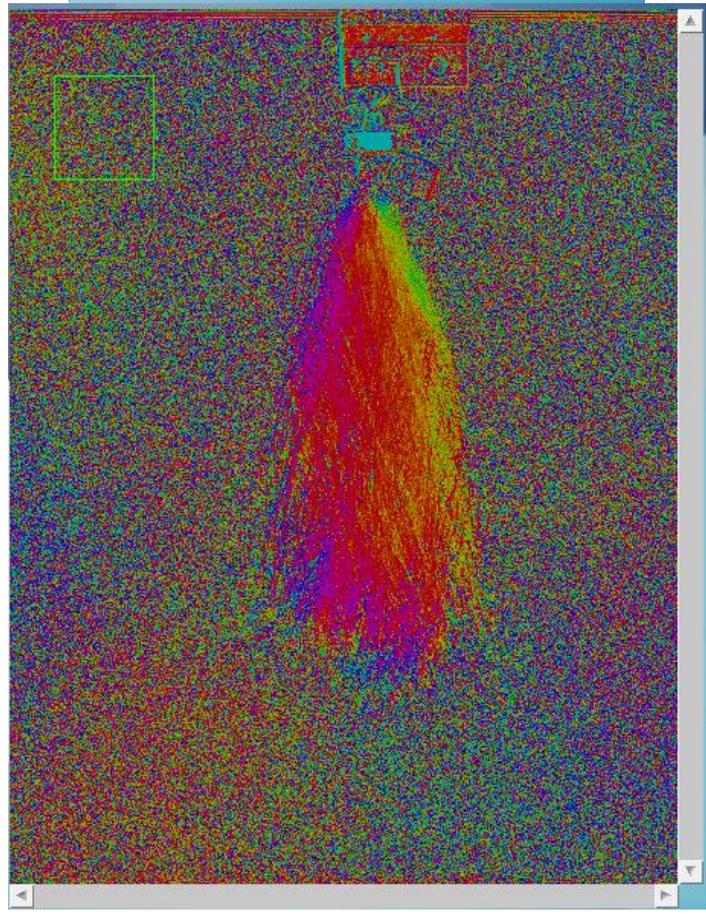
Background management

Threshold 0 250 invert selection

Set current ROI as background

Use eraser tool

Undo all background modifications



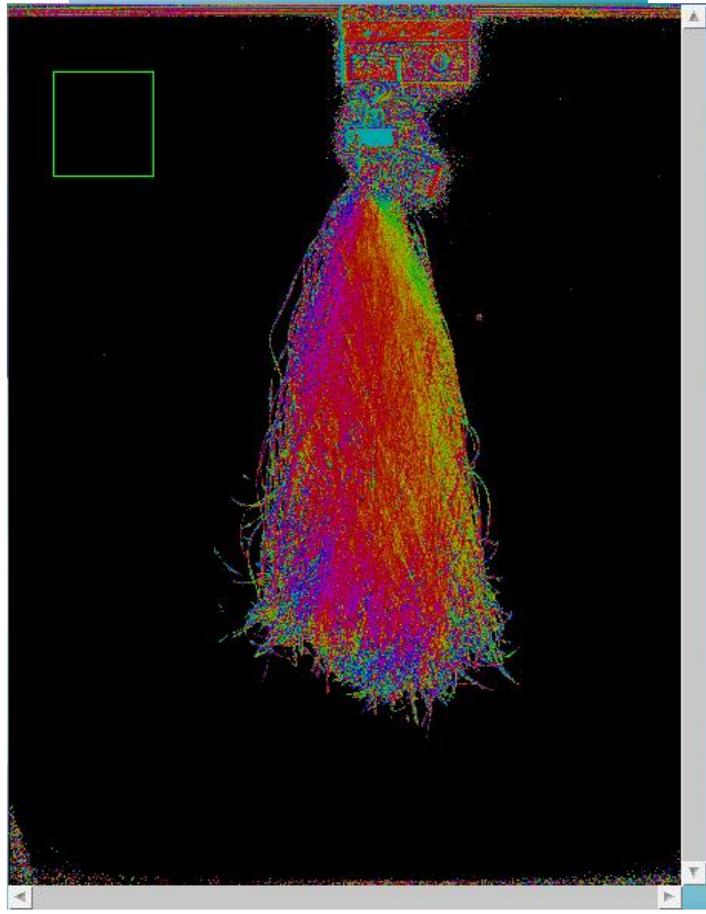
Background management

Threshold 0 250 invert selection

Set current ROI as background

Use eraser tool

Undo all background modifications



RUMBA

Comparison-Analysis [Histograms]

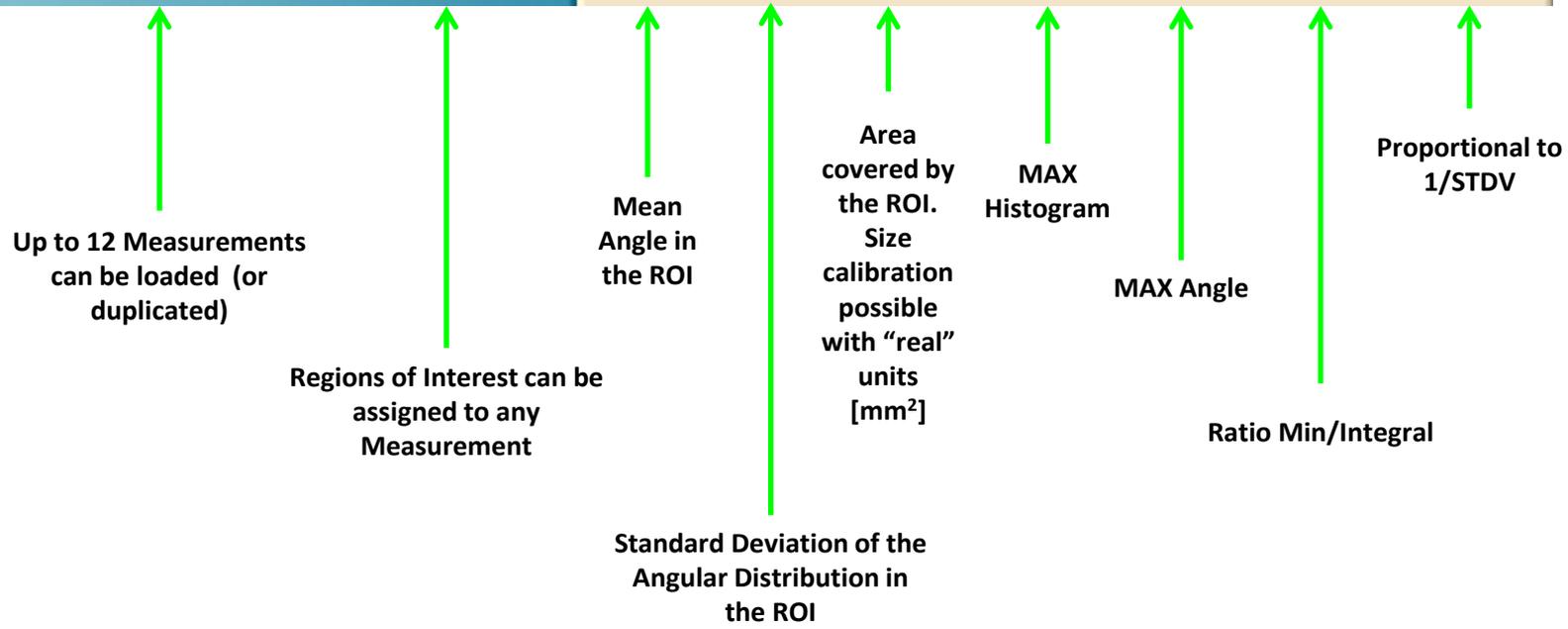
The screenshot displays the RUMBA software interface. On the left, a 'Color coded Orientation image' window shows two vertical, elongated regions of interest (ROI) with a color gradient from blue (-45°) to red (+45°). A legend above the image shows the color scale. The main interface includes a 'Background management' panel with a threshold of 40 and a suggestion of 53. Below this is a 'Fusion' panel with a 'Fusion ON/OFF' checkbox and a 'Gamma' slider set to 0.75. A table at the bottom lists two ROIs: 'BEF - AFT' and 'AFT'. The 'AFT' ROI is highlighted in pink, and a pink arrow points from its name in the table to its corresponding ROI in the orientation image. To the right, an 'Orientation Histogram' plot shows 'Population in ROI' on the y-axis (0 to 9000) and 'Angle (deg)' on the x-axis (-45 to 45). Two curves are shown: a purple curve peaking at 0 degrees and a red curve peaking at approximately 10 degrees. A pink arrow points from the 'AFT' ROI in the table to the red curve in the histogram. A 'Tools' panel is visible in the bottom right corner.

Measurement lot	ROI name	Mean (deg.)	STDEV. (deg.)	Integral betw. cursors (# pix.)	Max value (# pixels)	Angle/Max (deg.)	Min./Int. (%)	Alignment Coefficient
BEF - AFT	BEF	0.9	18.9	487574	6517	8.0	19.6	7.00
BEF - AFT	AFT	1.9	13.9	401140	8856	0.5	8.6	18.21

Each Region Of Interest has the same color as the histogram plot

RUMBA Data Extraction

Measurement list	ROI name	Mean (deg.)	STDEV. (deg.)	Integral betw. cursors (# pix.)	Max value (# pixels)	Angle Max (deg.)	Ratio Min/Int (%)	Alignment Coefficient
Sample 1	Rect2	-0.1	6.7	61159	2174	0.5	0.6	11.13
Sample 1	Rect1	-0.6	8.2	152602	5092	0.5	2.0	8.40





- Hair Alignment Measurement

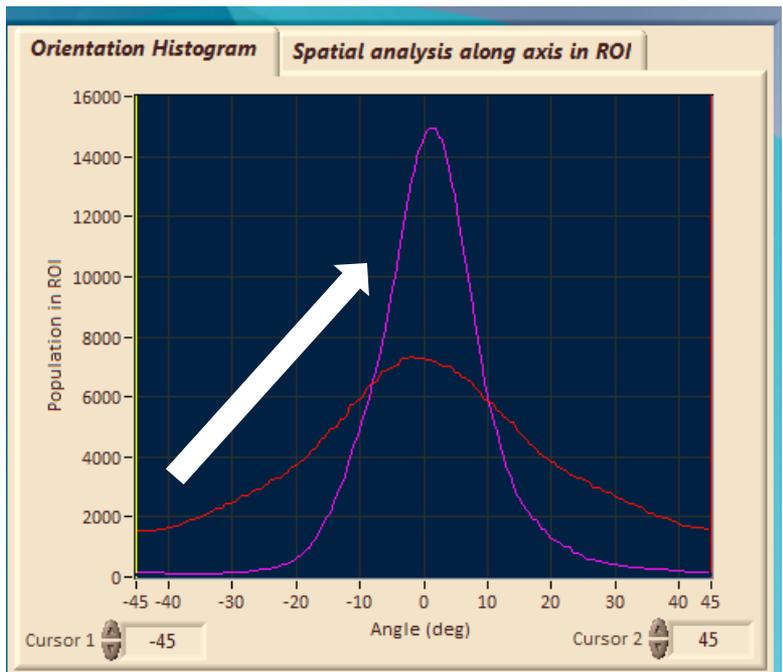
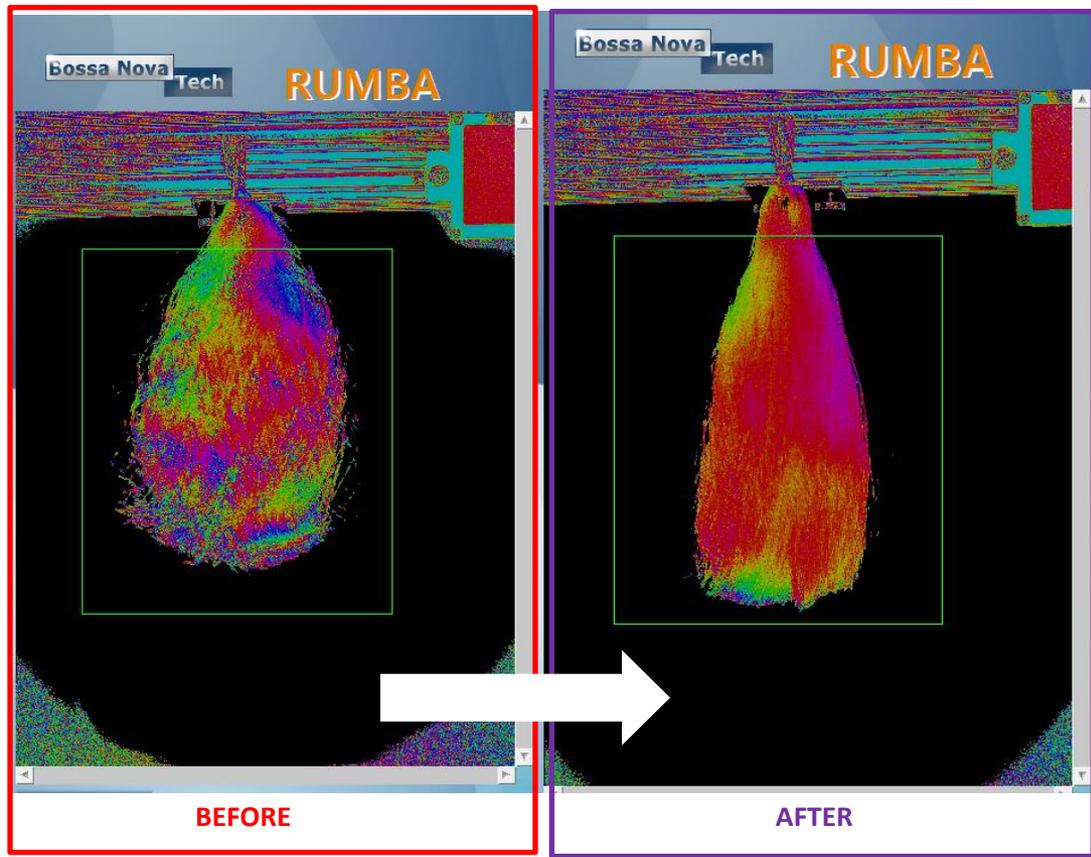


- Before treatment



- After treatment





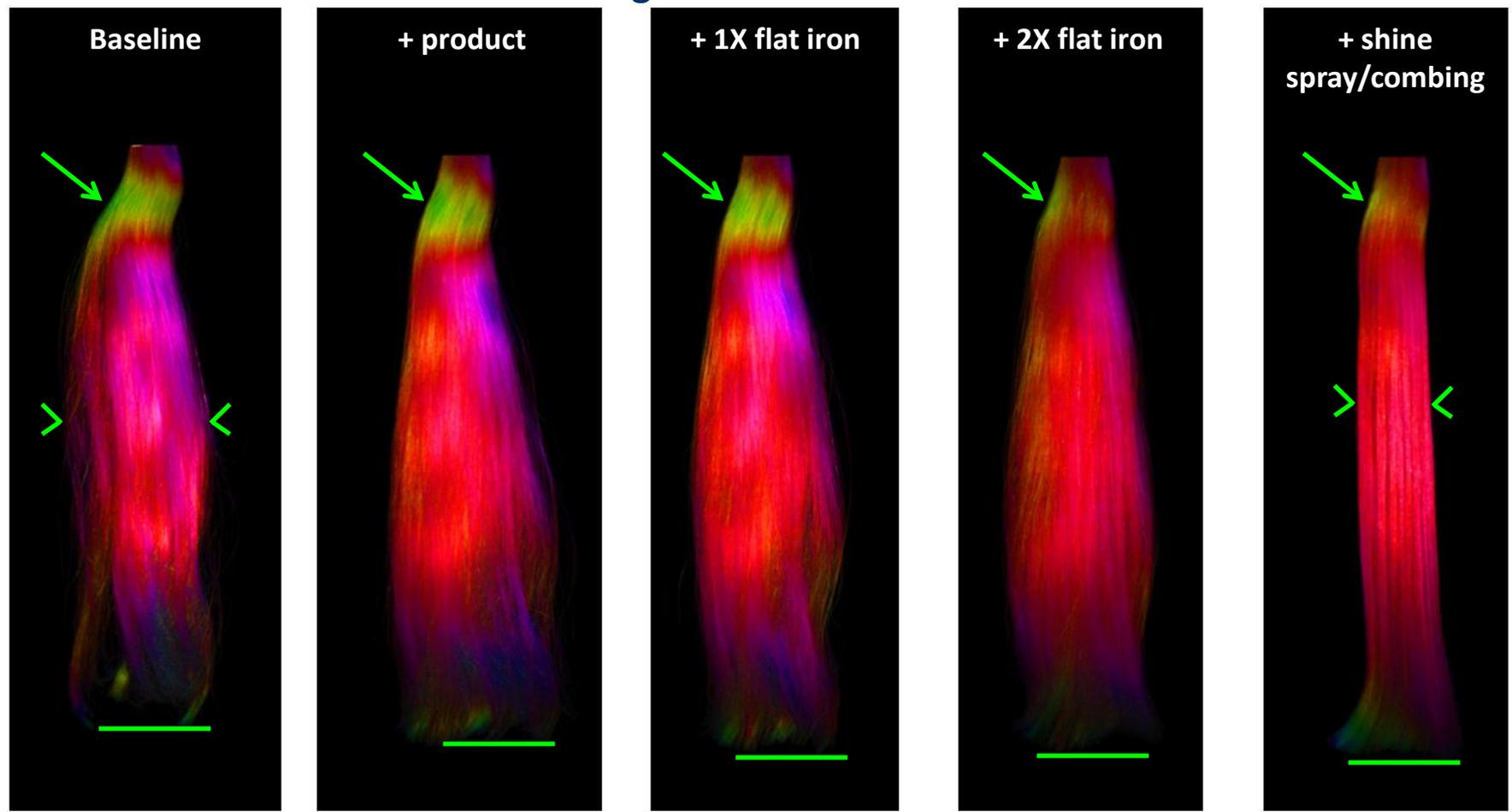
The histogram is thinner, the fiber are better aligned.

Measurement list	ROI name	Mean (deg.)	STDEV. (deg.)	Integral betw. cursors (# pix.)	Max value (# pixels)	Angle Max (deg.)	Min /Int. (%)	Alignment Coefficient
F1R	-	0.2	20.1	707010	7312	-2.0	39.3	6.71
F1T	-	1.4	10.1	567102	14939	1.0	3.5	29.36

The alignment coefficient reflects the increase



Color coding shows visual differences



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Data Export



Name	Region Of Interest	ROI width (mm)	ROI height (mm)	Mean (deg.)	STDEV. (deg.)	Integral (# pixels)	Max (# pixels)	Angle/ (deg)
Sample 1	Rect2	740	1089	-0.1	6.7	61159	2174	0.!
Sample 1	-	682	3465	-0.7	8.6	179482	5679	0.!

All Data can be exported in Excel spreadsheet

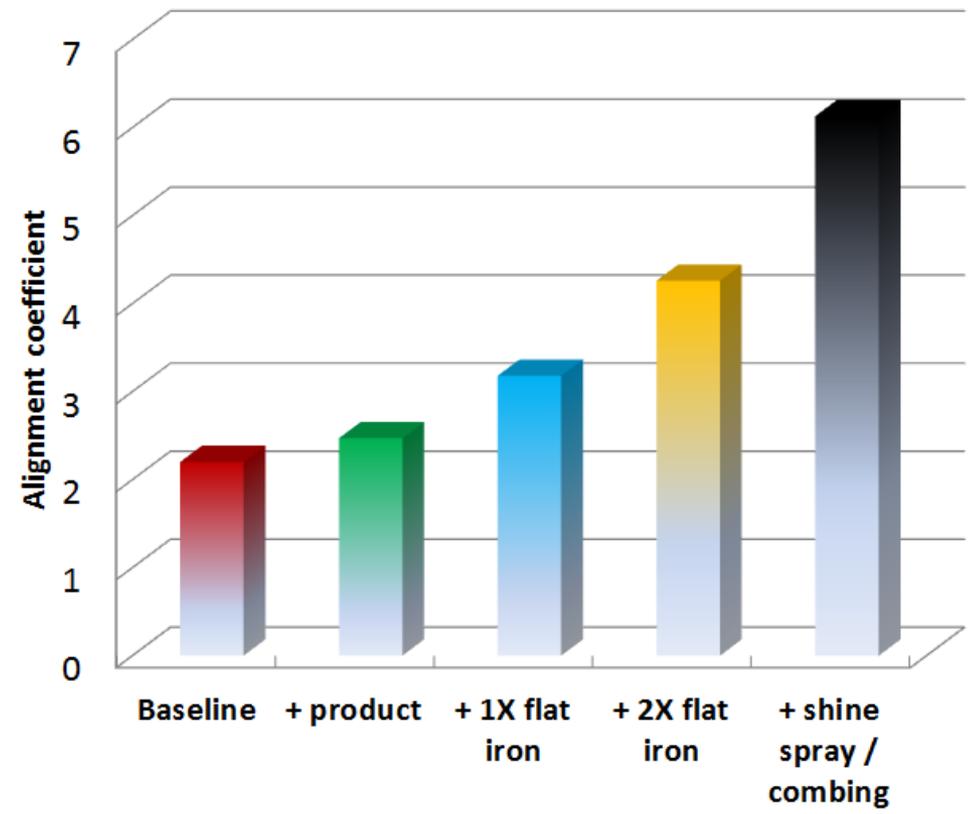
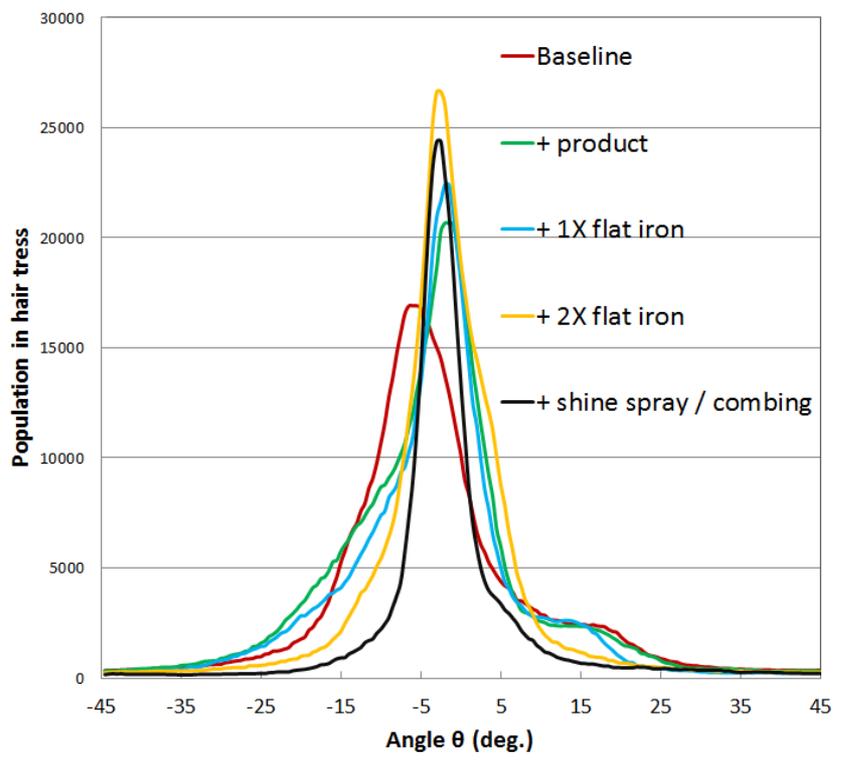
Angle (deg.)	Sample 1
ROI	Rect2
-44.5	3
-44	6
-43.5	6
-43	7
-42.5	7
-42	7
-41.5	6
-41	6
-40.5	5
-40	5
-39.5	5
-39	5
-38.5	5
-38	5
-37.5	6
-37	5
-36.5	5

RUMBA

Quantitative data allowing objective comparison of Alignment

Histograms:
Angular distribution in the Region Of Interest

$$\text{Alignment coefficient} = \frac{\text{Max}}{\text{Area}} \cdot \frac{1}{\text{Stdev.}}$$



▪ Hair curling Measurement



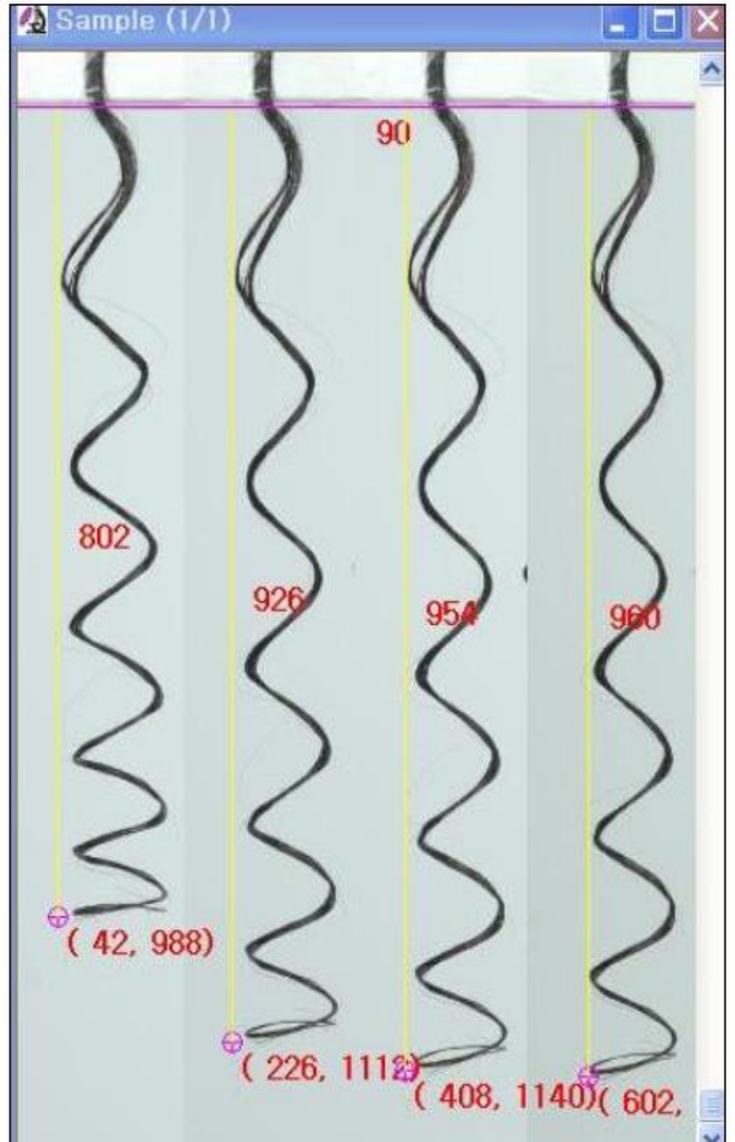
Wave I

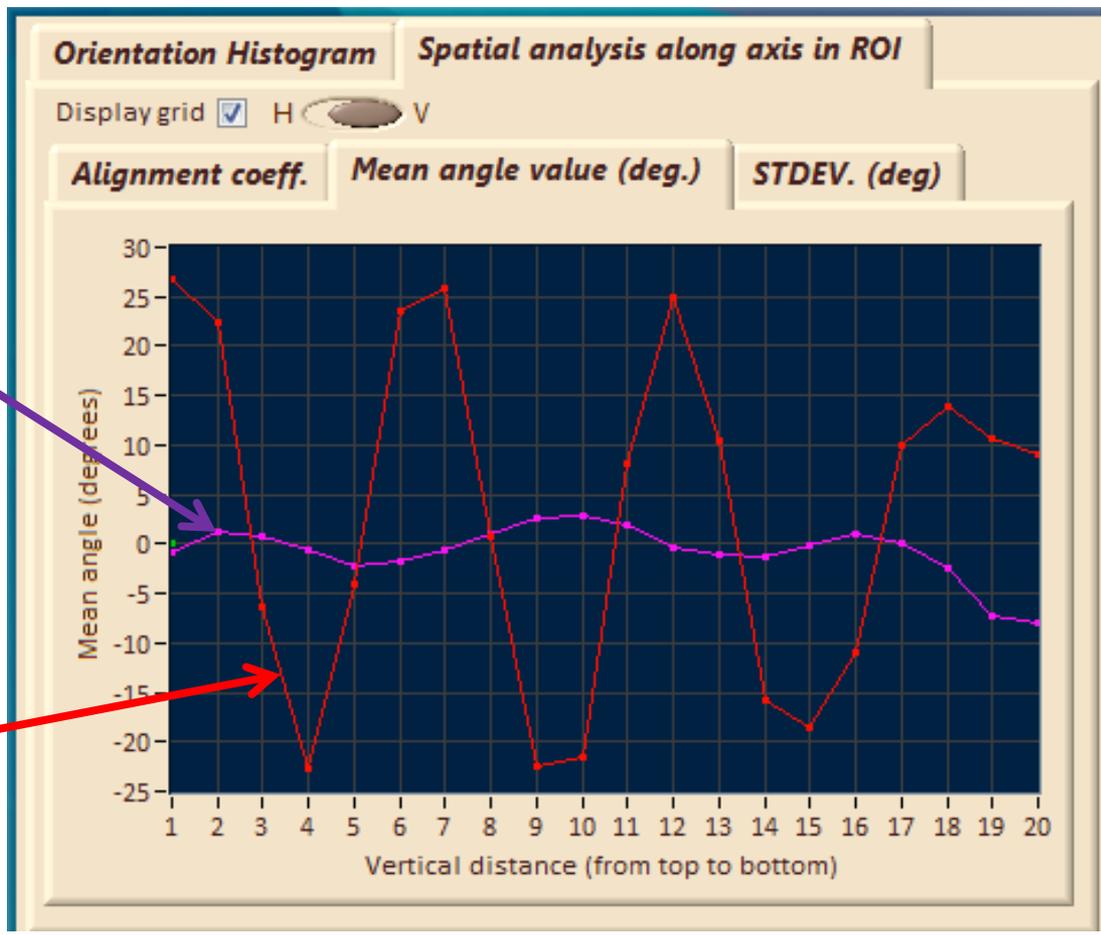
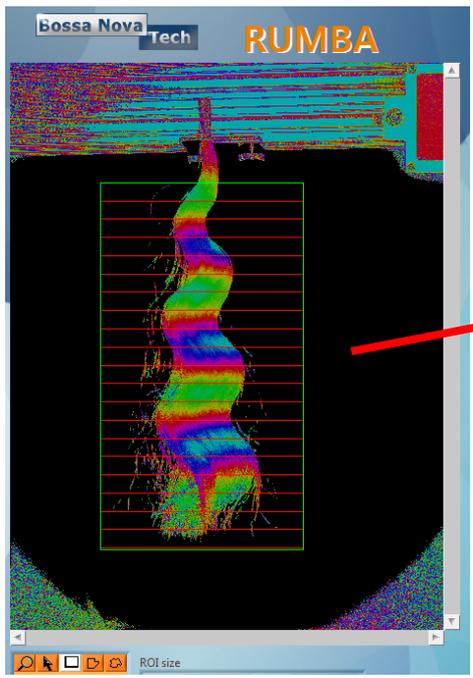
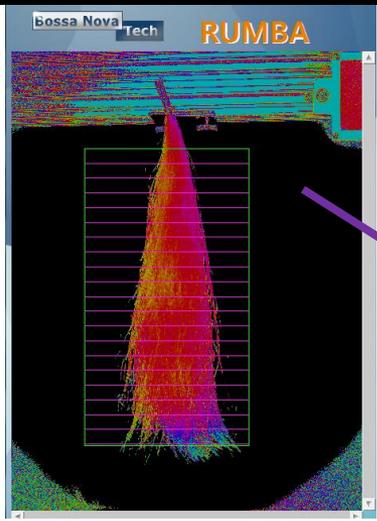


Wave II



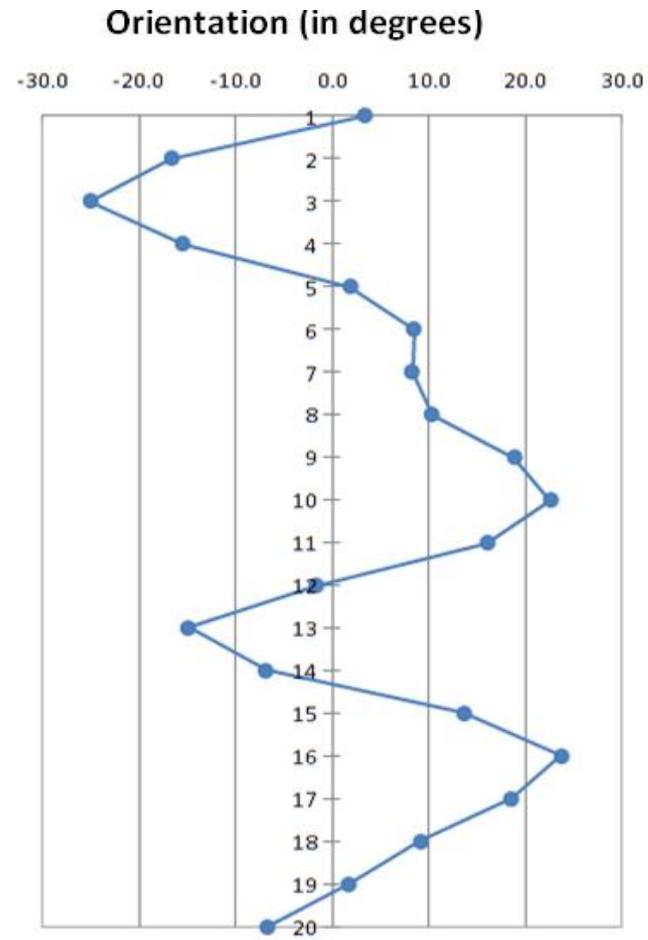
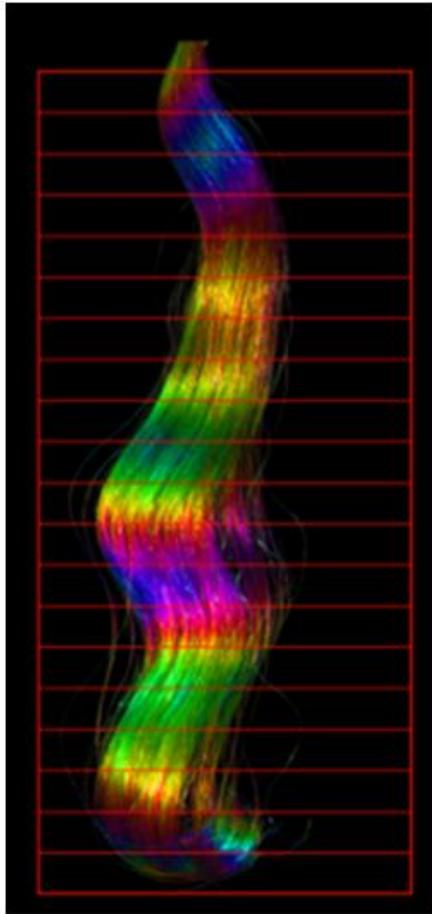
Wave III



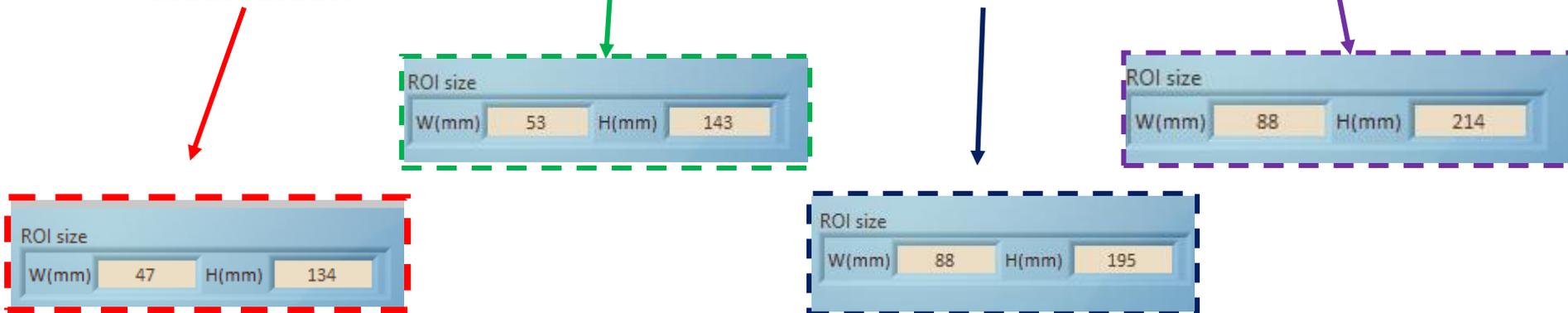
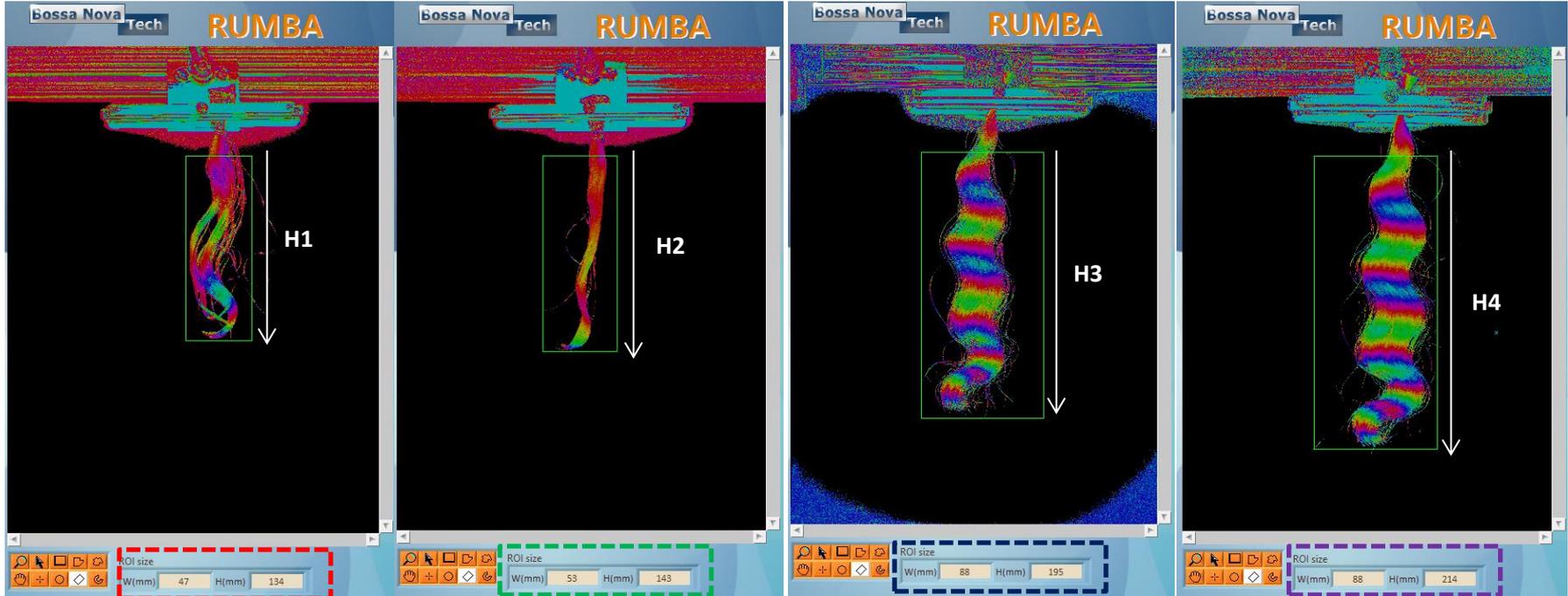


RUMBA can perform spatial analysis to count the number of cycles or the amplitude of the curls

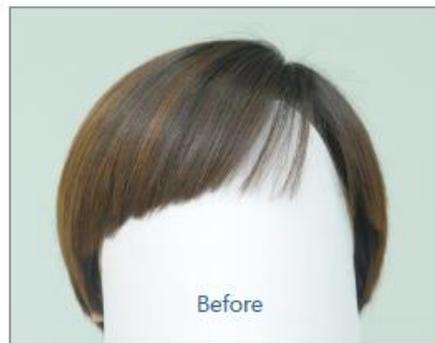
RUMBA Spatial Analysis



The ROI can be divided into “boxes” and provide spatial analysis of Mean Angle or STDV parameters.

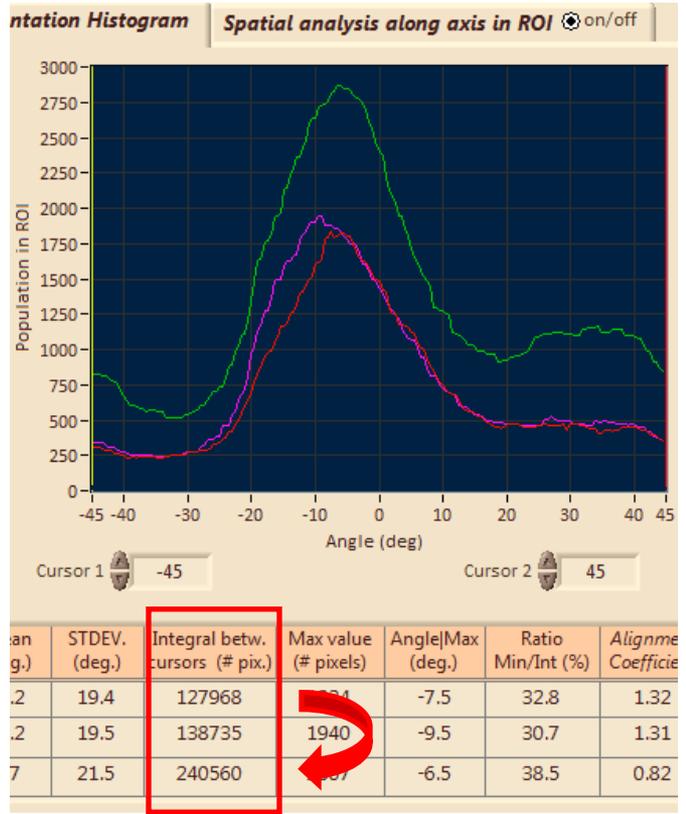
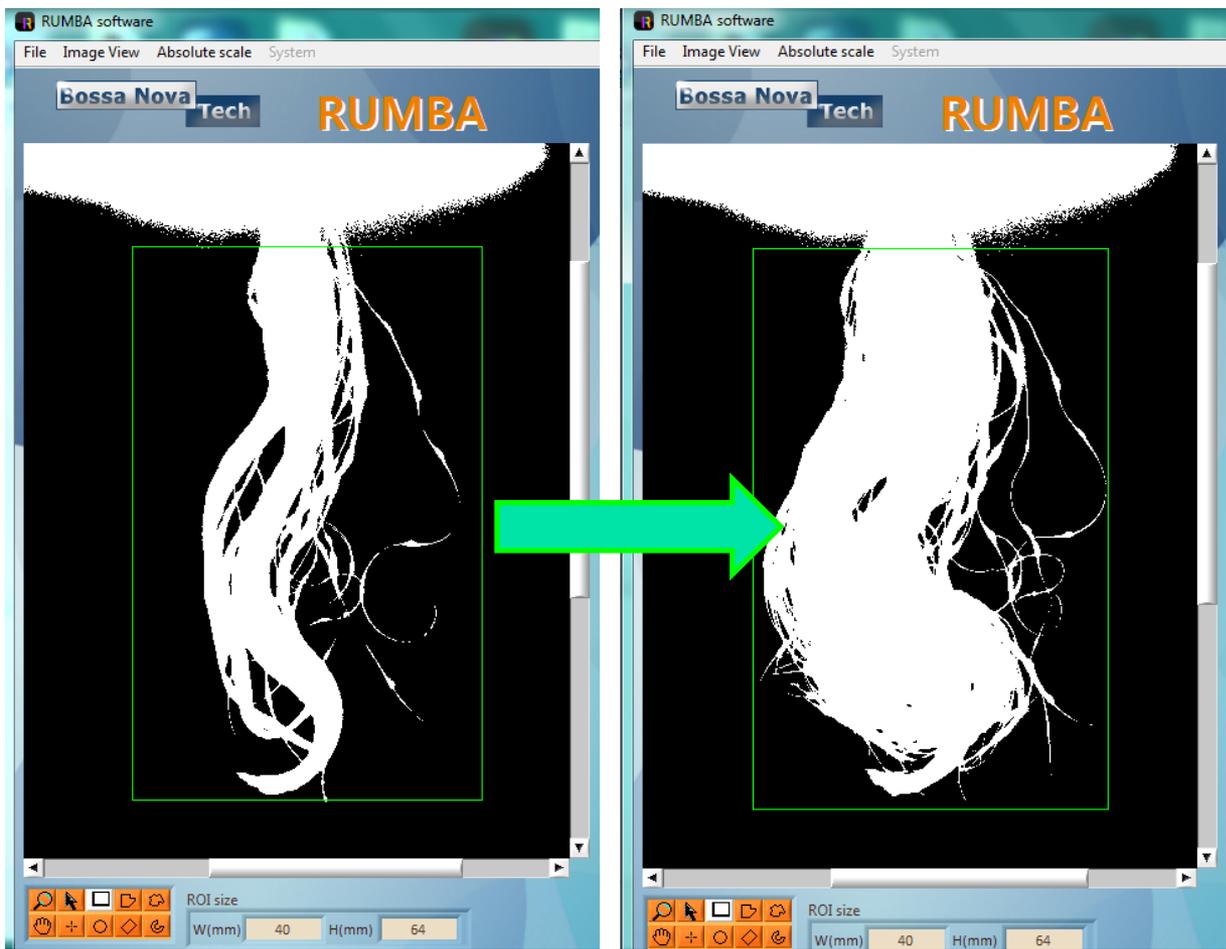


RUMBA provides the size of the Region of Interest in Real units (mm), so it is possible to track extension/shrinking of hair swatch



"Volumizing"





+73%

The RUMBA software can track the projected volume of the tress by counting the data pixels (the background is extracted).

Timed measurements allows the user to start a study at t=0 and generate auto-measurements every x Minutes.

RUMBA

Conclusions

- **RUMBA is a robust, turn-key system for fiber orientation measurement**
- **Thanks to the complete lab setup, RUMBA provides accurate and repeatable in-vivo and in-vitro measurements**
- **Data management and comparison is very easy thanks to a user friendly RUMBA software**

Thank you!