

WIR i-Star Professional Tutorial No. 3

“Ozone Fading of Inkjet Prints”

For Use With:

WIR i-Star Professional Edition

Fully-Enabled Free Public Beta – Version 7.2 (2010-01-01)

Powerful CIELAB based, full tonal scale, comparative image analysis software with simplified single-number or two-number reporting of results. Developed by Wilhelm Imaging Research, WIR i-Star also provides comprehensive analysis of image appearance differences with specific colors, including critical human skintone colors, or with user-selected pictorial “regions of interest,” in both color and black-and-white photographic images.



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Tutorial Three: Ozone Fading of Inkjet Prints

For this project, use a standard WIR target produced on a glossy paper using dye-based ink and custom-made profile. Expose the samples to 5ppm of ozone in a protected, dark environment at 23°C and a relative humidity of 50%. The samples have dimensions of 15 rows by 9 columns. The Examples folder contains i-Star screen captures of the initial target and necessary data for this example. The purpose of this project is to analyze and quantify the deterioration of the print as a result of ozone exposure.

Initially, collect the necessary data using an appropriate tool. The spectral data supplied in the Examples folder has been collected using the Gretag Macbeth Spectrochart Lite software and the Gretag Macbeth Spectrolino spectrophotometers. Because spectral data is supplied, instructions for data collection are omitted. Guidance for data collection can be found in corresponding manuals for chosen instruments and software.

Now, begin the project.

[Start i-Star](#)
[Create a new project.](#)

Press Ctrl + n or choose “New Project” in the “Project” menu. A request for a reference measurement will appear. This measurement is considered the “ideal” or starting point. In this case, choose the measurement marked as “_000” for the reference measurement. Locate the “WIRv3 Ozone Fading Example” sub folder in the Examples folder on your install disk for all project related files. See (Fig. 1).

Choose “sn17717_mn000_ms.xls” in the open file dialog.

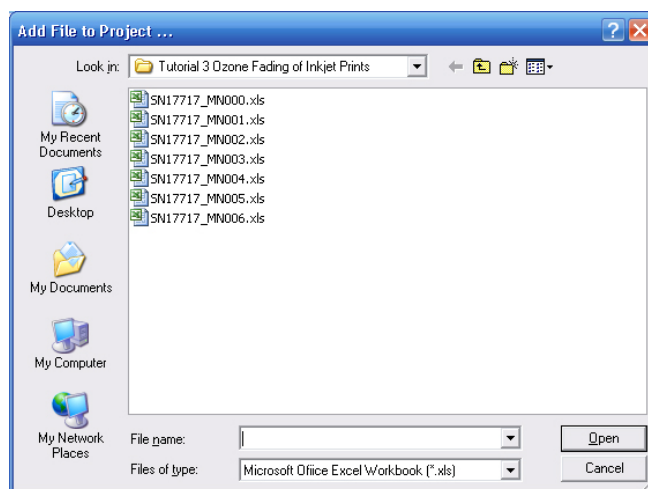


Fig. 1

i-Star will process and report the file on the “Data Layout” page. A warning will appear requiring specific information.

This warning means the data collecting software did not report the number of columns and rows in the output file. Fill in the “Number of Rows” and “Number of Columns” fields. See (Fig. 2). The originating data targets contain 15 rows and 9 columns each. The target reading sequence is left-to-right.

Enter the number of rows and columns in the appropriate fields.
Select “left-to-right” in the Reading Sequence radio group.

The “Examples” folder contains i-Star screen captures of the initial target and the data necessary for this example.

Press “Proceed” button.

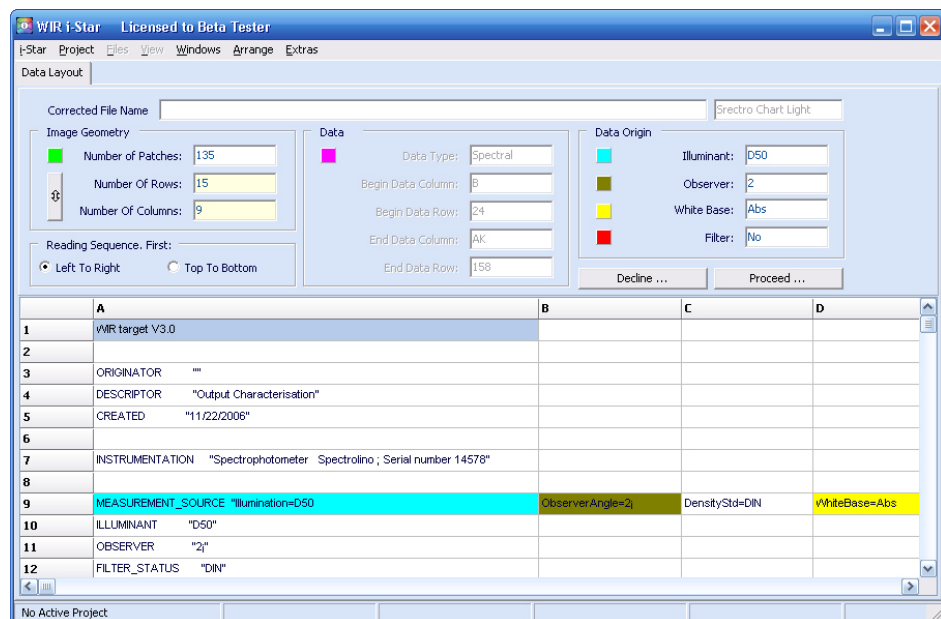


Fig. 2

i-Star will interpret the data contained in the file and evaluate the parameters for all predefined regions of interest. Unless the option is disabled, a message to check (and possibly reassign) the color map values of the target will appear. See (Fig. 3).

The color map values may be changed on the “Project Color Map” tab of the “Preferences” page.

Press F2 or choose “Preferences” in the i-Star menu.
Navigate to “Project Color Map” tab.

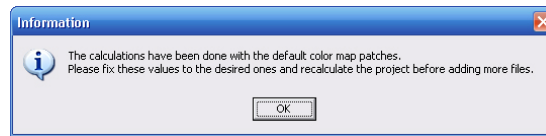


Fig. 3

i-Star has several ways of interpreting extreme values of L. Ideally, with images representing the entire L band, readings of L values range between 0 and 100. In reality, only values close to these are achievable. The first option, “Defined by user,” allows manual setting of these values reasonable for the test. “Defined by image” will analyze the image and assign values automatically. Finally, “Defined by map,” analyzes a percentage of patches from the target for each L extreme and computes a mean value. Depending on preferences and the necessity for repetition of the test, choose one setting. Keep in mind, only the first and last choices offer a basis for cross-examination of projects. See (Fig. 4).

In this example, use the “Defined by map” option and calculate the Lmin and Lmax values from the first percentile of extreme L values.

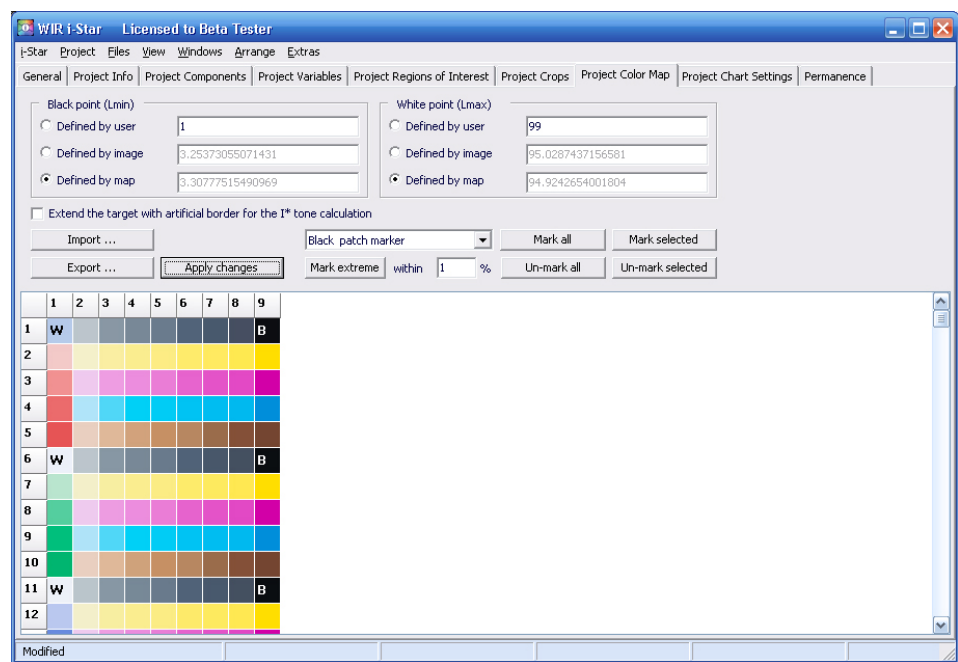


Fig. 4

Choose “Defined by map” for both black and white patches.
Click “Mark Extreme” button for a value of 1%.
Apply changes.

Next, define an area of neutral patches. Notice a predefined region of interest containing near neutrals and neutrals. This region, however, does not correspond with patches intended as grey on the target. Create a “Neutral Rows” custom crop to include all of these patches. The grey areas on the target are the first, sixth, and eleventh rows.

Navigate to “Project Info” tab.
Select an empty entry in “Custom Crop” drop down list.
Select the first row in the target and press “Mark selected” button. Repeat this for the sixth and eleventh rows of the target.
Press “Apply Changes” button, and when prompted for a name of the newly created custom crop, enter “Neutral Rows.”

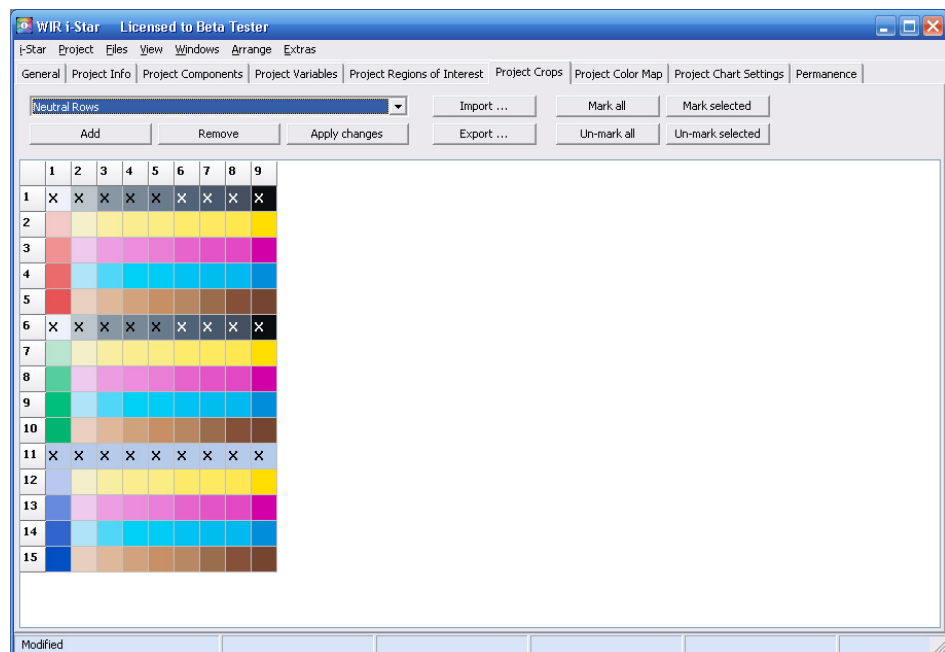


Fig. 5

Because the remaining files have the same geometry as the initial file, activate the Data Import Assumptions (DIA) engine. Make note, though, that the default selection of the DIA engine is the left-to-right reading sequence. In this example, mark this option in the Sequence Assumption radio group. The DIA engine makes assumptions about the size and measuring parameters of the “import to” targets based on the reference file for the i-Star project. Con-

sequently, before employing DIA, verify that the data is compatible. Data may not be compatible if it was gathered using different measuring devices or software. The check boxes in the “Data import options” section will assist in verifying that the data meets the necessary criteria for accurate comparison. See (Fig. 6).

Navigate to “Data import options” sub-tab on “General” tab.

Activate all assumptions and select the sequence of patches for top-to-bottom.

Deactivate “Import only user confirmed data” option.

Activation of the “Import only user confirmed data” option allows for additional modifications from the “Data Layout” page after the completion of the DIA engine cycle.

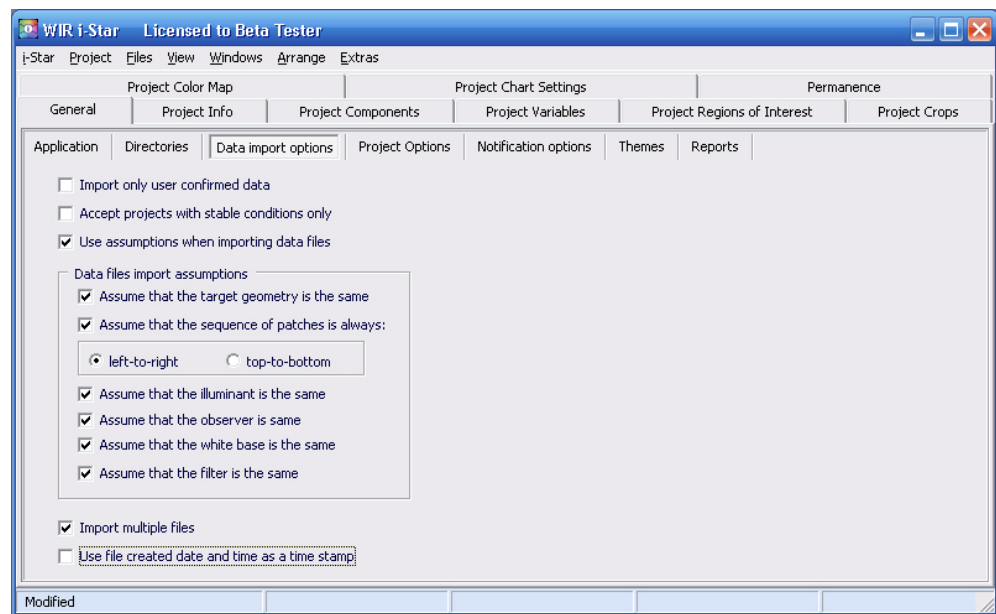
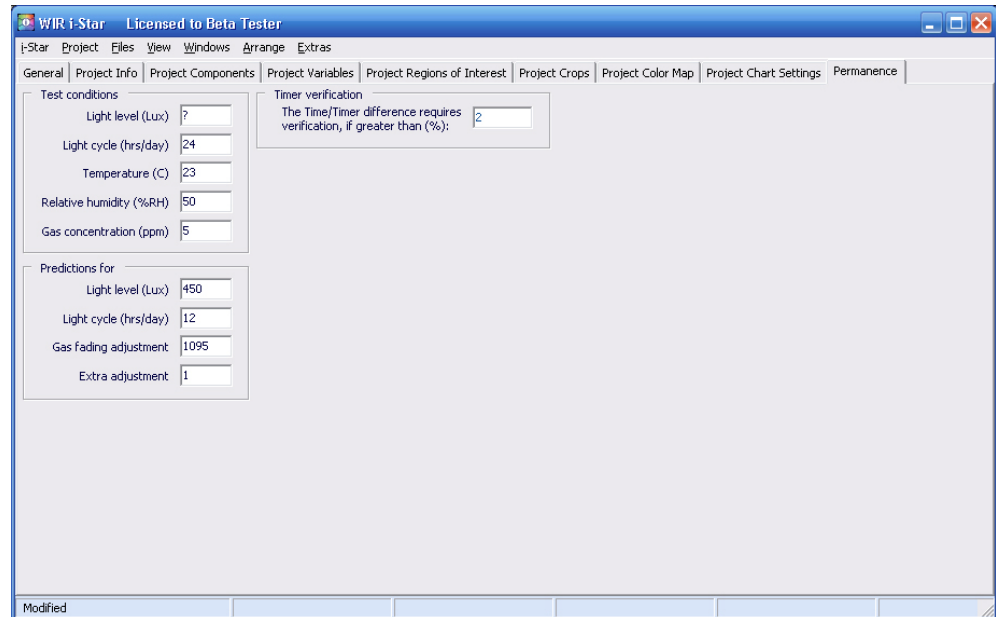


Fig. 6

Next, test specific information is adjusted. As mentioned earlier, the samples were continuously exposed to 5ppm of ozone in a protected environment at a temperature of 23°C and relative humidity of 50%. Adjust this information on the “Permanence” tab. See (Fig. 7).

Navigate to “Permanence” tab.

In “Test Conditions” group box enter 5 for the gas concentration value, 23 for the temperature, 50 for the humidity, and leave the remainder of values unchanged. Change the gas fading adjustment value to 1095.

**Fig. 7**

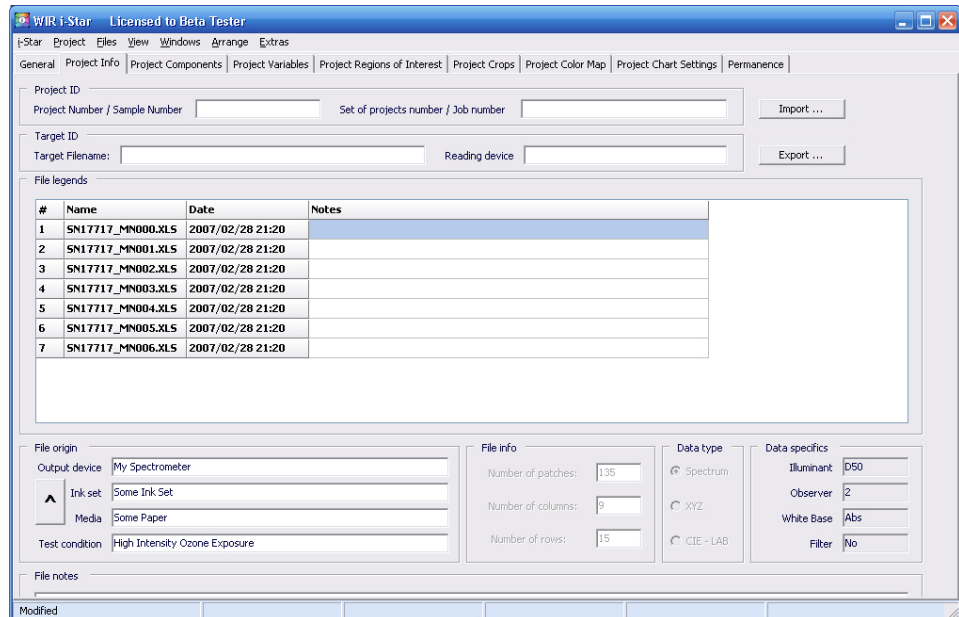
There is no need to change the Light cycle value for this project because the samples were exposed to light 24 hours a day. The default values in the “Predictions for” box mean that the target is expected exposure to no light in normal conditions of 23°C and 50% relative humidity at a fixed ozone level. The adjustment factor is a linear function of the ozone exposure level, and some sample values are offered as suggestions for this text box.

Next, specify more project information. For this example, use the dummy data. See (Fig. 8). Real data in subsequent tests will provide future reference.

Navigate to “Project Info” tab.

Enter “My Spectrometer” for output device, “Some Ink” for ink set, “Some Paper” for media, and “High Intensity Ozone Exposure” for the test condition value.

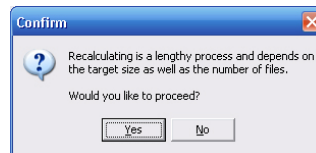
Note that additional data and other project specifics may be included in the box underneath. Examples of such notes are any abnormalities related to the test (e.g. light intensity and temperature fluctuations), side effects to the ink set or the printing medium (e.g. ink bleeding or granulation, aberrations and changes of the printing medium, etc.), and anything else considered important regarding the project.

**Fig. 8**

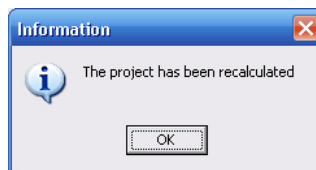
Return to “Project Description” page.
Press F2 or choose “Preferences” in the i-Star menu.

Because i-Star calculates results based on the parameters set on the “Preferences” page, any data-related parameter change requires a recalculation. Because the color map was modified, recalculate the averaged data for the project. See (Fig. 9).

Press F7 or select “Recalculate Project” in “Project” menu.

**Fig. 9**

A completion notice will appear. See (Fig. 10).

**Fig. 10**

Press Ctrl + a or choose “Add to Project” in “Files” menu.
Choose “sn17717_mn001_ms.xls” in the open file dialog.

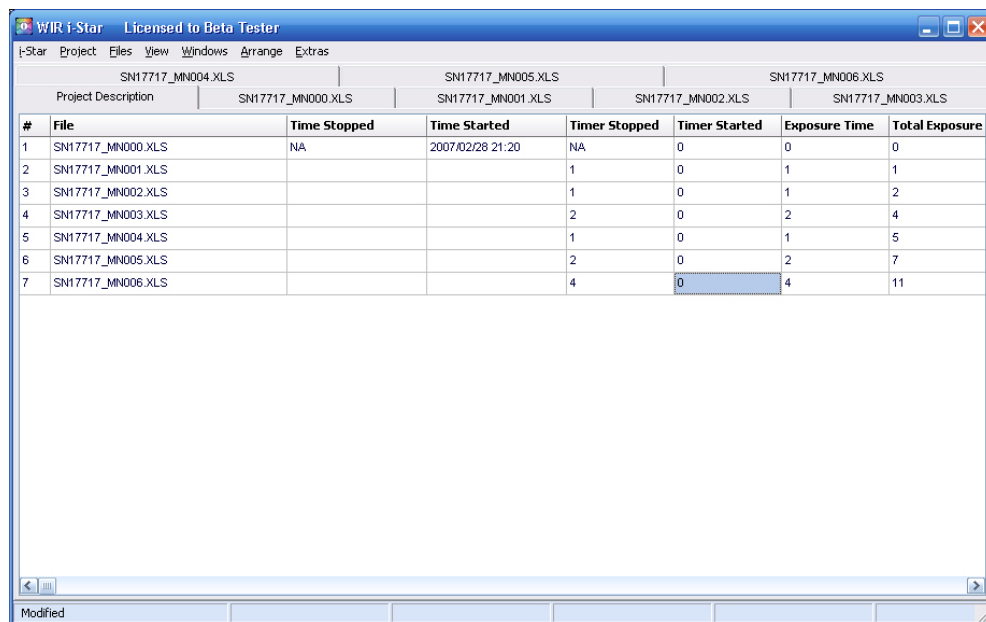
i-Star will process the file and report on the “Data Layout” page. Return to the “Project Description” page.

Numerically add the remaining project files into the folder.

Now, enter the timer values for these measurements in the i-Star “Project Description” page. The time intervals between measurements were respectively, one, one, two, one, two, and four hours. See (Fig.11).

Navigate to “Project Description” tab of the Main i-Star window.

Enter the values one, one, two, one, two, and four in the second through seventh rows of the “Timer Stopped” column.



#	File	Time Stopped	Time Started	Timer Stopped	Timer Started	Exposure Time	Total Exposure
1	SN17717_MN000.XLS	NA	2007/02/28 21:20	NA	0	0	0
2	SN17717_MN001.XLS	1		0	0	1	1
3	SN17717_MN002.XLS	1		0	0	1	2
4	SN17717_MN003.XLS	2		0	0	2	4
5	SN17717_MN004.XLS	1		0	0	1	5
6	SN17717_MN005.XLS	2		0	0	2	7
7	SN17717_MN006.XLS	4		0	0	4	11

Fig. 11

Now that all files have been imported, the data is ready for analysis. Before analysis, though, check the “Target Model” window. This window shows the visual representation of imported data and must look exactly like the target used for collecting the data. See (Fig. 12).

Press Ctrl + t, or select “Target Model Window” in the “View” menu.
Press “g.”

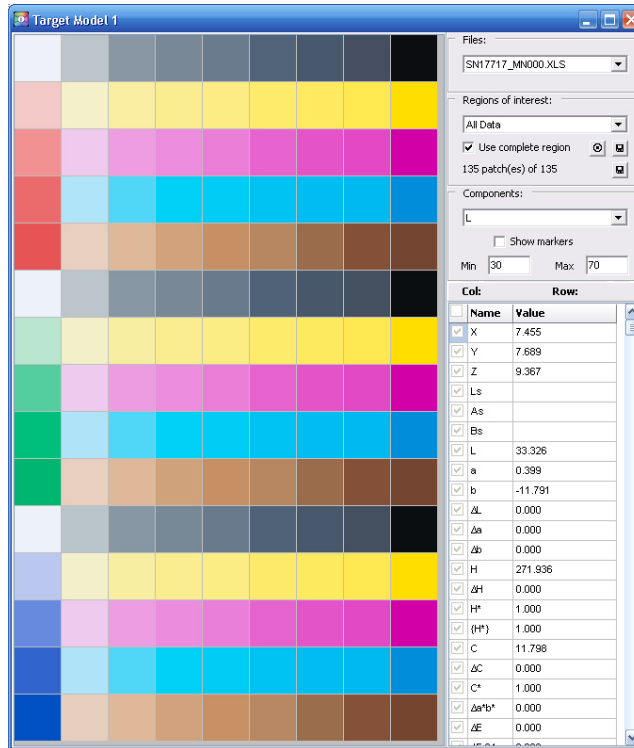


Fig. 12

The target window now shows the reference target, i.e. the original measurement of the print. This window offers a number of controls all described in the i-Star User Guide. The first control changes the file (and the corresponding target) represented by the image on the screen.

The grid on the “Target Model” window can be turned on or off any time. To toggle the appearance of the grid, press “g.” Change the view to the last measurement and a direct comparison of skin tone patches will appear from before and after the test. Because the grid improves visibility of the target, leave the target model grid visible.

Next, view the target model for the last print in the series.

Select “sn17717_mn006.xls” in the first drop down list. See (Fig. 12).

The second drop down list changes the region of interest/custom crop represented in the “Target Model” window. View “Neutral Rows” region.

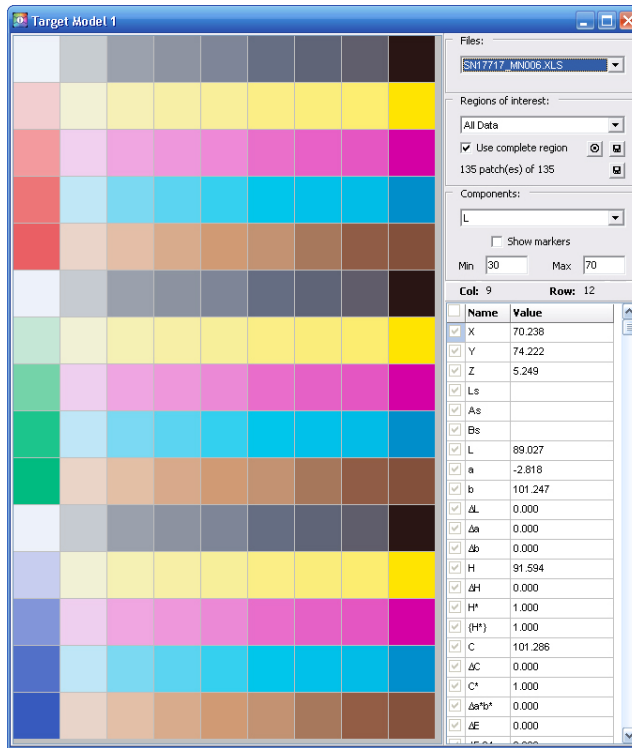


Fig. 13

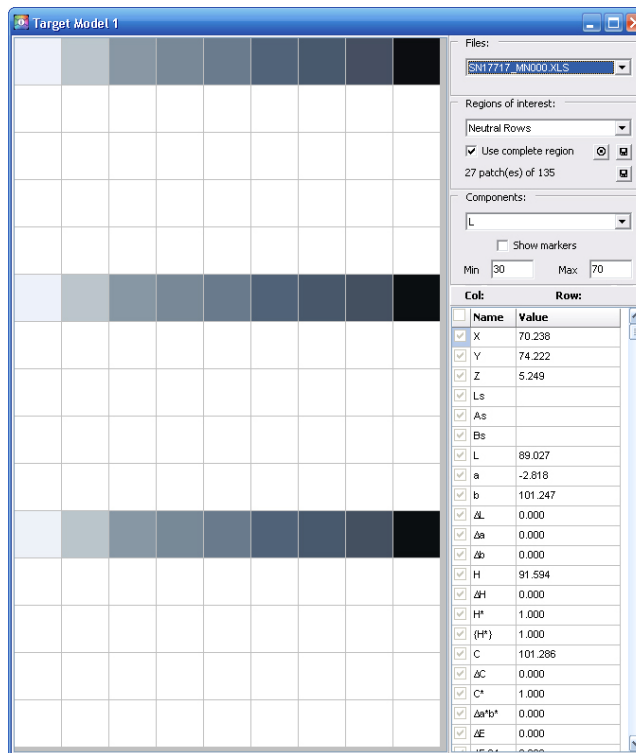


Fig. 14

Select “sn17717_mn000.xls” in the first drop down list.
Select “Neutral Rows” in the second drop down list. See (Fig. 14).

Observe the changes of patches in the rows with Neutral patches.

Select “sn17717_mn006_ms.xls” in the first drop down list. See (Fig. 15).

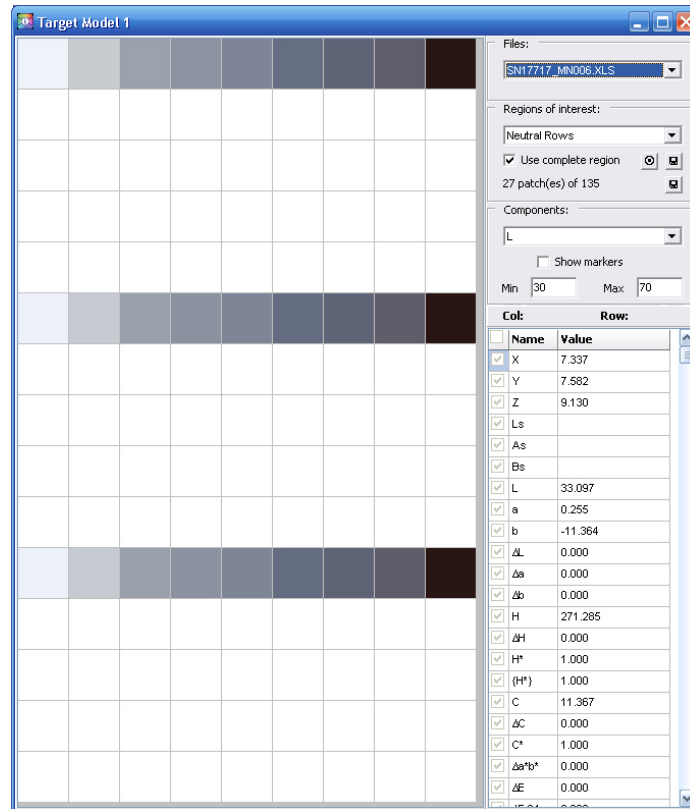


Fig. 15

Now that all data has been imported, close the “Target Model” window. In some instances, the “Target Model” window will be opened much sooner. For example, data sets imported from multiple measuring systems and associated software will require the “Target Model” window.

Close “Target Model” window.

Next, consider the project charts. i-Star provides a number of easy charting options which may include spectral and hue angle distributions, i-Star component development and results, tonal reproduction charts, and component histograms. Custom specifications of the charts is possible, so becoming

familiar with the manual entries of factors will lead to greater efficiency. The “Chart” window consists of a single page with the “Settings” and “Chart” tabs. The “Chart” tab contains the chart and a lower panel with controls. Right-click any unused surface on the lower panel to access the chart selection menu which contain choices for all available charts. The “Settings” tab contains all controls for the appearance of charts. The individual group box titles indicate settings for the charts.

Press **Ctrl + g** or choose “Charts Window” from “View” menu.

This project considers changes for I^* total, I^* tone, I^* color, Δe_{2000} , hue angles, and L values. The main regions of interest are the complete data set, neutrals, and near neutrals. Additionally, an evaluation of differences between the patches with L_{max} and L_{min} will occur. See (Fig. 16).

Navigate to “Settings” tab.

In the I^* Component Results and Averaged Parameter Development check the boxes for I^* total, I^* tone full, I^* color full, Quality Control for both I^* tone and I^* color, Brightness Factor full, and Contrast Factor full.

Navigate to “Chart” tab. Check “Show legend” box.

Choose “Adjusted Time (Yrs)” in the x axis group box.

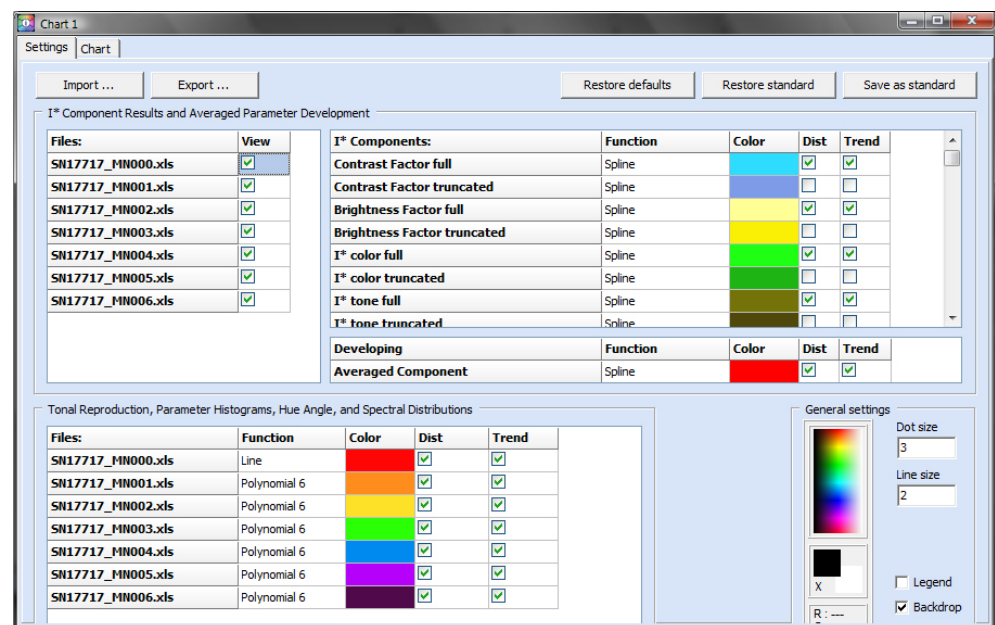


Fig. 16

The chart window will allow easy interpretation of both measurement and trend lines. See (Fig. 17). Click on each data point and the status bar will show the corresponding file and x,y coordinates.

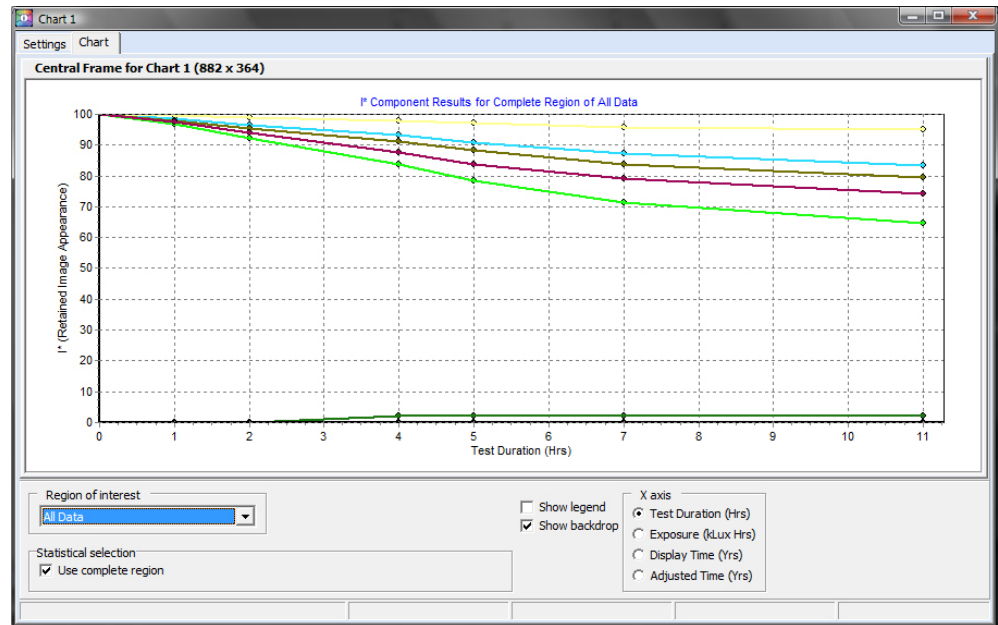


Fig. 17

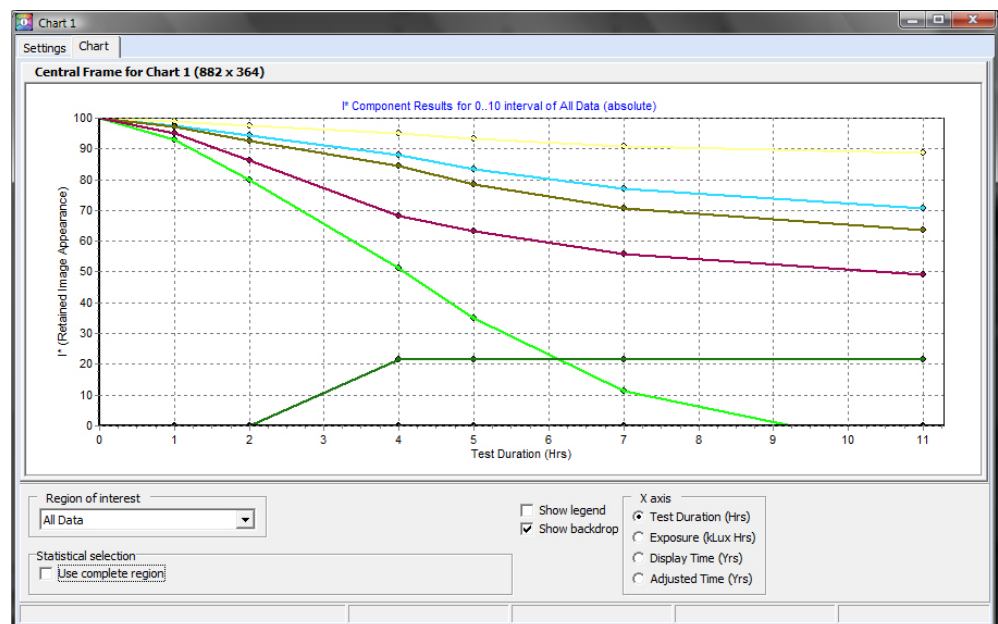


Fig. 18

Uncheck “Use complete region” check box. See (Fig. 18).

View the worst 10% of patches, and note that those affected by very low levels of quality. The most visibly affected patches on the target are those with lower L values and neutral patches. i-Star may also analyze data for any chosen color space region of interest. Consider the region of “Neutral Rows” as defined in the template. See (Fig. 19).

Select “Neutral Rows” in the Regions of Interest drop down list.
Check the “Use complete region” check box.

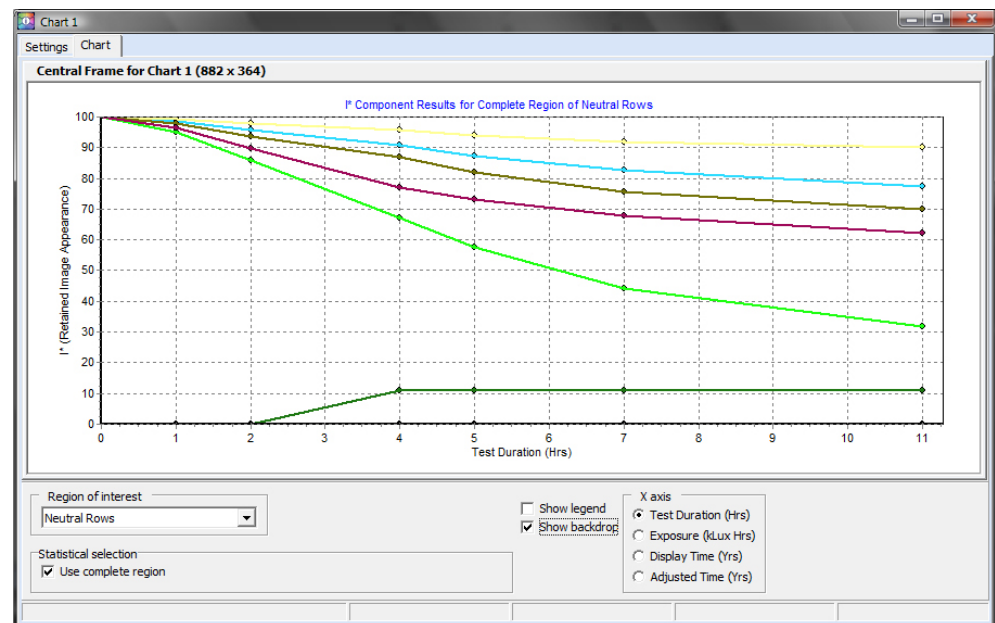


Fig. 19

This chart indicates that the region of neutral rows have deteriorated significantly, and as much as 11.11% of the patches have a hue angle shift greater than 60° in the LAB color space.

i-Star can also analyze and report Δe values. By default, all Δe values are calculated and presented on the corresponding tabs for each patch of the target measurements. An overall value or histogram can be created for better analysis of results. Observe the Δe histograms for all the patches of the target shown in increments of 5 for the value of Δe_{2000} .

Right-click on the panel and select “Component Histogram” in “Context” menu.

Select “Neutral Rows” in “Region of interest” group box, and ΔE_{2000} in the “Components” group box and check “Use complete region,” and choose a step interval of 3. See (Fig. 20).

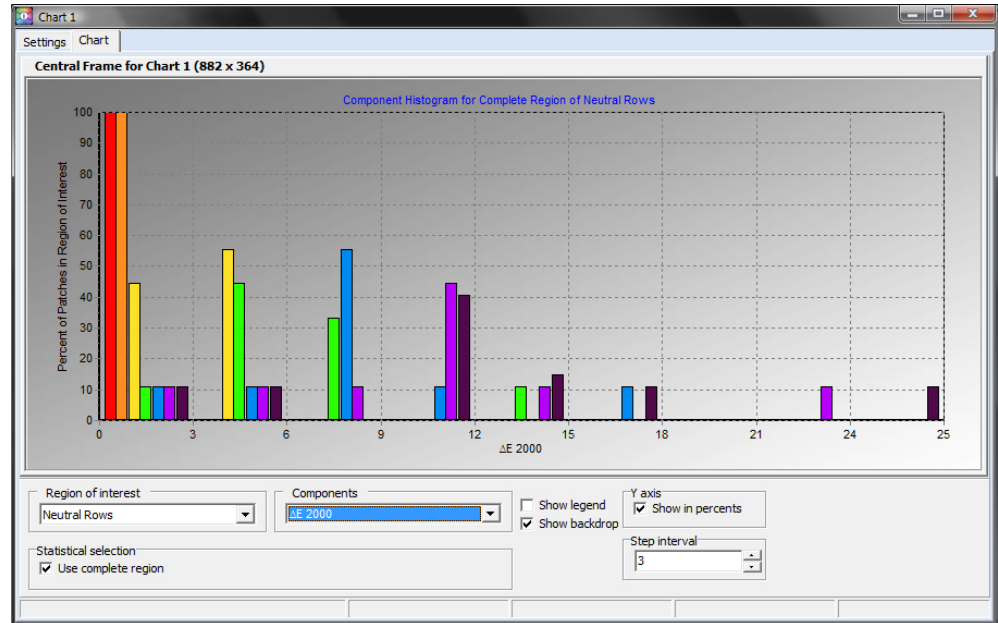


Fig. 20

View the summary of this chart with average Δe_{2000} values on the Component Development chart. See (Fig. 21).

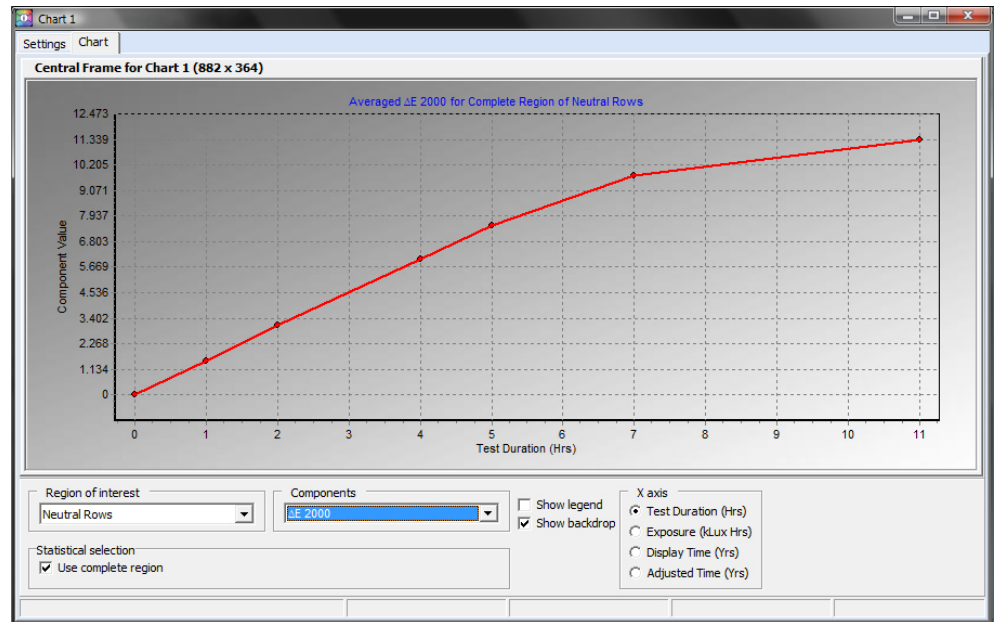


Fig. 21

Right-click on the panel and select “Component Development” in “Context” menu.

Observe the “Tonal Reproduction” chart for this target, and focus on the region of interest the “Neutral Rows” custom crop. See (Fig. 22).

Right-click on the panel and select “Tonal Reproduction” in “Context” menu.

Select “Neutral Rows” in “Region of interest” group box.

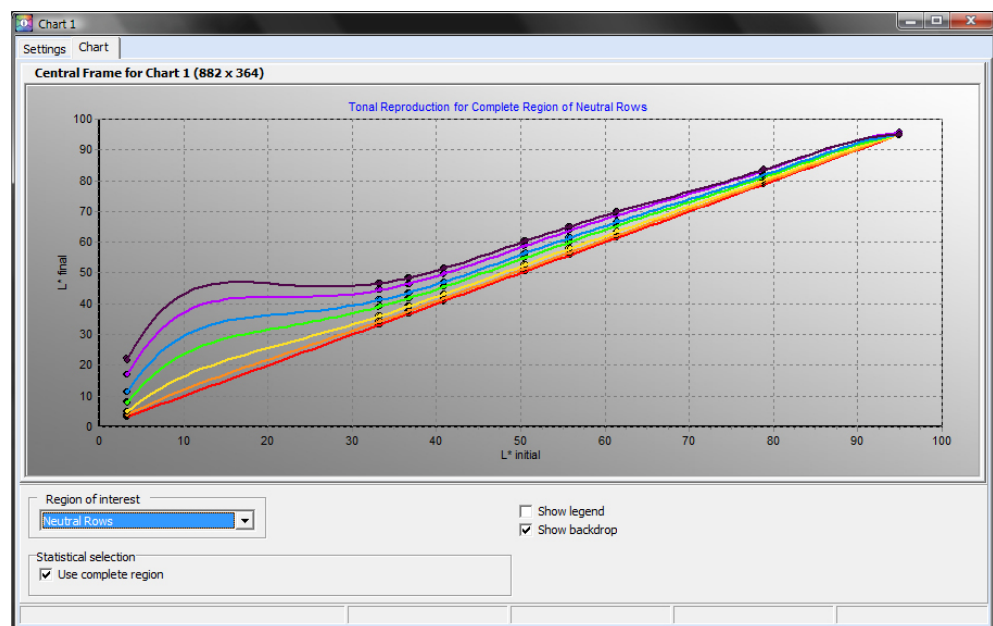


Fig. 22

Check the spectral distributions for some “Neutral Rows” patches. Because the more affected patches, according to the last chart, were the darker ones, analyze how one of the “darker” patches changed. Use the i-Star spectral distribution chart.

Right-click on the panel and select “Spectral Distribution” in “Context” menu.

Change the column value to 9 and the row value to 11.

The tricolor chart displays overall spectral response of the target. See (Fig. 23). Lower wavelengths represent the shades of blue and violet. The center wavelengths represent greens, cyans and yellows. The higher wavelengths represent the oranges and reds. Observe the chart and evaluate the changes that have occurred.

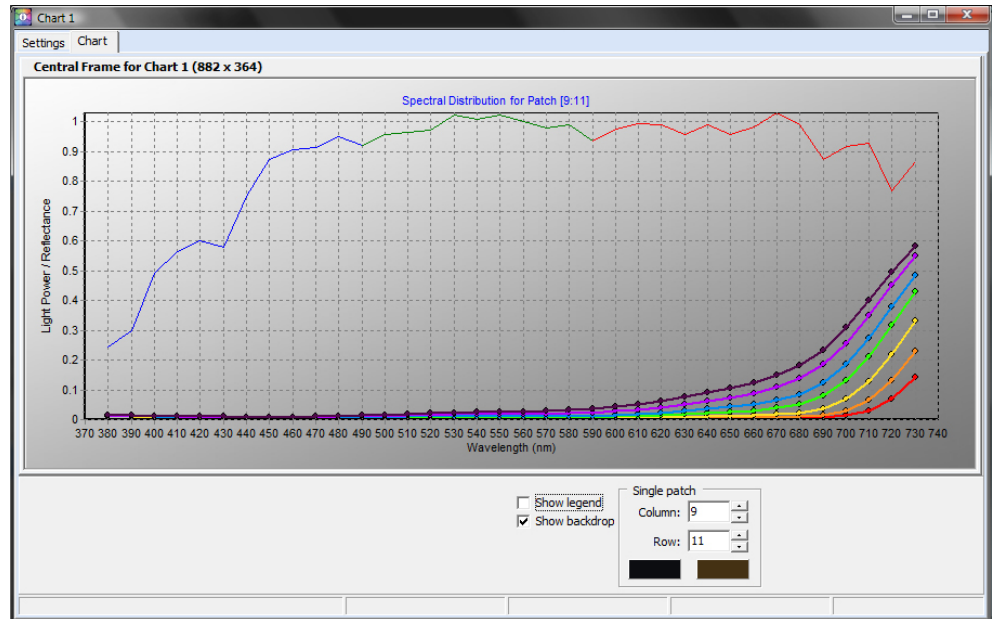


Fig. 23

Notice the cyan patches have also lost fidelity, so observe the spectral distribution of a cyan patch.

Change the column value to 6 and the row value to 9. See (Fig. 24).

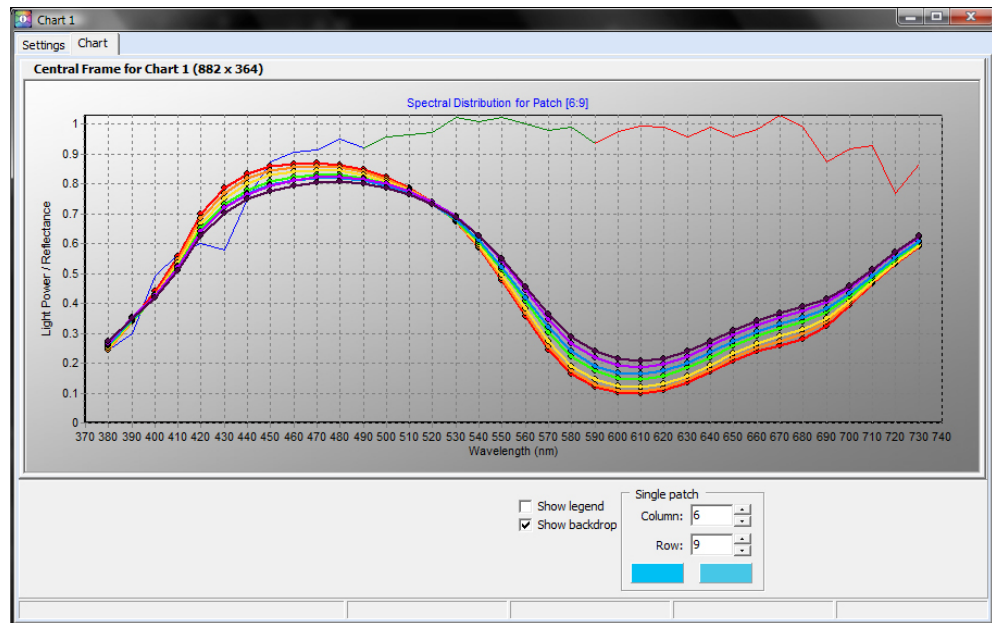


Fig. 24

The cyan patch lost some of the blue tones and gained small amounts of yellow and orange. This explains the overall lightening of the patch and the slightly more yellow tone.

Experiment with other row/column values and observe spectral distribution changes.

Using the i-Star User manual will help to maximize productivity when using the i-Star application.

Finally, save the project. This allows access to data easily without having to reenter any information. i-Star will save the complete set of data, a snapshot of the settings, and the results of all calculations. Please note that i-Star will not save any open windows or generated graphs, so export either of these items before closing the windows. See (Fig. 25).

Although i-Star saves all project data entered in the application, as a further safeguard against data loss, keep the original source files and periodically back up all i-Star projects.

Press **Ctrl + s** or select “Save Project” in the “Project” menu.
Choose a filename for the project.
Click “Save” button.

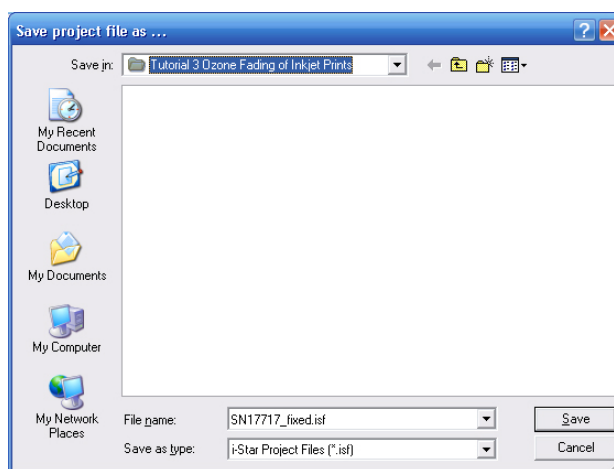


Fig. 25

WIR i-Star contains a custom report creation utility, allowing the creation of PDF reports for the analyzed data. This tutorial shows the steps taken to create a standard WIR report using the i-Star application.

Click “PDF Report Preview Window” under “View” menu.

The Summary page of the PDF Report Preview window will appear. The first page on the PDF will contain a summary of the project details. The file-name text box displays the name of the PDF. Choose a name suitable for the project. In this example, name the PDF “Ozone_report_2007_12_13.pdf.” The remaining three check boxes and corresponding text boxes designate the destination of the PDF file. For this example, place the PDF in the same folder as the project. Check the “at project folder” check box. The remaining entries, colored white, must be filled from the “Preferences” page under the “Project Info” tab. These fields are not required, but provide more detail about the nature of the project. All yellow fields (text boxes) may be directly modified from the PDF Report page. Be sure the ‘Wilhelm Imaging style (short)’ radio button is checked. This is the reporting format of a standard Wilhelm Imaging Research report.

The check boxes on the right side of the PDF Report Preview show which pages are included in the current “Report Preset” selection (in this case ‘Wilhelm Imaging style short’). The buttons to the right of the check boxes allow you to preview the pages before printing the PDF. A green label on the button indicates that you are currently viewing the page represented by that button. In order to view a particular page, the corresponding check box must be checked (i.e. that page must be included in the PDF report). Click each to view the PDF page.

After reviewing the PDF preview, click “Create PDF Report” button to print the PDF.

Continue exploring i-Star. Explanations of remaining controls, including those for the main settings page, are available in the i-Star User Guide. When done, press Ctrl + q or choose “Quit” in the “i-Star” menu. Save any additional changes to the project.