imatest®

Part 3: Table of contents

Common operations

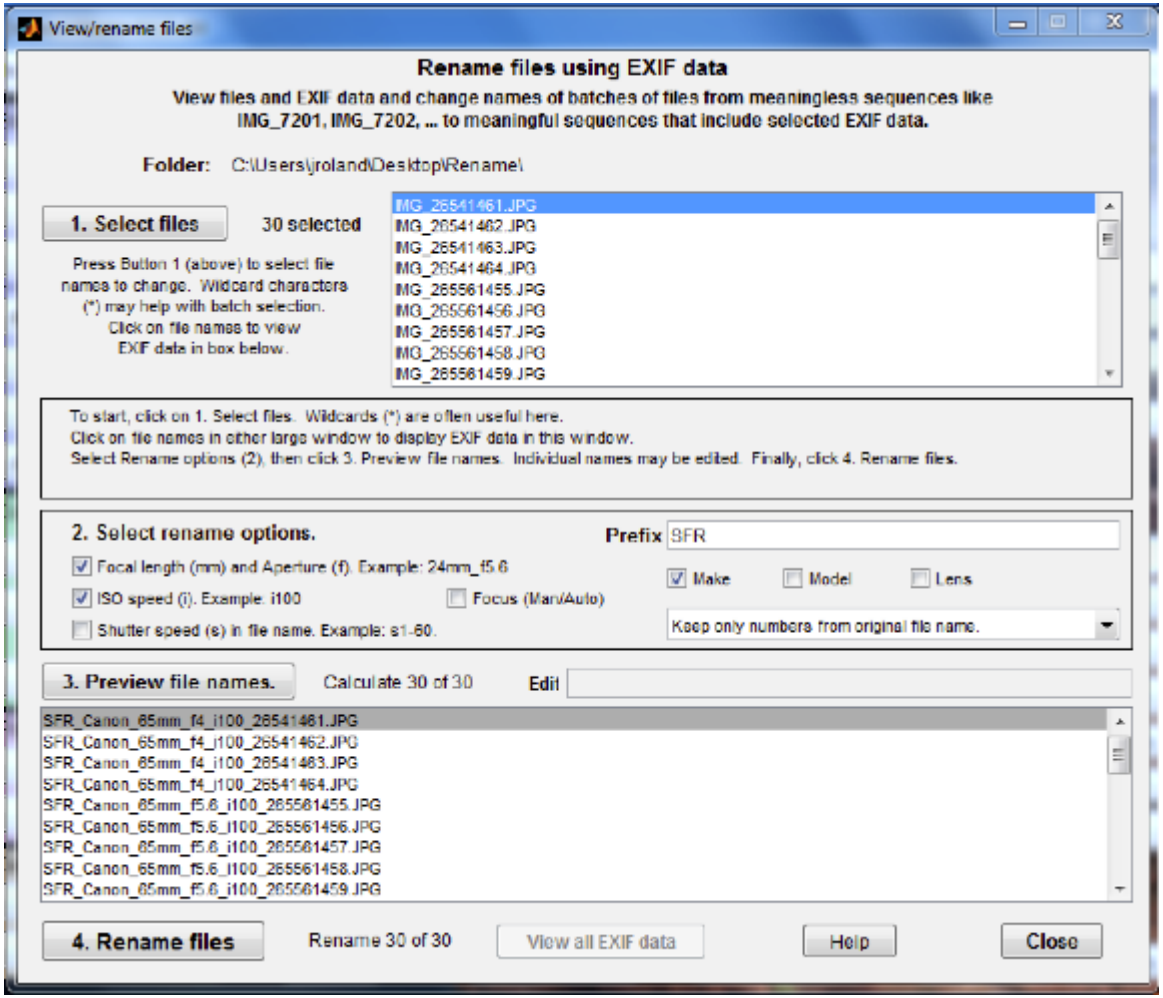
(workflow for most modules)

- **Rename files (if needed).**
- **Select file (batch, etc.)**
- **Select region of Interest (ROI).**
  - Same size as a previous image: option to use same ROI.
  - New image size: coarse selection followed by fine adjustment
  - Automatic ROI detection available for some modules.
- **Set options.**
- **Save results.**

View/Rename files

Changes meaningless file names (e.g., IMG_8299.jpg) into meaningful names using EXIF data and user input.

1. Select folder.
2. Select files. Can use wildcards, etc.
3. Select rename options.
4. Preview.
5. Rename files.



File selection

The first operation in most modules.

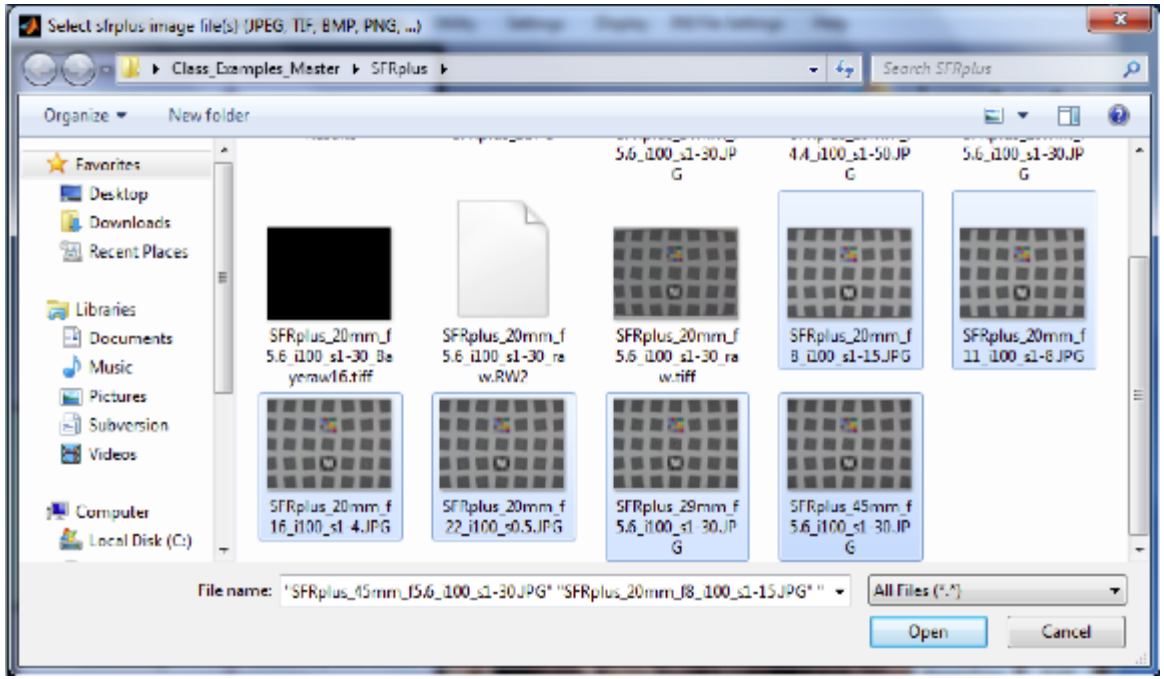
View can be changed to thumbnails.

Batch runs

Several files can be selected (**fixed modules**).

Use control-click or shift-click.

Image size and framing must be the same for all files in batch, except for SFRplus or eSFR-ISO.

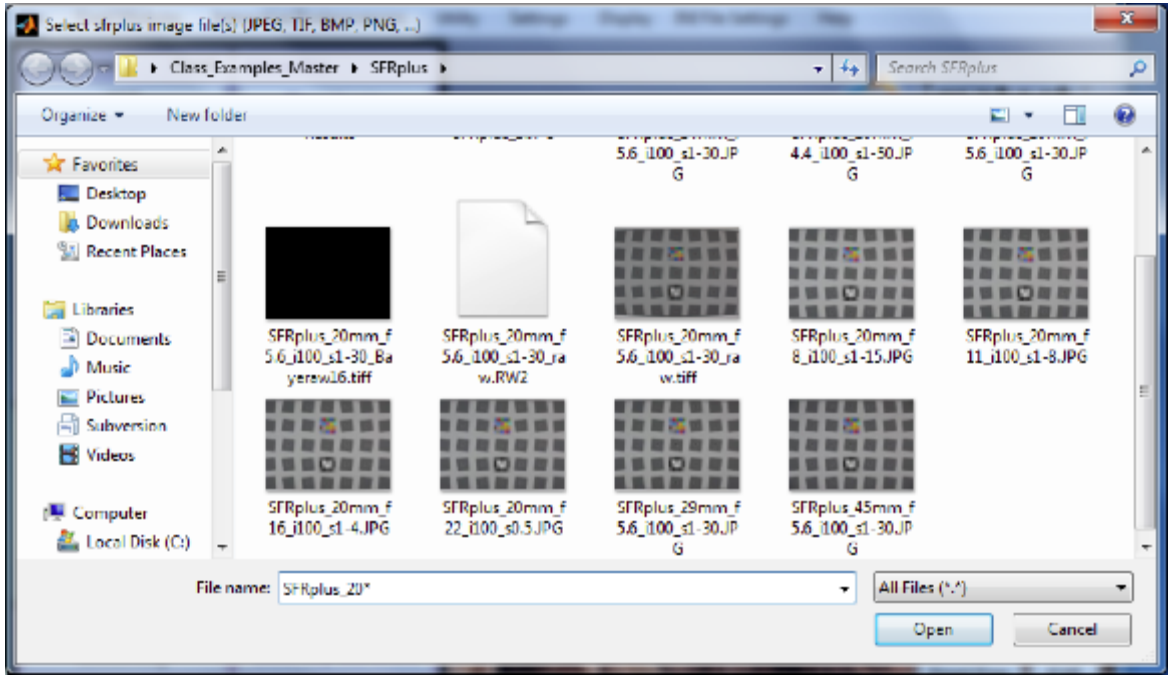


File selection
Wildcards for batch runs

Enter file name with wildcard (* in SFRplus_20*.jpg) in the File name box, then press Enter.

Only the matching files are shown.

Use shift-click to quickly select batch for processing.



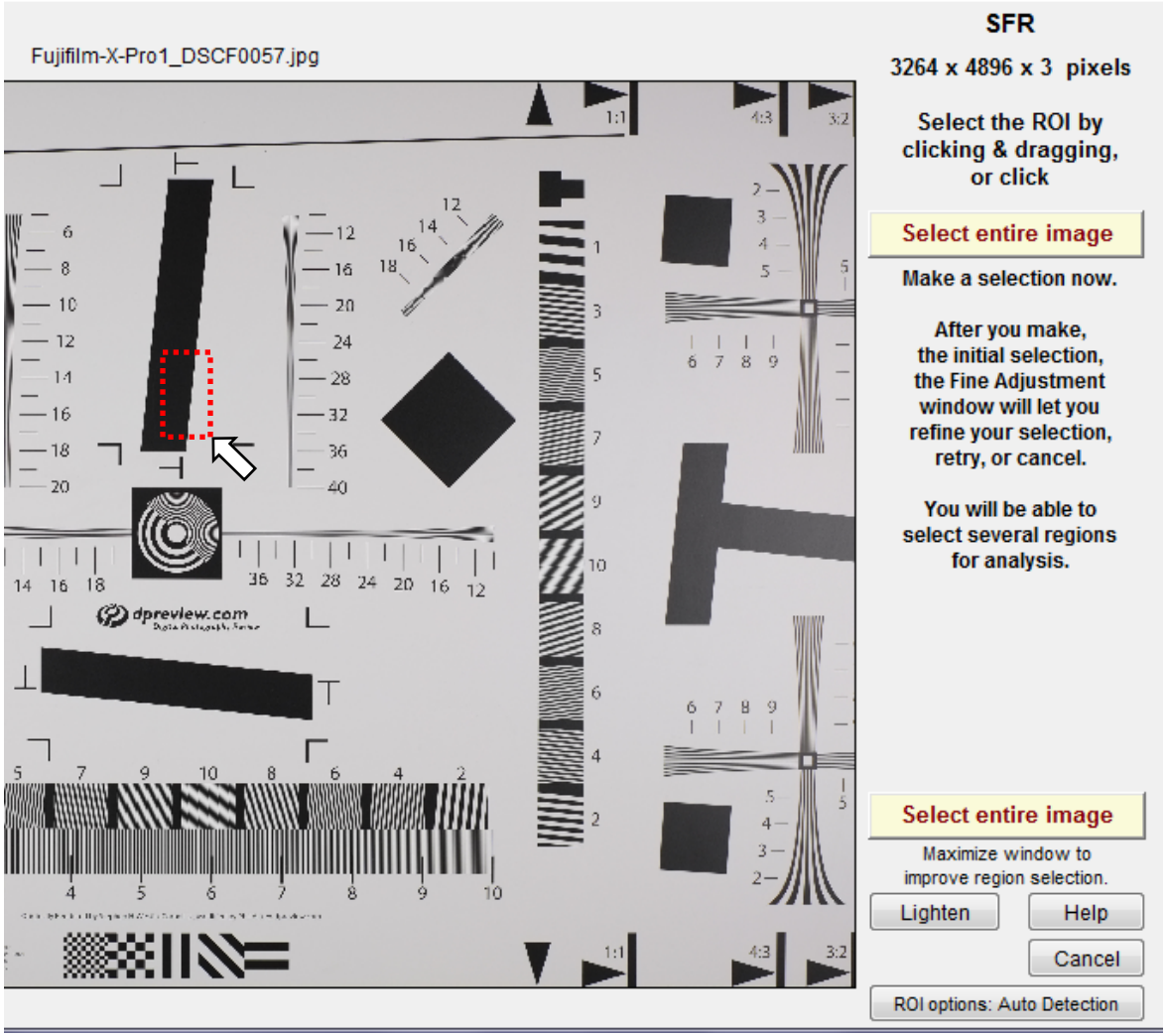
ROI (Region of Interest) Selection

Select initial (coarse) ROI clicking and dragging cursor.

Selection doesn't need to be accurate: You'll refine it in the fine adjustment window.

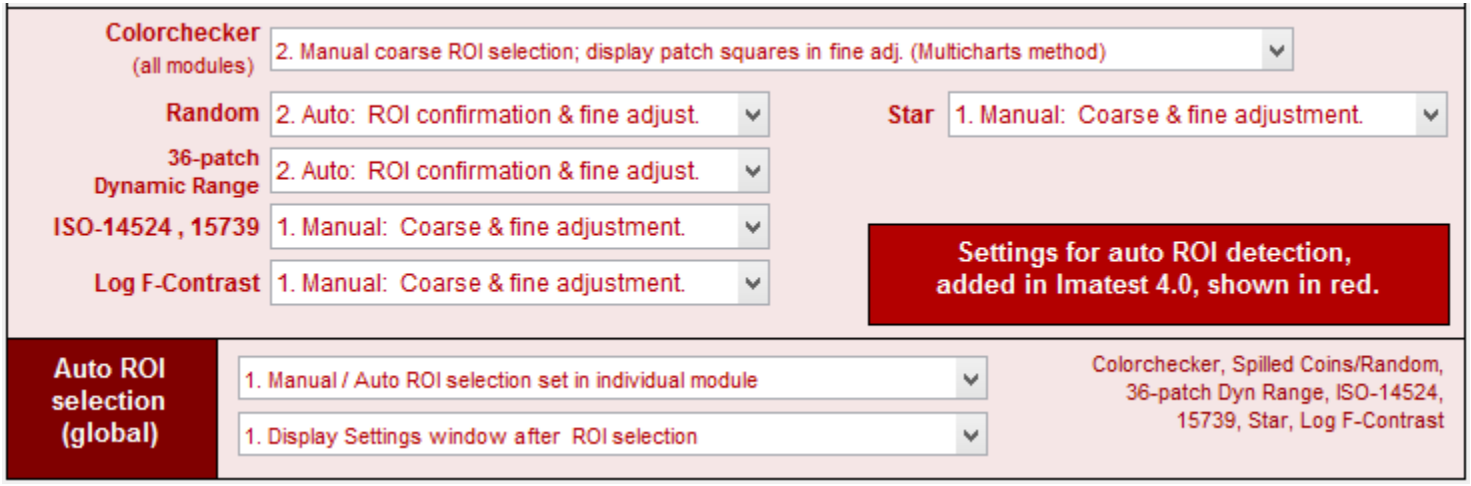
Follow instructions for fine adjust.

No ROI selection in SFRplus & eSFR ISO, which have automatic ROI selection.



Automatic ROI (Region of Interest) Selection

Options set in ROI Options (bottom of Imatest window).



Auto ROI selection uses Colorchecker features or registration marks.

Modules that have Auto ROI option: Spilled Coins/Random, 36-patch Dynamic Range chart, ISO-14524*, ISO-15739*, Star*, Log F-Contrast*

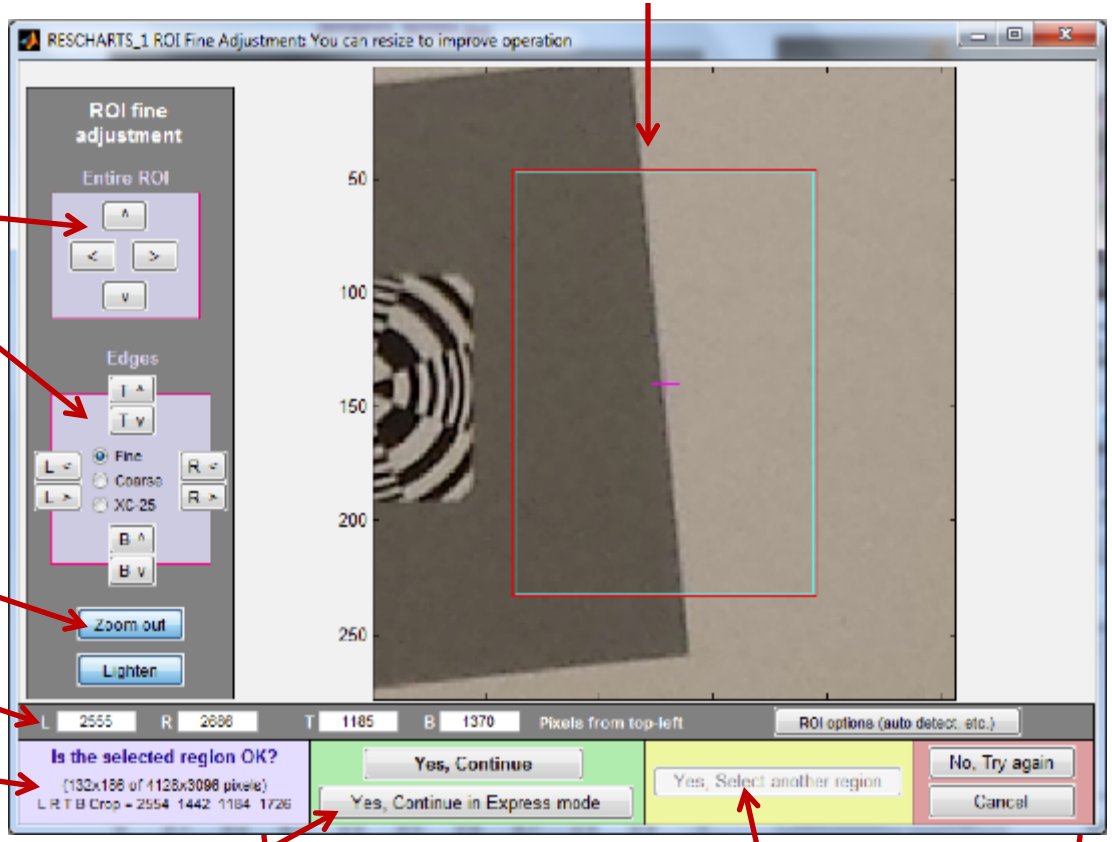
*modified with added registration marks.

Automatic ROI selection was included in SFRplus from the beginning.

ROI Selection: Fine adjustment :simple

Rectangular

Maximize window for visibility



Move entire ROI

Adjust T, B, L, R

Fine = 1 pixel/step
Coarse = 5 pixels/step
XC-25 = 25 pixels/step

Zoom in/out

L R T B Pixel locations

Crop/image size

Express mode skips over Input dialog box (uses saved settings)

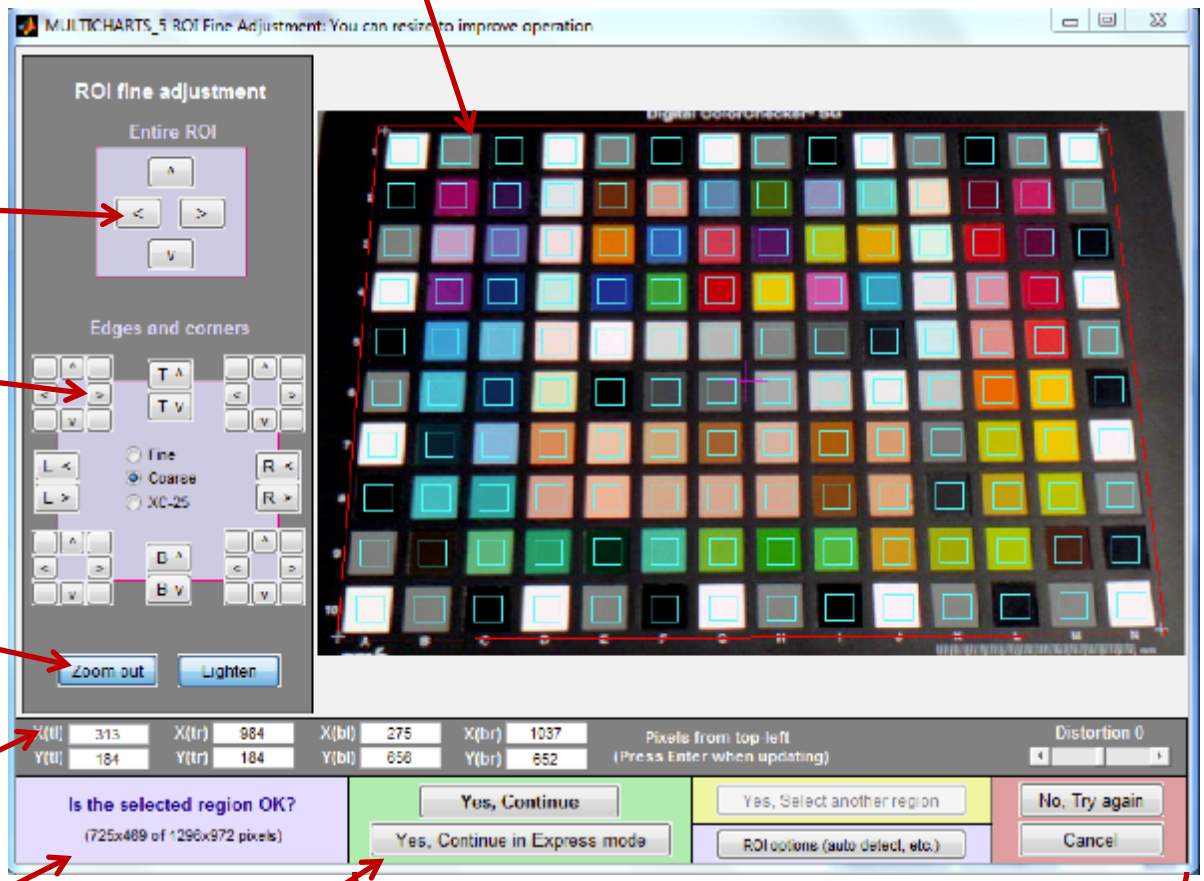
Actions

Select another region (SFR-only)

ROI Selection: Fine adjustment: complex

Maximize window for visibility

May be distorted (not rectangular)



Move entire ROI

Adjust T, B, L, R, or corners

Fine = 1 pixel/step
Coarse = 5 pixels/step
XC-25 = 25 pixels/step

Zoom in/out

Lighten (enhance)

Corner X,Y Pixel locations

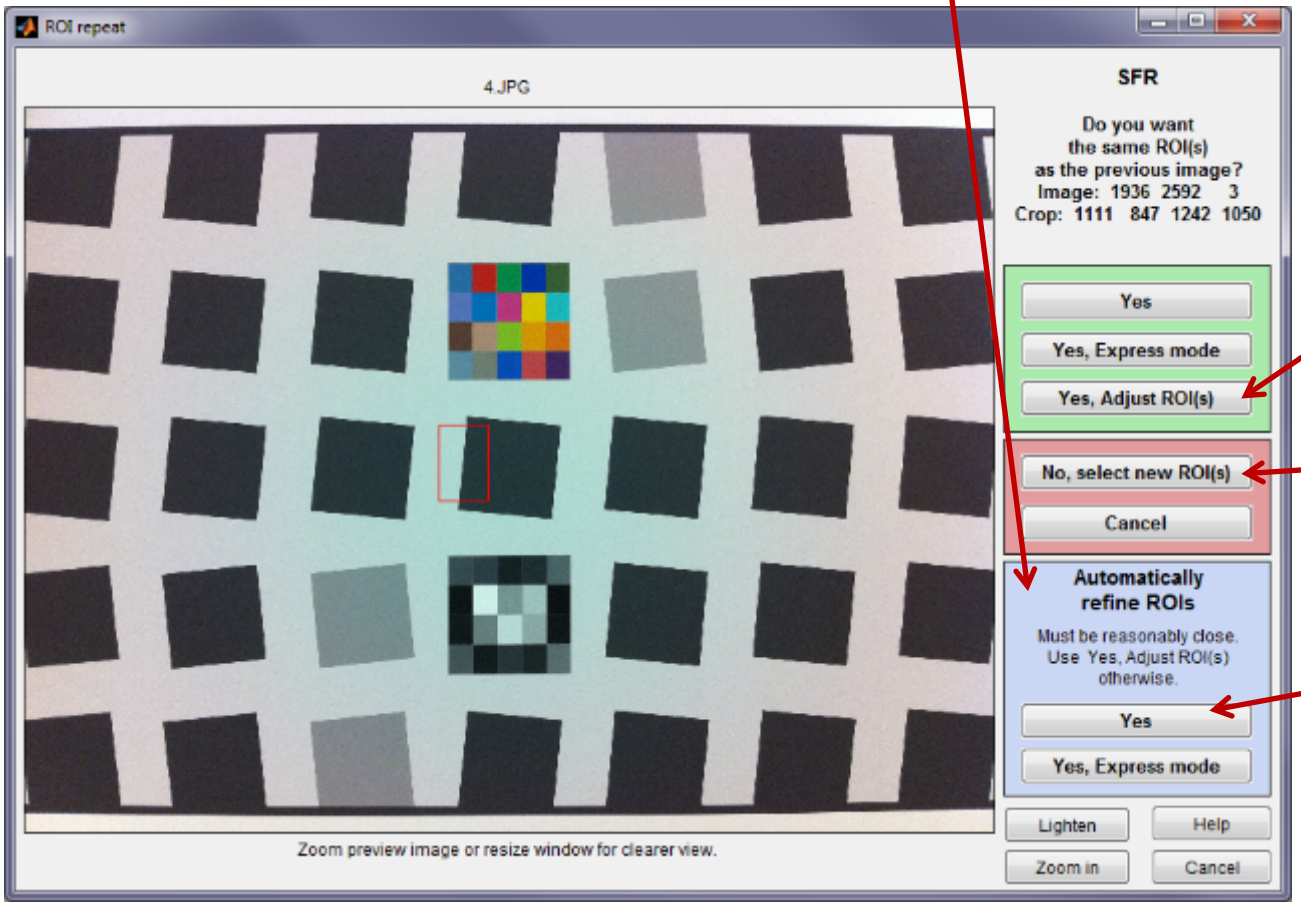
Crop/image size

Express mode skips over Input dialog box (uses saved settings)

Actions

SFR repeated runs: ROI Selection

SFR-only: Auto-refine ROIs if they are close to desired values.



Open fine adjustment window (single or multiple region

Select new ROI

Repeat ROIs, but with automatic fine adjustment (must be close)

SFR-only

Typical Input dialog box

Online Help
opens web page

Plot selection

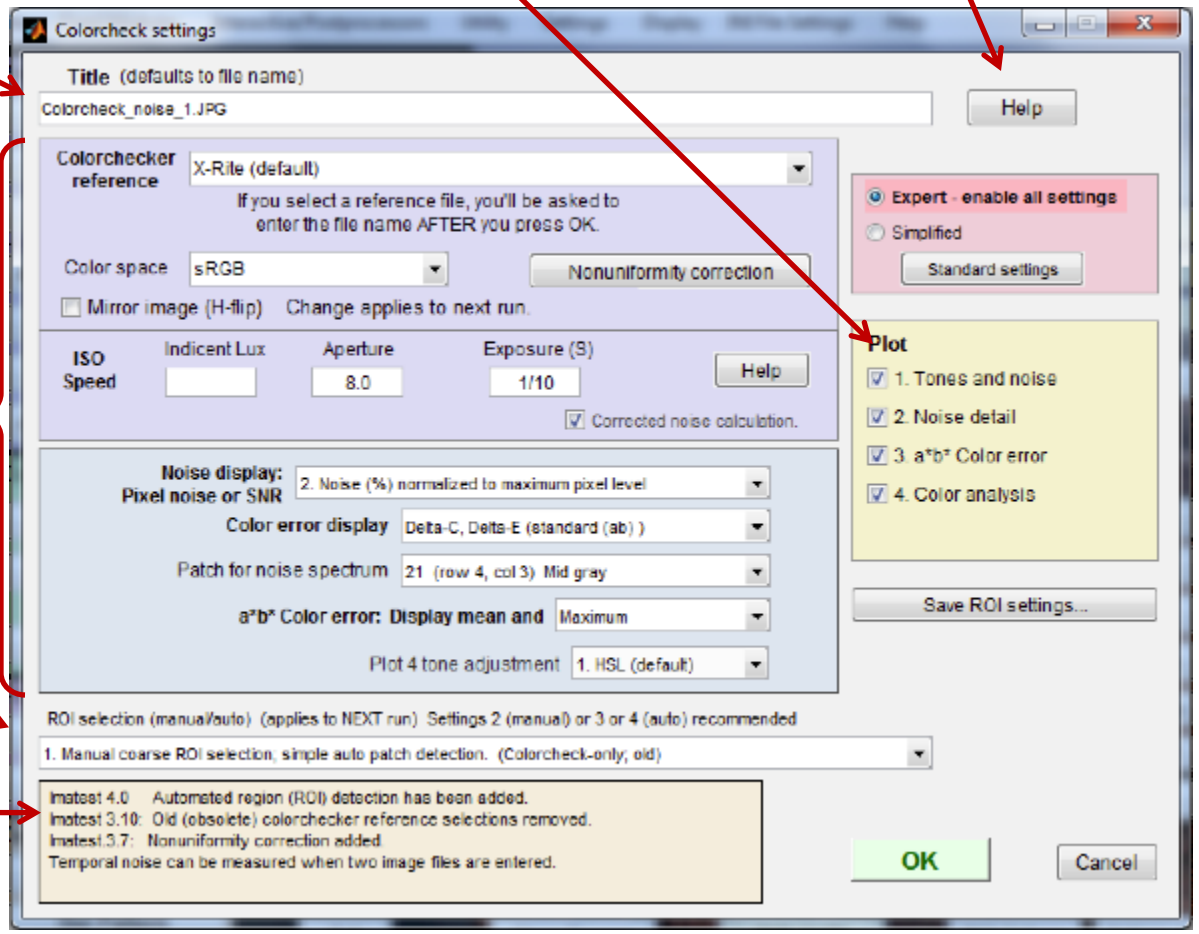
Title:
edit if needed

Calculation and display options

(different for each module)

Auto/manual ROI selection (next run)

News:
Recent changes to this module



Typical Save Results

Select individual plots to save.

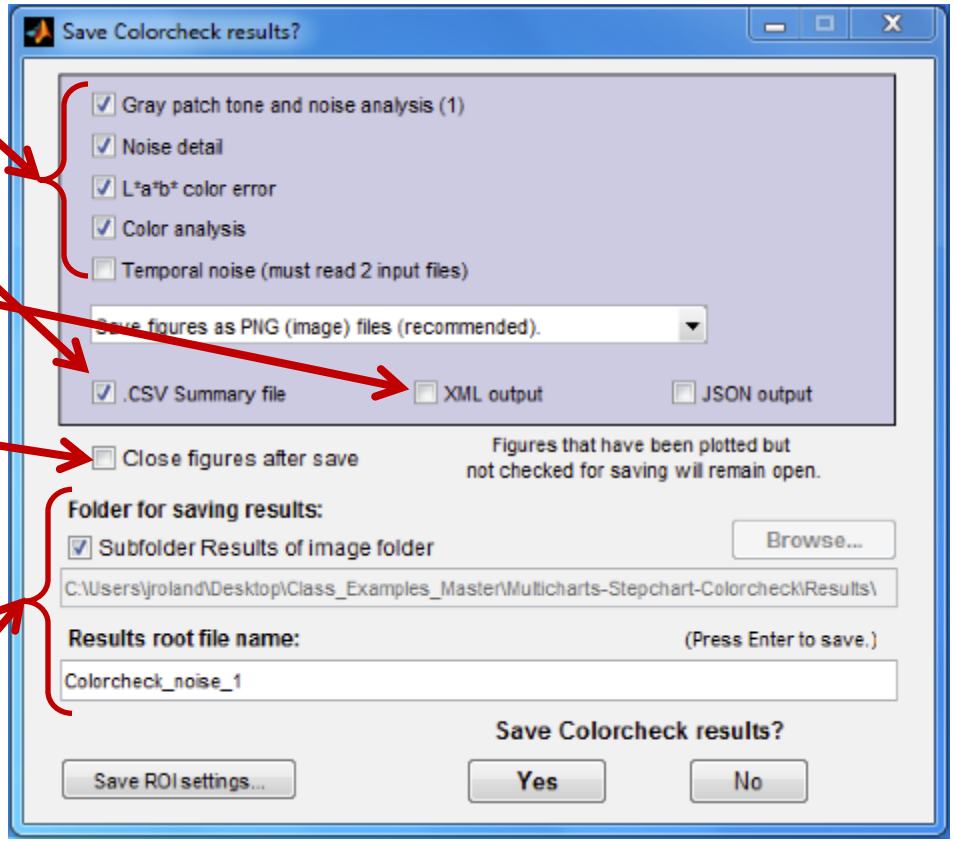
Save CSV output file.

Save XML output file.

Close figures after save.

For large batch runs where too many open files slows run.

Save folder and root file name (_CSV etc. appended)



Recent addition: save PNG (standard image) or FIG (Matlab figure; large) files

Detailed Module Descriptions: I. Sharpness

SFR – Sharpness (MTF/SFR) & chromatic aberration (CA) from slanted edges

SFRplus – Highly automated analysis of SFRplus chart for sharpness, CA, distortion, tonal response, gamma, and color accuracy.

eSFR ISO – Highly automated analysis of ISO 12233:2014 chart

MTF Compare – Postprocessor for SFR & SFRplus: compare MTFs.

Batchview – Postprocessor for SFRplus: for displaying lens test results

OIS/Image compare – Postprocessor for Optical Image Stabilization.

Rescharts – Interactive analysis of resolution related charts:

Slanted-edge SFR

SFRplus – Used to set up parameters for automated runs

Log F Calculate MTF from sinusoidal log frequency chart

Log F-Contrast Effects of signal processing on MTF measurements

Siemens Star, Random/Dead Leaves/Any Image Sharpness

Modules
Detailed descriptions
II. Color/tone/geometry

Stepchart – Tonal response, noise, and ISO sensitivity from B&W step charts

Dynamic Range Postprocessor for Stepchart and Multitest: calculates DR by combining several step chart exposures.

Colorcheck – Analyze the X-Rite Colorchecker for tonal response, color accuracy, and noise

Multicharts & **Multitest** – Interactive & fixed analysis of a large variety of color & grayscale charts. Performs most Stepchart, Colorcheck functions.

Distortion – Lens distortion (barrel, pincushion), decentering

Dot pattern – Lens distortion, Lateral Chromatic Aberration (CPIQ)

Uniformity – Measure uniformity, hot/dead pixels on a blank image

Blemish Detect – Measure visible blemishes (defects) on a blank image.

Stepchart

Standard fixed module

Multicharts (interactive) and Multitest (fixed) perform the same functions as Stepcharts but display more detailed up-to-date results, especially noise.

Analyze step charts:

Reflective (ISO 15739/14524, Kodak Q-13/Q-14, etc.),

Transmissive (36-patch Dynamic Range or HDR, Xyla-21, etc.)

Special care needed to avoid glare in dark patches with wide angle lenses.

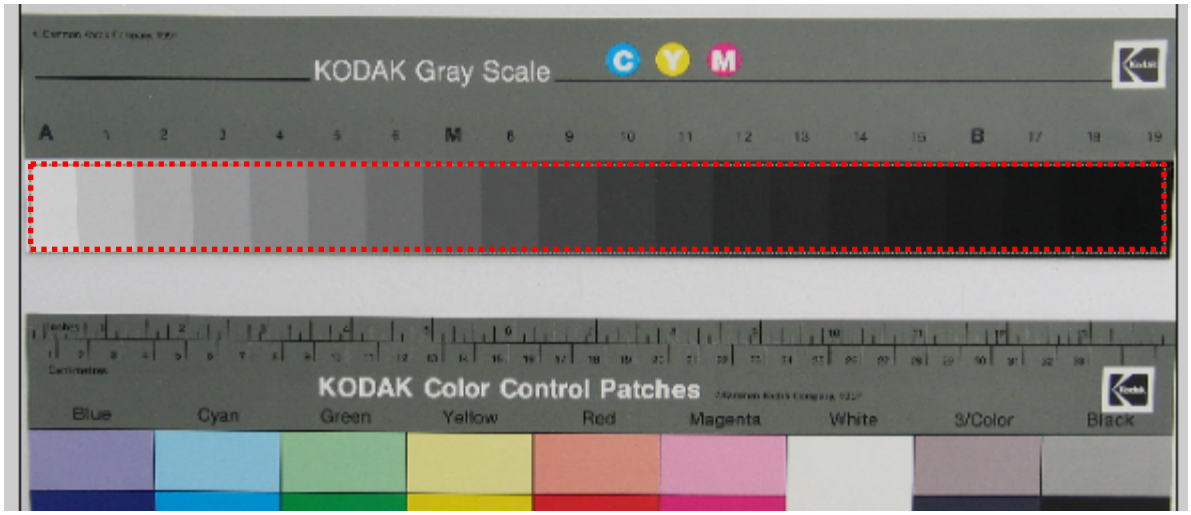
OK if linear charts (Q14, etc.) are vertically oriented or reversed.

Measure

- Tonal response,
- Gamma (contrast; average and instantaneous),
- Noise (or SNR), including temporal noise
- Dynamic range (transmission charts only),
- Exposure error (reflective charts only),
- Veiling glare (flare) (special setup) with Q-13/Q-14
- ISO Sensitivity

Stepchart 2: Start

1. Photograph the chart with even illumination. Avoid glare in dark zones.
2. Open ***Stepchart***. Select file(s). Does not need to be full width of image.



Initial selection shown in red for emphasis.

3. Make initial crop by clicking and dragging. Does not need to be accurate.

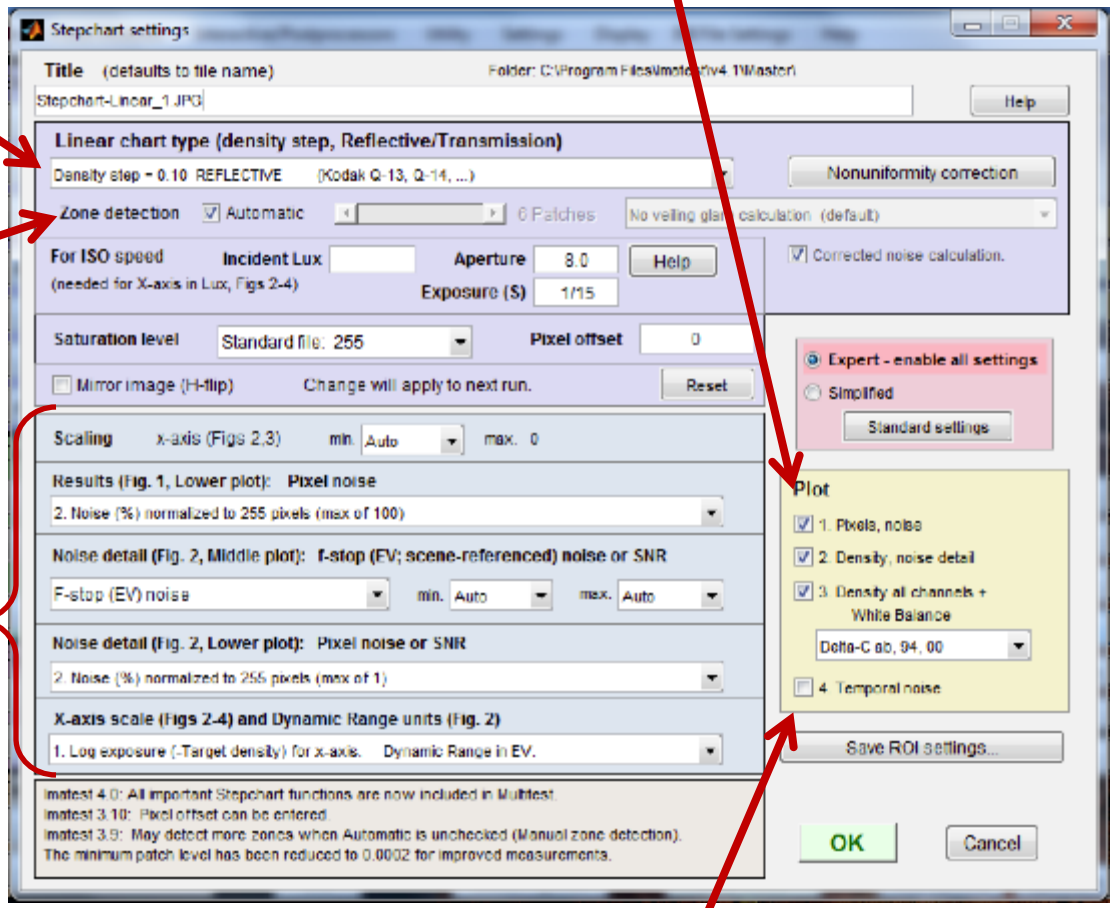
Stepchart 3: Dialog box

Plot selection

Type: Reflective or transmission, density step

Zone detection: auto or manual (enter number of patches). Veiling glare can be selected with manual when special "black hole" is used.

Results: noise & SNR display options



Temporal noise available when 2 image files entered

Stepchart 4: fine selection (auto)

Maximize for best display.

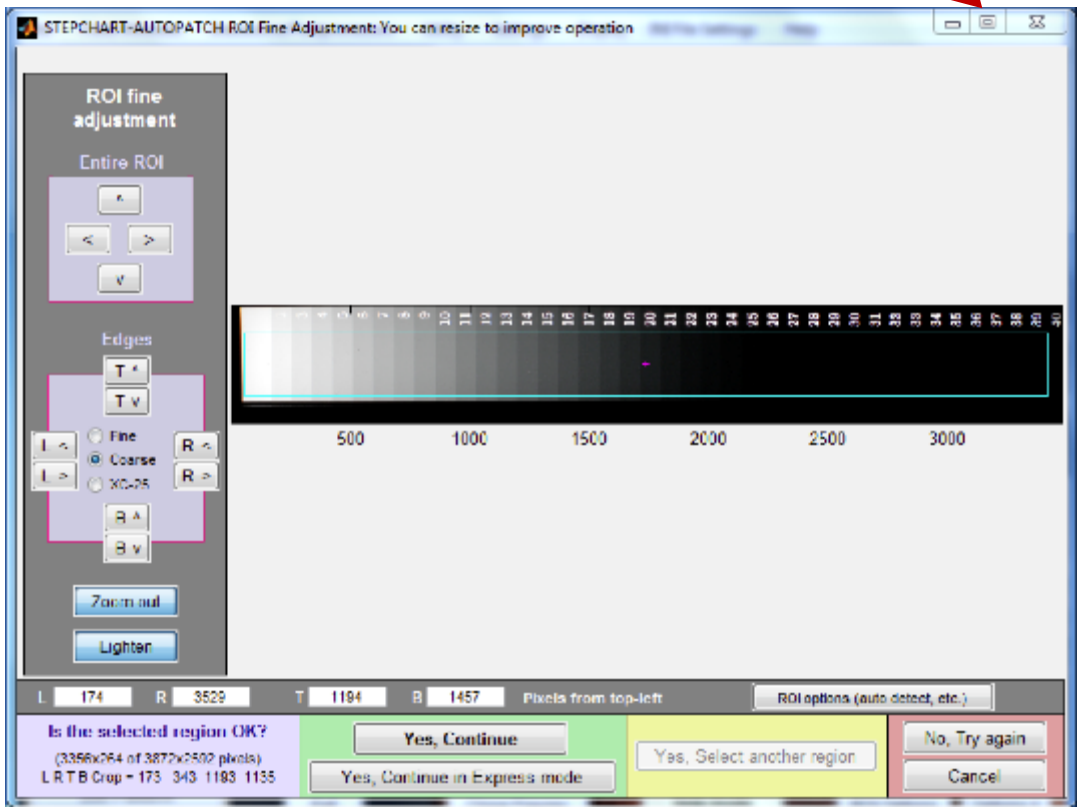
Fine adjustment

Shown for auto ROI selection– patches automatically selected, based on density steps.

Adjust ROI to boundaries of chart.

Chart must be carefully oriented (little tilt or distortion).

Simpler than manual patch selection, but some dark patches may be missed.



Not recommended for noisy images.

Stepchart 5: fine selection (manual)

Maximize for best display.

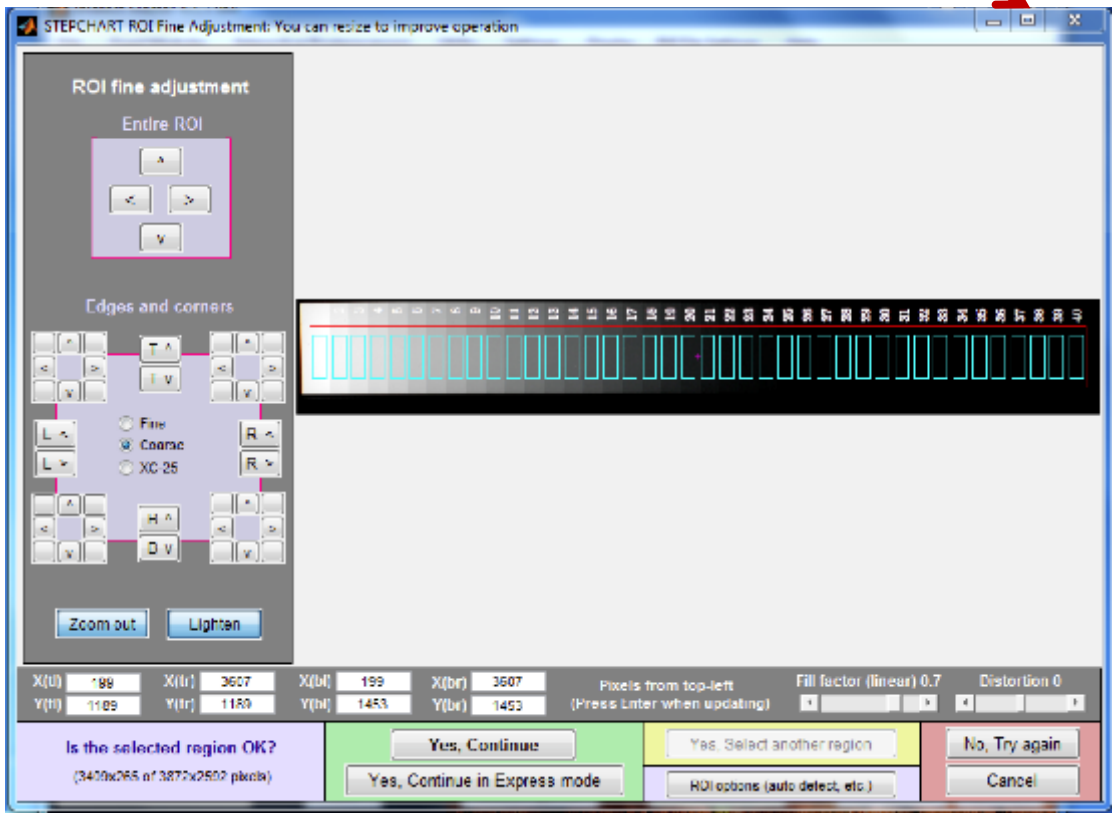
Fine adjustment

Shown for manual ROI selection. The correct number of patches must be selected.

Tolerates tilt, distortion, noisy images better than auto ROI selection.

Adjust ROI so regions are inside their respective patches.

Outer selection may go above, below the patches.



Generally recommended, especially for noisy images.

Stepchart 6: First plot

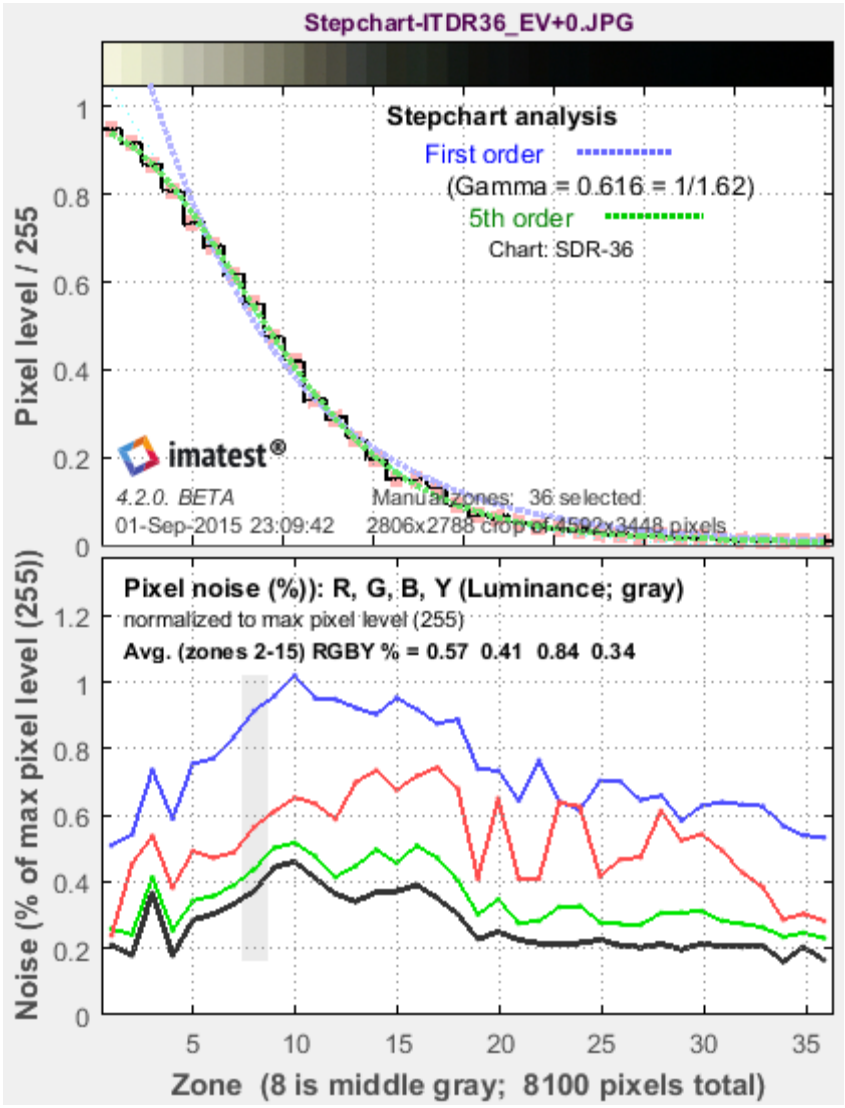
Relatively unprocessed results
X-axis is the zone (linear scale).

Top Pixel level/255 (1 max.)

- Flat top steps indicates even lighting.
- Hard to read in dark areas (log scale is better)
- Pale blue lines indicate boundaries between zones (auto patch detection-only)

Bottom Noise in R, G, B, and Y (luminance) channels

- Several noise displays available.

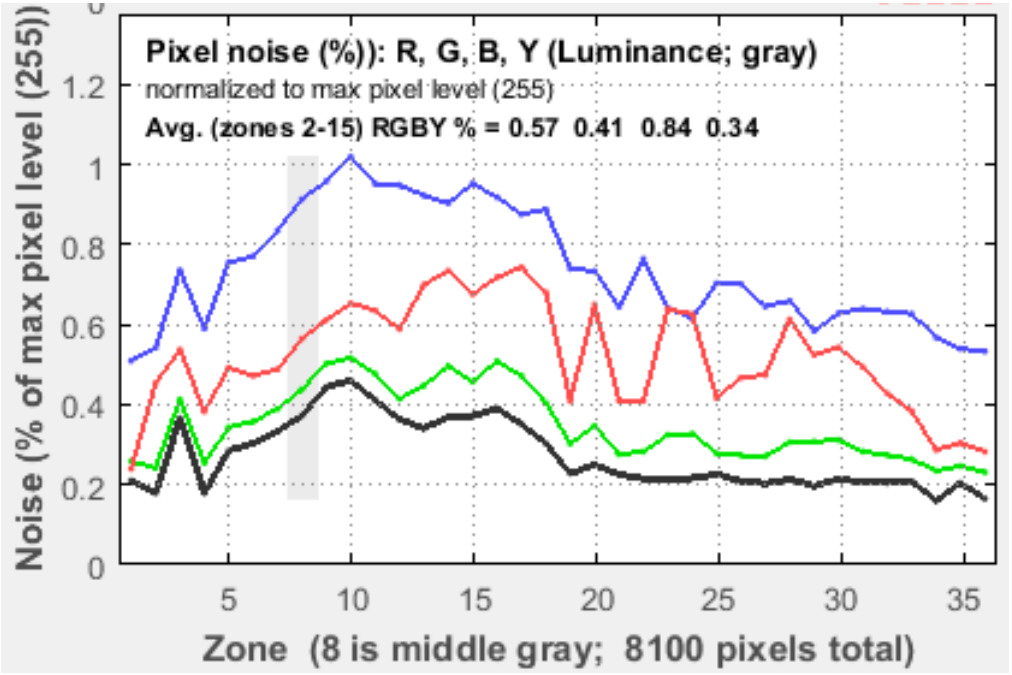


Stepchart 7: First plot: noise

Plot 1, bottom

Noise in R, G, B, and Y channels

- Y is luminance: 0.2125R+0.7154G+ 0.0721B
  (for sRGB images)
- Noise display is selected in input dialog box.



Noise (%) normalized to image density range = 1.5	0-1. References noise to the scene: removes camera contrast (no longer recommended).
Noise (%) normalized to 255 pixels	0-1. Worse for higher contrast cameras (affected by gamma)
Noise in pixels	0-255.

Stepchart 8: Second plot

X-axis is Log exposure.

Top Left Density response (characteristic "H&D" curve)

•Log pixel/255 vs. Log exposure

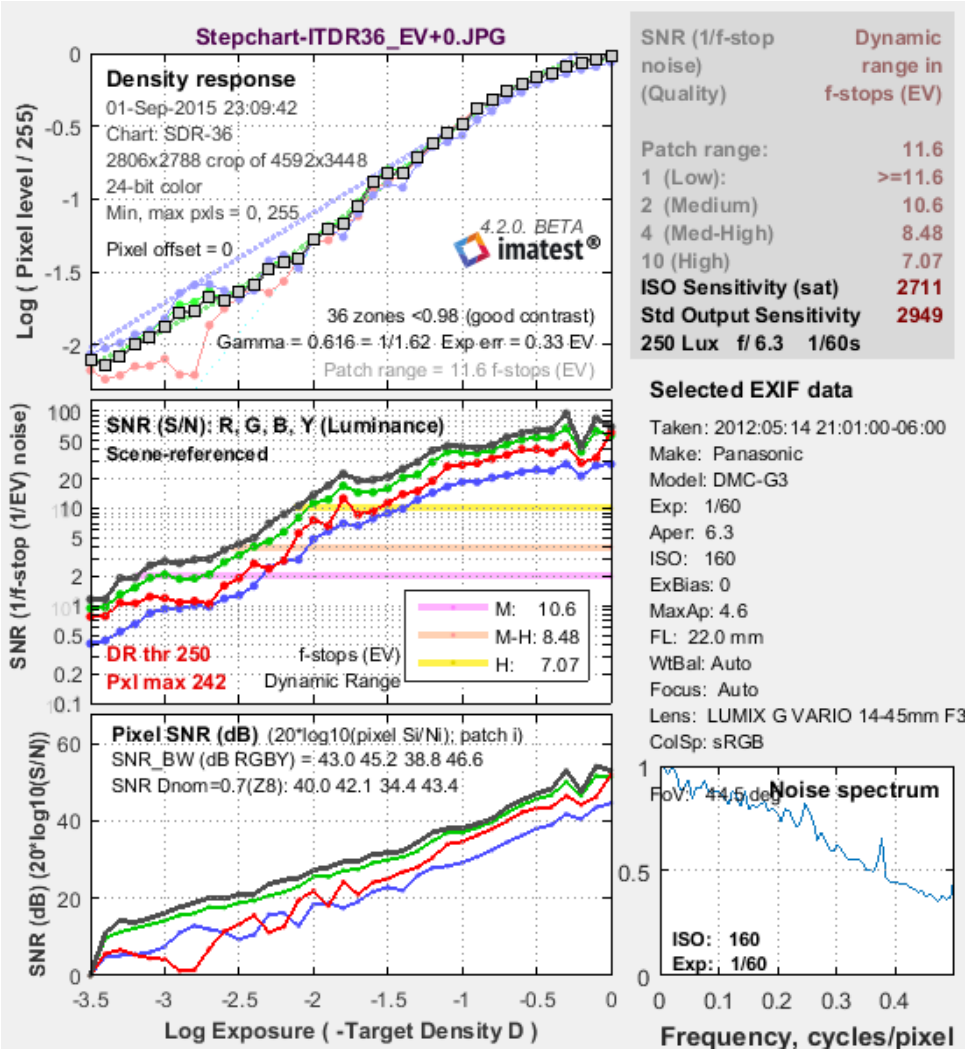
•Shows gamma (avg slope)

Middle Left Scene-referenced SNR (1/f-stop) noise (or f-stop noise) in R, G, B, Y channels

•Several noise/SNR displays available.

Bottom Left Noise in R, G, B, Y channels

•Several displays available.



Stepchart 9: Density response

Plot 2, Upper Left Density response (characteristic "Hurter & Driffield" curve), (Y-axis was density for film.)

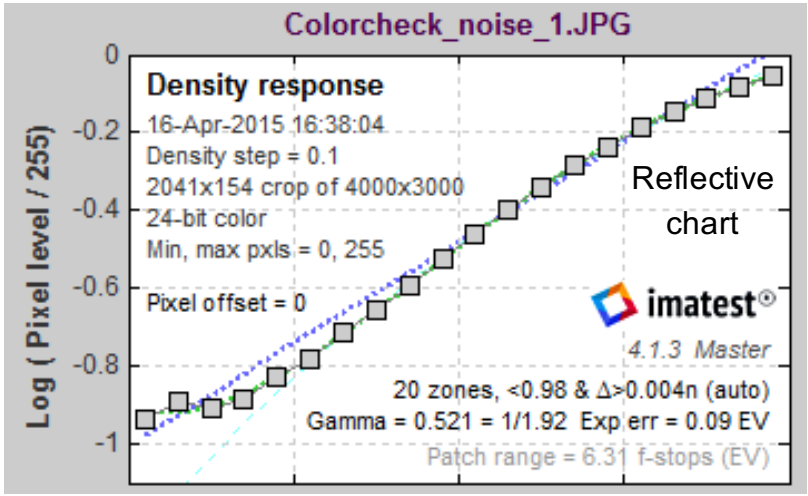
Log pixel/255 vs. Log exposure

•Often curved: "shoulder" at top reduces tendency for highlight burnout; makes image more "film-like."

•Shoulder or S-curve allows increased mid-tone contrast for a given dynamic range.

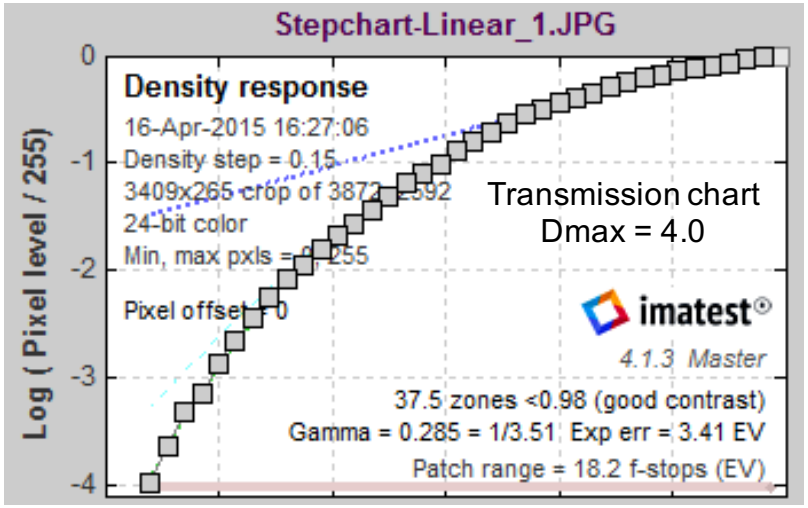
•Shows gamma (contrast; average slope in middle-brighter areas)

•No clear cut "good" vs. "bad" (pictorial differs from technical / scientific).



Log exposure (-Target density)

Log(Pixel level / 255)



Stepchart 10: f-stop noise or SNR

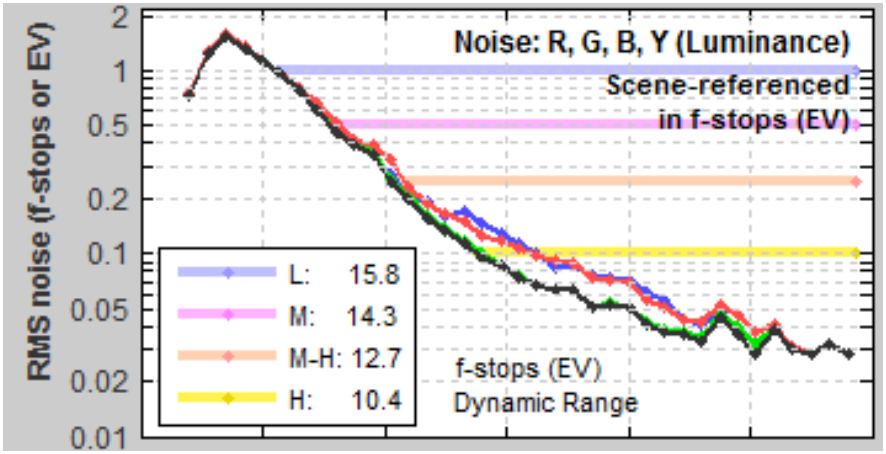
Plot 2, Middle Left

f-stop noise is referenced to the scene, and hence is independent of camera contrast.

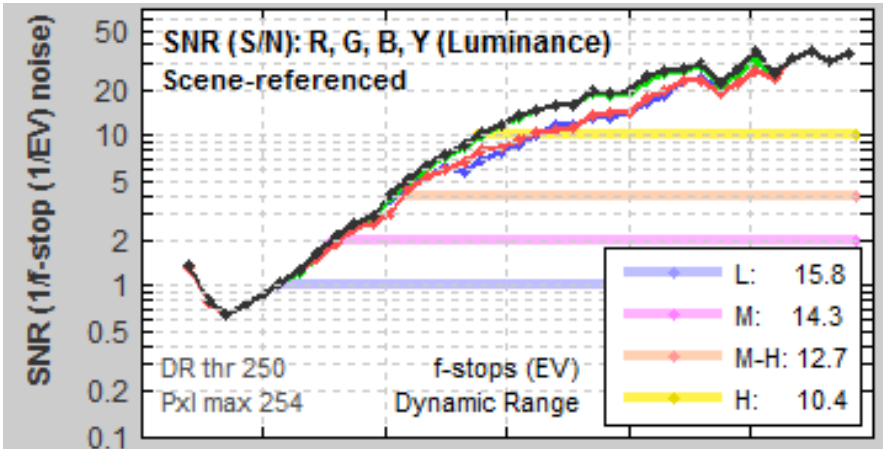
(f-stop) SNR is 1/f-stop noise.

Quality levels for measuring dynamic range are tied to f-stop noise or SNR.

f-stop noise	Quality
1.0	Low
0.5	Medium
0.25	Medium-high
0.1	High



Log exposure (-Target density)



Stepchart 11: pixel noise or SNR

Plot 2, Lower Left

Noise display selections (all pixel-related):

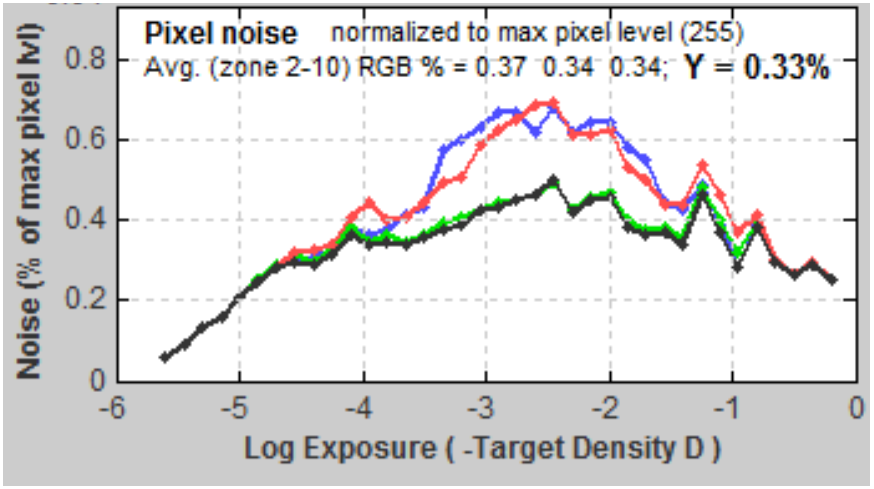
Noise (%) normalized to image density range = 1.5

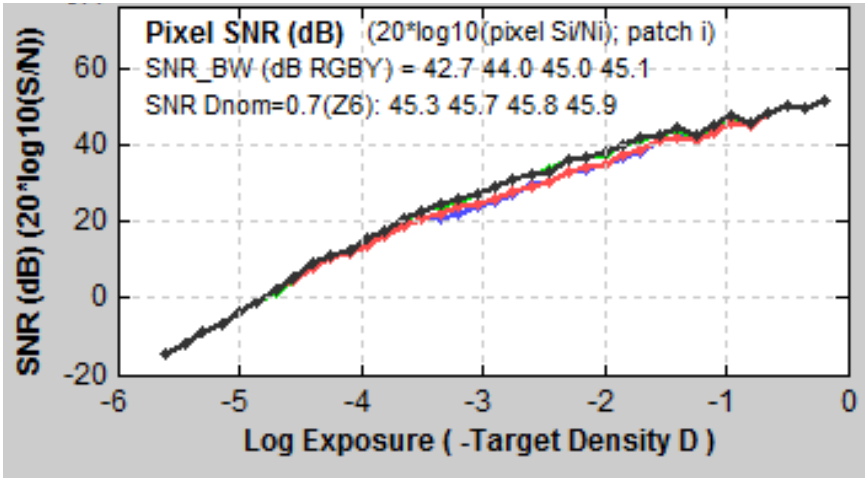
Noise (%) normalized to 255 pixels (max of 100)

Noise in pixels (maximum of 255)

Pixel S/N (Signal in patch/RMS noise) dimensionless

Pixel SNR (dB) (20*log10(S/N))





Stepchart 12: 3rd plot

Emphasizes results for all channels: R, G, B, Y (Luminance)

Upper

Density response

Exposure error

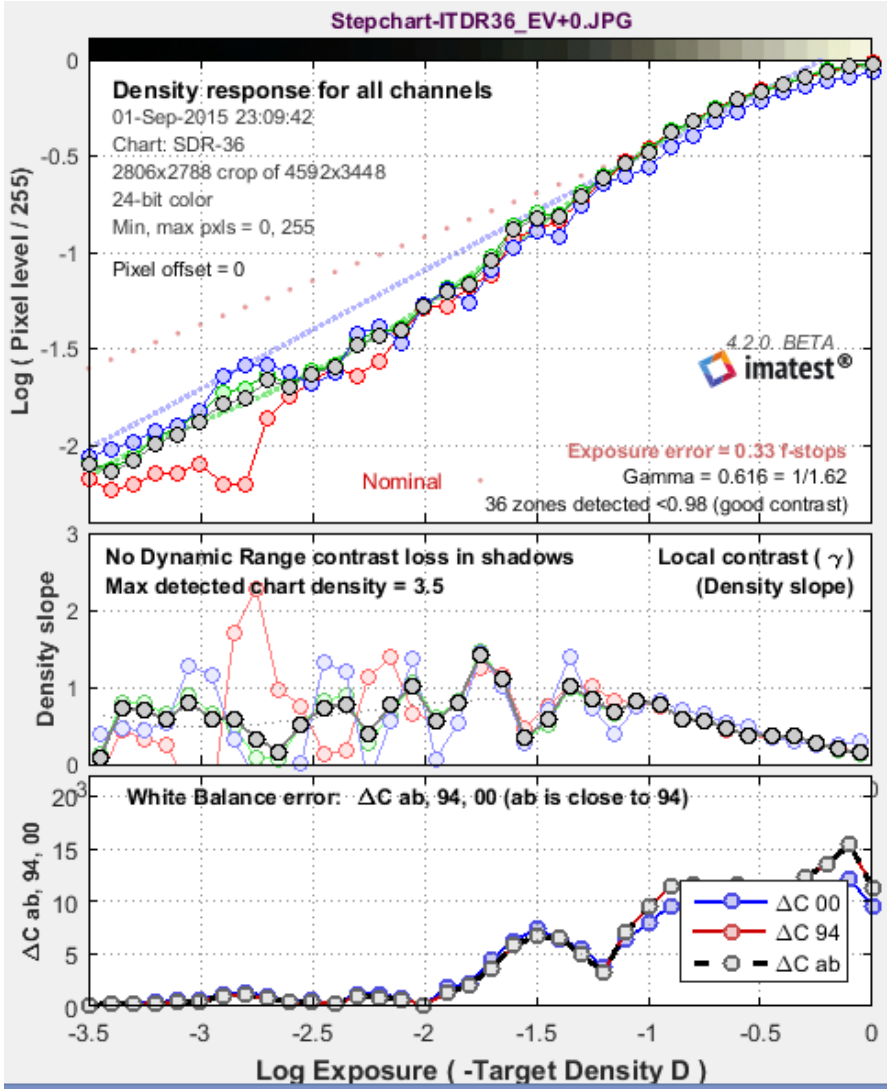
Gamma (γ) (average)

Middle

Local gamma (γ) = contrast (slope of density response)

Lower

White Balance error – ΔC (00, 94, ab)

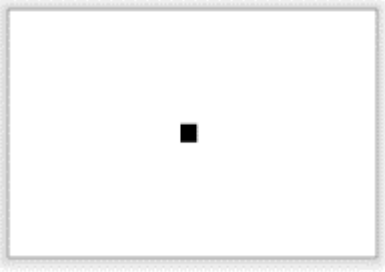


Stepchart 13: Veiling glare

Also called flare

Caused by stray light bouncing between lens elements and barrel

Fogs shadow areas



Measure by photographing perfect black object on white field (with Step chart for tonal reference).

Veiling glare = *V* =

***L*(black object) / *L*(white surface)**,

where ***L*** is the illuminance at the sensor.

Note: signal processing - offsets or pedestals, can affect results.

Veiling glare example

Pretty good Bad

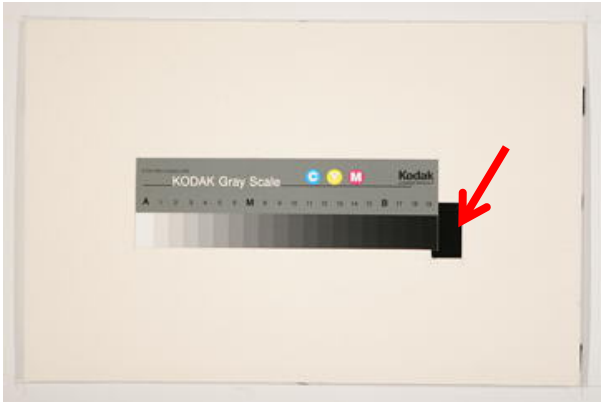
Stepchart 14: Veiling glare measurement

Make a “black hole” (velvet in box).

Mount it next to step chart on large white board.

Photographic the chart, leaving boundary (at least length of chart, all sides).

Run Stepchart.



From Settings window

Fine ROI adjustment

Stepchart 15: Veiling glare results

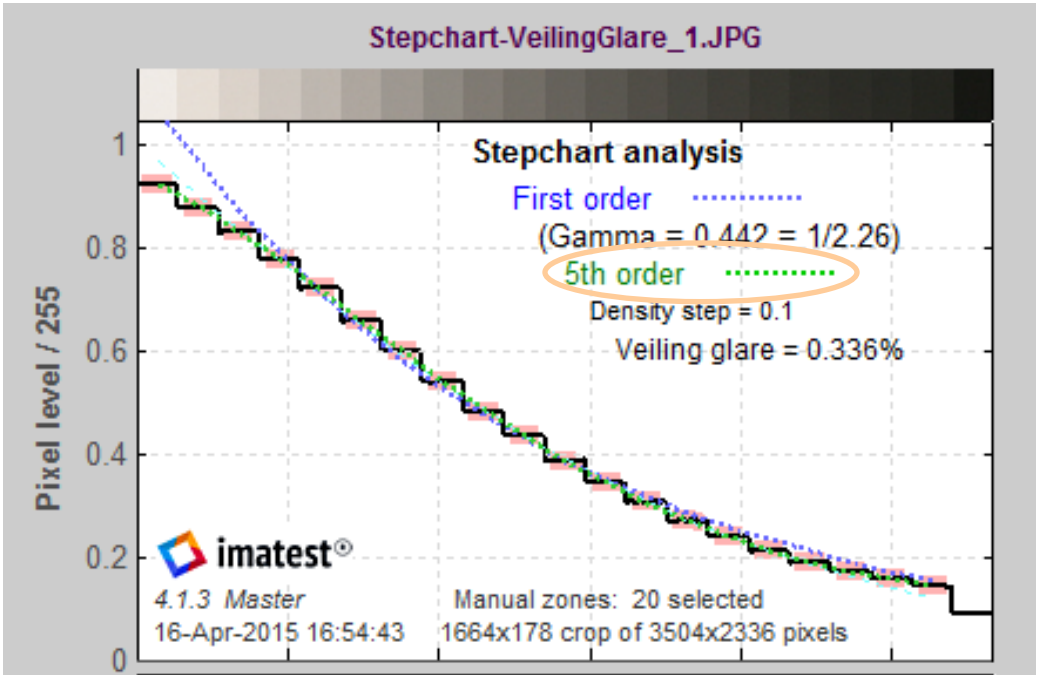
Veiling glare %

in first figure

Veiling glare = *V* =

***L*(black object) /**
***L*(white surface)**,

where ***L*** is the illuminance at the sensor.



Cheap lens (Canon 28-80 kit lens)

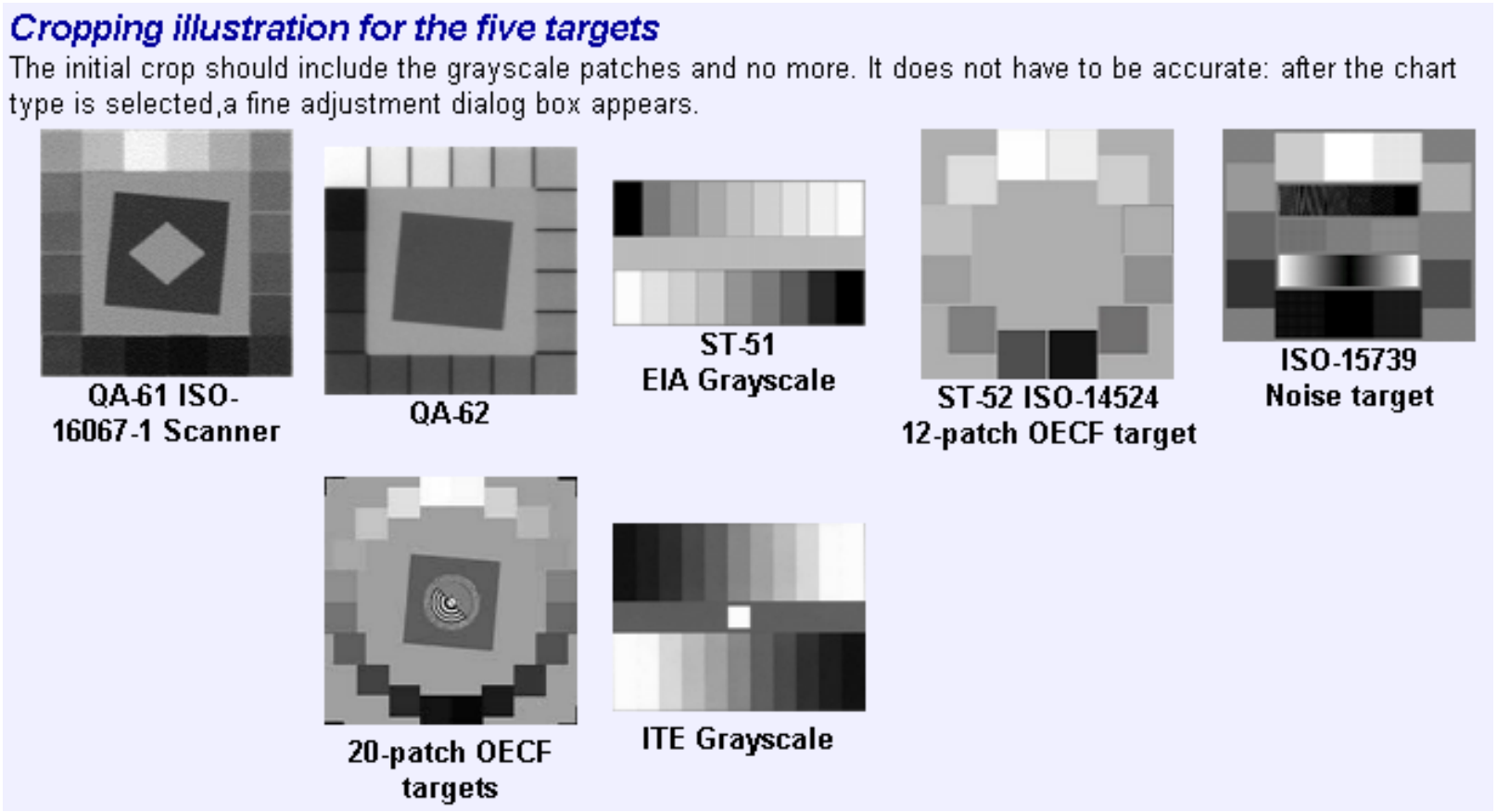
V is an ***approximate*** predictor of overall veiling glare. Does not predict specular glare, etc.

An excellent lens (Canon 90mm TS) had Veiling glare = 0.269%

Note: for accurate results, pixel offset should be entered or unprocessed RAW images should be used for this test

Stepchart 16: Additional charts

Some circular; useful with cameras with significant light falloff (vignetting).



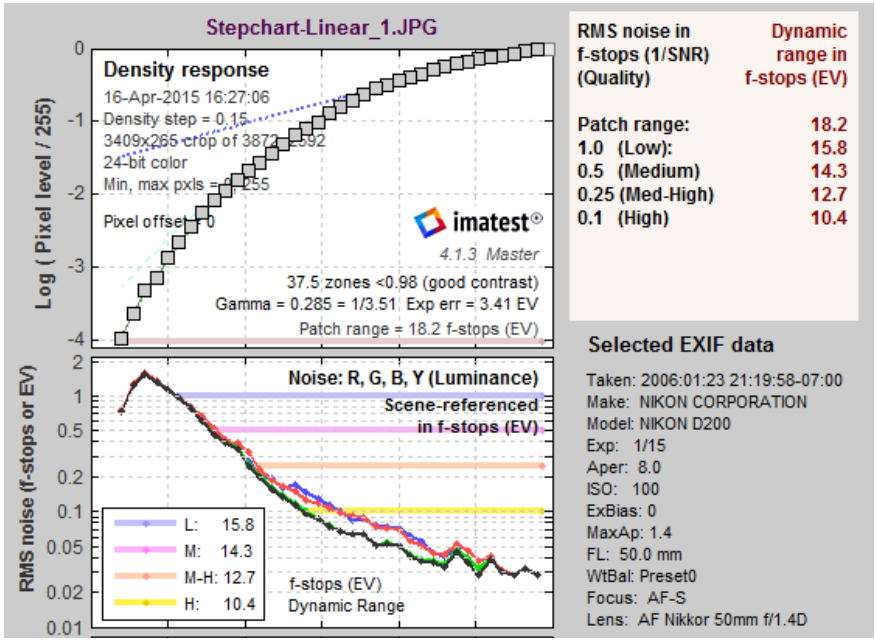
Dynamic range 1

DR is the range of illumination a camera can respond to with

- reasonable contrast: >= 20% of maximum contrast (in dark areas)
- reasonably low noise (good SNR): various quality levels
- Usually in f-stops (EV; zones): factors of 2, or density units = 3.32 f-stops

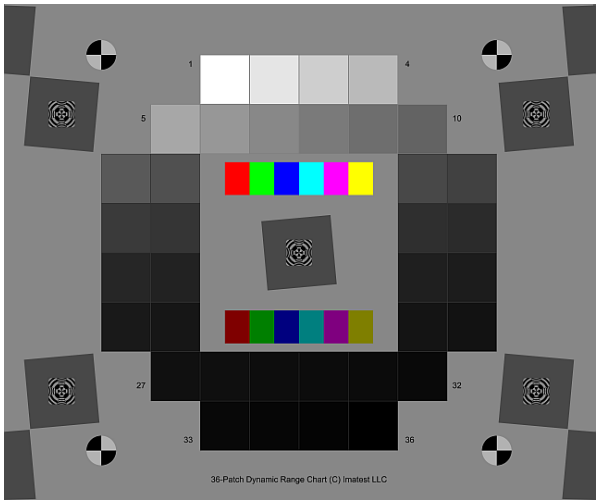
Measure with *Stepchart*, *Multicharts*, or *Multitest*

- with transmission chart (36-patch Imatest DR chart; Density range ≥ 3.4; HDR chart (D range ≥ 6, or Xyla-21)
- ***Dynamic Range*** module: Stepchart/Multitest postprocessor that combines **CSV output** from several differently-exposed reflective chart images



Dynamic range 2: transmission charts

Imatest 36-patch DR chart (D_{max} >= 3.4)
HDR chart available



Supports fully auto patch detection

Stouffer T4110

Illuminate transmission chart evenly from behind. The GLX-16 or ITI LED light box (Imatest Store) are recommended.

Photograph in ***totally*** darkened room

- taking care with exposure
- minimizing stray light in image (could cause veiling glare).

Run ***Stepchart***, ***Multicharts***, or ***Multitest***.

Stepchart

Dynamic range 3: transmission charts

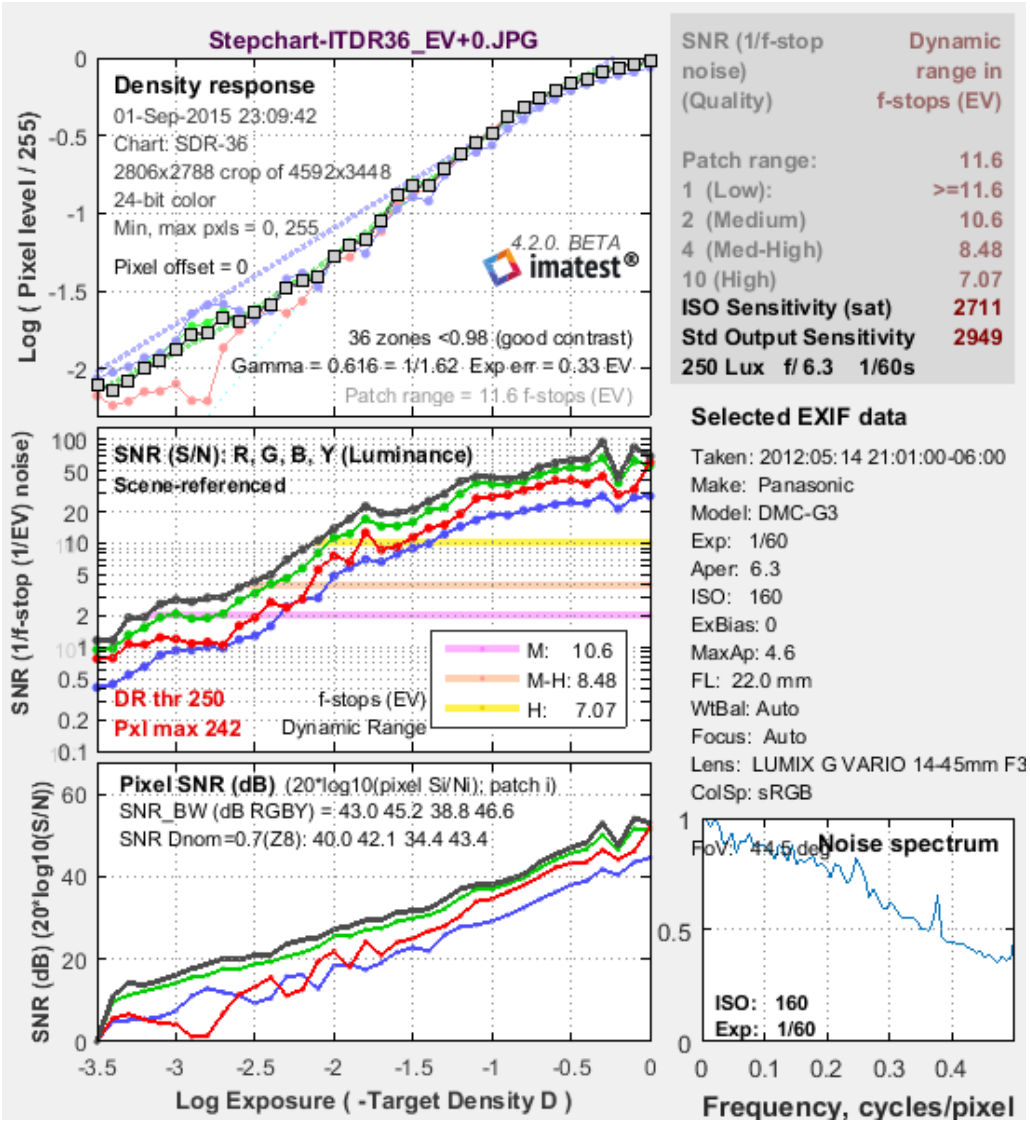
Summary on upper right:

DR vs. quality level

DR is shown as horizontal lines in the middle-left plot (noise/SNR; scene-referenced).

Detected DR is the number of detected regions: not very meaningful.

Signal/Noise for the Luminance (Y) channel stayed > 1, so “Low” quality DR is not measured. (It’s greater than the detected DR.)



Dynamic range 4
Dynamic Range module 1

Postprocessor to *Stepchart and Multitest*

Photograph reflection chart at several exposures (slightly over-strongly under)

+1 EV

-2 EV

-5 EV

Analyze the images with ***Stepchart*** or ***Multitest*** (can run as a batch).

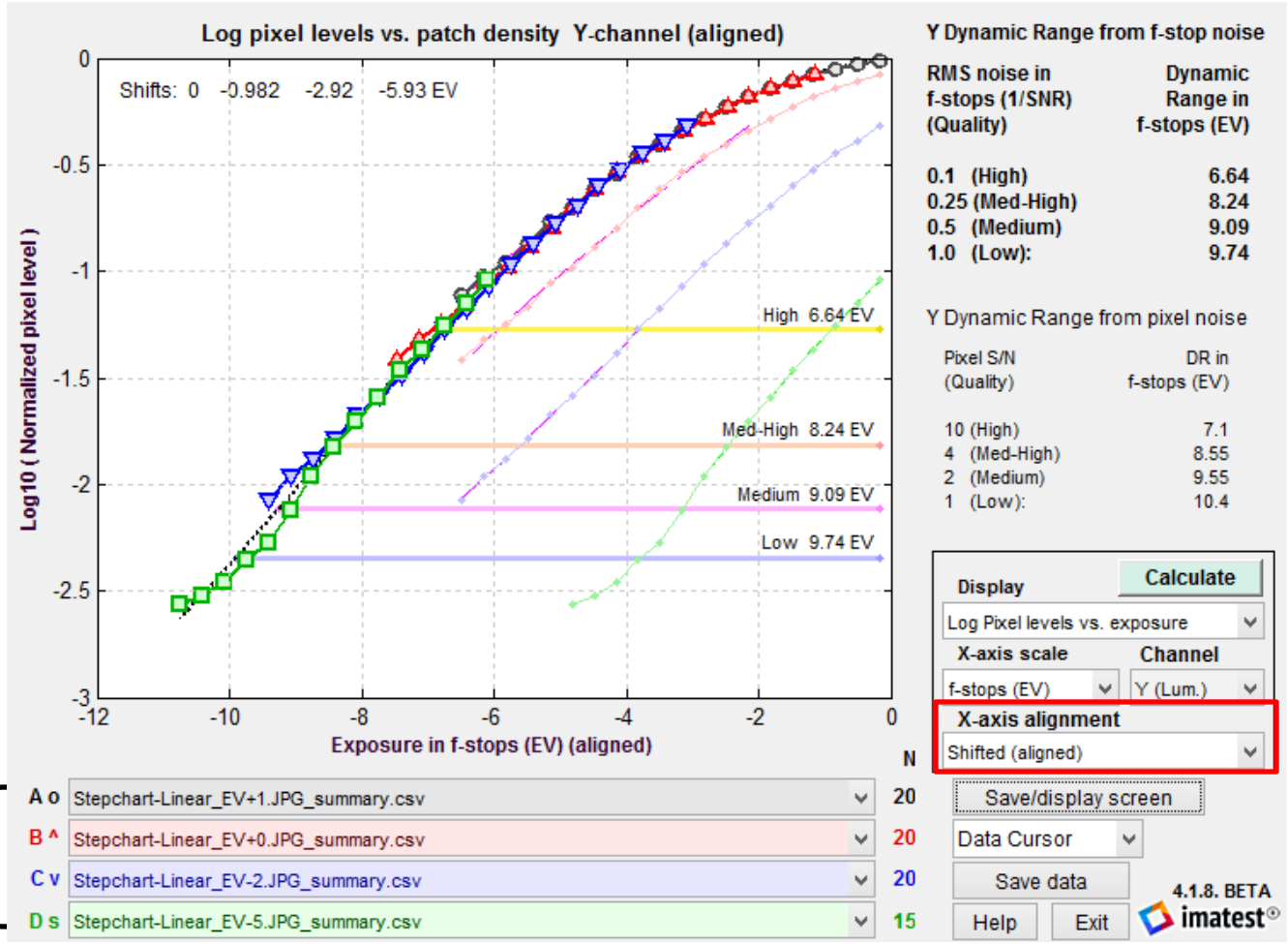
Save the CSV output files.

Open the Dynamic Range module and enter the saved CSV files.

Dynamic range 5: DR module 2

Results from differently-exposed files are automatically aligned.

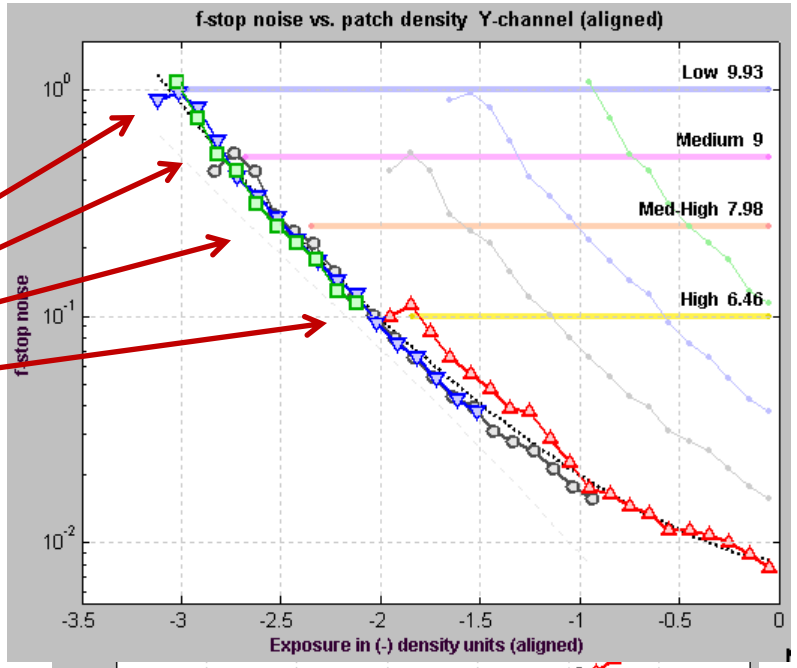
Enter up to 4 CSV results files from SFRplus runs.



Dynamic range 6: DR module 3

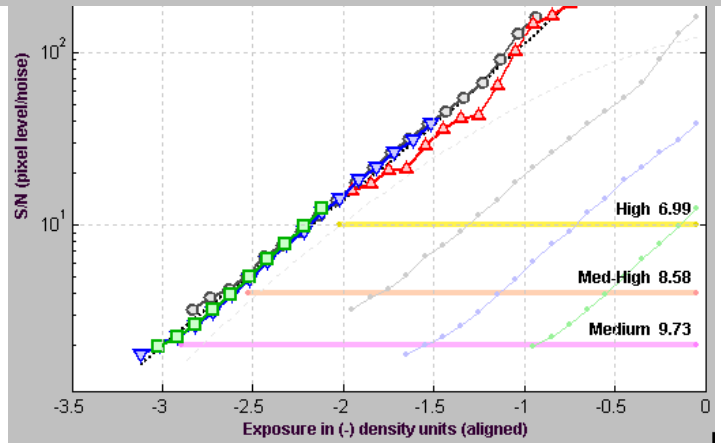
f-stop noise (Log scale both axes)

Horizontal lines display dynamic range for different quality levels (high: S/N = 10; …, low: S/N = 1).



Display *options*:

- f-stop noise or S/N
- Pixel noise or S/N
- Linear or Log scales
- Aligned or unaligned
- Y, R, G, or B channel



S/N (pixel level/noise
(Log scale both axes)