



## Renewal of the Camera Resolution Measurement Software "HYRes"

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# Renewal of the Camera resolution measurement software “HYRes”

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## Abstract

*This is an explanation on the freeware HYRes IV that has released in March this year. HYRes is a software tool designed by the author, for use in accurately gauging the resolution of a digital camera using a resolution chart compliant with ISO standard. It supports the measurement methods described in both ISO 12233 [1] and CIPA standard DC-003 [2], and conventional two versions HYRes 3.1 and HYRes ACE have already been provided by CIPA and have contributed to the camera industry and users. However, recent PC OS progress has induced them become useless.*

*HYRes IV is the integration of the functions of those two software and has been renewed to run on the latest OS where IV is an abbreviation for the Integrated Version.*

## Introduction

“HYRes” the measurement software can measure the resolution of digital cameras coinciding with the visual resolution measurement. It is automatic, highly repeatable, and does not depend on an image display device while avoiding some of the problems of using visual observations.

This paper basically describes the last renewal of this software. However, it will be explained after what is HYRes is introduced since it is important to understand the *raison d'être* of this software before mentioning about the renewal.

## Resolution measurement and its problems

Resolution (camera resolution) is defined as a measure of the ability of a camera to depict picture detail and practically measured as follows. A test pattern called ‘wedge’ that has black and white lines converging gradually is taken by the camera to be tested. Then a human measurer observes the recorded image and decides visually the limiting point where the B/W lines of the wedge can be seen separately without any artifacts.

However, there are some problems such as difficulty to avoid influence from artifacts, difficulty to keep repeatability by every time and to have stability by respective measurers.

ISO 12233 have the rules for judgement as follows to solve the above problems:

- a) Beginning from the low frequency side, treat a spatial frequency as “Resolved” only when all lower spatial frequencies are also resolved. The resolution limit is achieved at the line (author’s note: means “position” or like, different from other “line”) just before the first occurrence of unresolved line features.
- b) Treat a spatial frequency as “Not resolved” when the black and white lines appear to change polarity or lines are blurred together to produce a reduced number of lines, compared to the number in the test chart.

The rules directly correspond whether artifact is occurred or not, thus they can effectively solve the problems to do a correct measurement. However, since the method depends on the human

visual observation, there still remain some problems such as measurer's fatigue or different proficiency that may disturb correct measurement.

## Purpose of HYRes

HYRes 3.1, the first public version and provided on the CIPA web site since 2004, had been started its development by the author at the end of 2000.

The purpose was to realize a tool software for resolution measurement to be able to solve said problems with human factors while obtaining the same measurement results done by a human measurer. Of course, there is no fatigue nor different proficiency with a software, thus what to be solved was how it can realize an equivalent judgement as a skilled human measurer.

## Key algorithm of HYRes

HYRes has two major functions of which the one is pre-process to crop the wedge pattern image area from the whole chart image taken by a camera and the other is main process to measure the resolution value by calculating the cropped image data. And the key method in the main process is detecting the limit point which is determined as the (visual) resolution limit position on the wedge image in the unit of pixel number. Specifically, the algorithm is as follows

At the main process the wedge image is set to open up-wise that means low and high frequency correspond to top and bottom. A sub-process named “Black line detection” is applied to each position (horizontal row of pixels) from the top towards the bottom on the wedge sequentially to count the number of the black lines at each position individually. This counting of “Black line detection” is executed by a procedure which simulates the recognition for lines by visual perception when a human observes a wedge pattern, though the details are not described in this paper. Meanwhile, at every time “Black line detection” has been executed it is judged whether the counted number coincides the number of black lines of the wedge of the test chart (in other words whether it is correctly resolved).

By the procedure described above, the judgement whether the number coincides is sequentially done from the top towards the bottom, then it reaches the first position where the counted number of lines changes to different from the number of lines of the wedge of the test chart. (It often comes below the number of lines of the wedge but can also be above by influence of artifact.) At the time the resolution limit position is determined as the position one before (upper) the first position described above.

Here considering the above explanation on the main algorithm of HYRes, it would be understood that it is equivalent to the rules for judgement in ISO 12233. Therefore HYRes can do an equivalent measurement by a skilled measurer and has more significant advantage of free from human problems such as fatigue or different proficiency. Also, it is apparent that it is free from dependency on output devices since no output device is used.

## Renewal of HYRes

Imagably from the above, HYRes has contributed the camera industries and users by providing easy and correct resolution measurement with good repeatability for almost 20 years. In the meantime, HYRes has been upgraded several times and every newer version has some additional functions and/or user interface improvements than the previous one. However, the most significant, the key algorithm has not been changed in any way therefore each version provides the same measurement results for the same camera to be tested.

In the history of HYRes, HYRes ACE is the second version which was released in 2006 and supports the advanced "CIPA resolution chart" different from the conventional ISO 12233-2000 chart supported by HYRes 3.1 ("ACE" means the Advanced Chart Edition). And along with progressive changes of Windows OS, both "3.1" and "ACE" have come unavailable to operate unfortunately.

HYRes IV is the integration of the functions of those previous two versions ("IV" means the Integrated Version) and has been renewed to run on the latest Windows OS. It is freely downloadable from the CIPA's web page:

[https://www.cipa.jp/dcs/hyres/hyres\\_iv1\\_e.html](https://www.cipa.jp/dcs/hyres/hyres_iv1_e.html)

## An important note

OM Digital Solutions is a company which the imaging business division of Olympus Corporation (hereinafter referred to as Olympus) was spun off from Olympus on January 1, 2021.

Since HYRes IV was developed before the independence and was released just after the independence, the description (including the link destination) related to the company name in the software itself remains "Olympus". As a transitional measure based on this circumstance, "Olympus" in all statements related to the use of this software (including licenses and oaths) shall be read as "OM Digital Solutions".

## Measurement using HYRes IV

The whole measurement procedure is indicated as following flow: [1] Recording the chart image for evaluation using the camera under test → [2] Trimming the wedge part from the evaluation image → [3] Analyze the trimmed wedge and calculate the numerical value.

\*HYRes series software uses "Trim" as the word meaning to cut out the image of a partial area from an original whole image although "crop" is a well-known synonym for this case.

### [1] Recording the evaluation image (without the software)

The evaluation image is let as a resolution chart taken at an adequate magnification using the camera under test. It is not necessary to use the standard magnification specified by ISO12233, and it may be taken at any magnification.

\* Note that the measurement accuracy (minimum step of value) will decrease if the magnification is decreased. Since the detection is performed on a pixel-by-pixel basis, the effect is small for a camera with a large number of pixels, but in the end, it is a trade-off with the required measurement accuracy.

### [2] Trimming the wedge part image

#### 1. Measurement mode

HYRes IV has two modes which use different measurement target charts. The charts are shown as Figure 1 and Figure 2. And the wedges to be measured in each chart are indicated below.

- ISO12233-2000 chart (HYRes 3.1 mode) targets the six wedges in the central area of the chart.

- CIPA chart (HYRes ACE mode) targets four wedges in the central area of the chart.

\*In either chart, any of the wedges other than the above is not a subject and correct measurement values cannot be obtained.

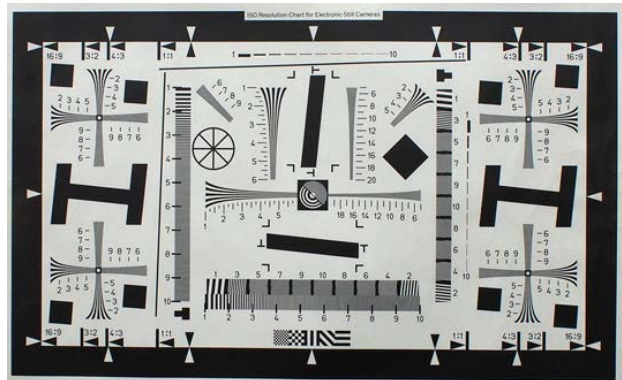


Figure 1. ISO12233-2000 chart for t"HYRes 3.1" Mode

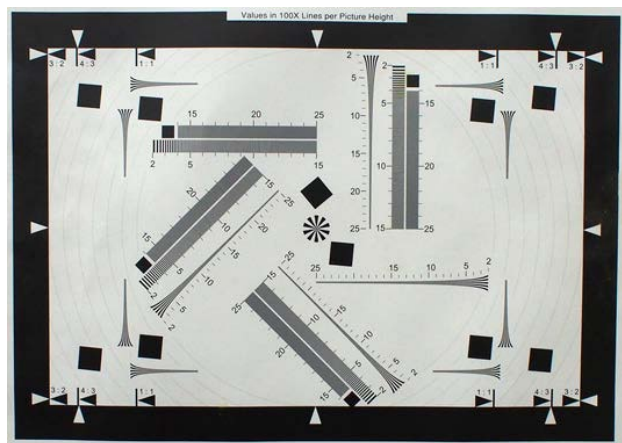


Figure 2. ISO12233 compliant CIPA resolution char for "HYRes ACE" Mode

## 2. Trimming

- (1) Start up the software.
- (2) Click "Trim" tab to move the window.



Figure 3. "Main" window of HYRes IV

(3) Click "File > Open" then select a chart image to be measured and open (then the image file is loaded).

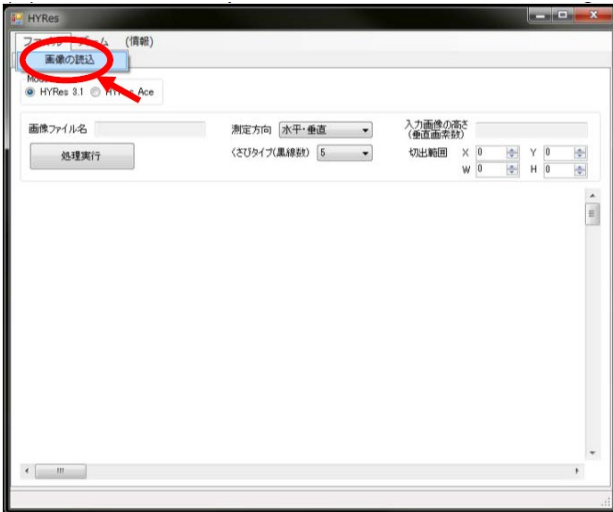


Figure 4. "Trim" tab window at Image file loading

(4) Select measurement mode, measuring direction and wedge type, or others.

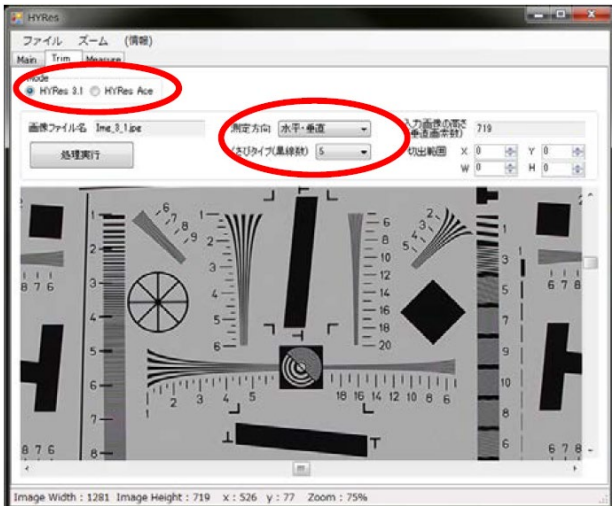


Figure 5. "Trim" tab window at selecting a mode or others

(5) Select the trim area by drag and drop of mouse so as to surround the wedge to be measured. (Also available to specify the area directly by entering respective numeric in the part shown by the blue line in Figure 6.) And click "Trim execute" button. (It is asked whether save the trimmed image thus select either.)

**[3] Measurement (numerical calculation)**

(6) Then it automatically results to move on to Measure tab and be displayed the trimmed (and rotated if needed) image as shown in Figure 7.

(7) Click "Execute" button (as shown by a red circle with arrow in Figure 7) to display measurement result.

(8) The result is displayed by a numeric of course, but also indicated by the position of the corresponding red line on the wedge image as shown in Figure 8 .

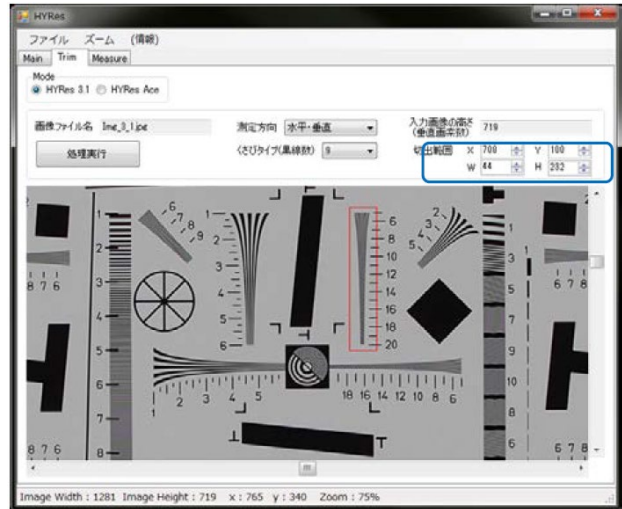


Figure 6. "Trim" tab window at specifying the trim area

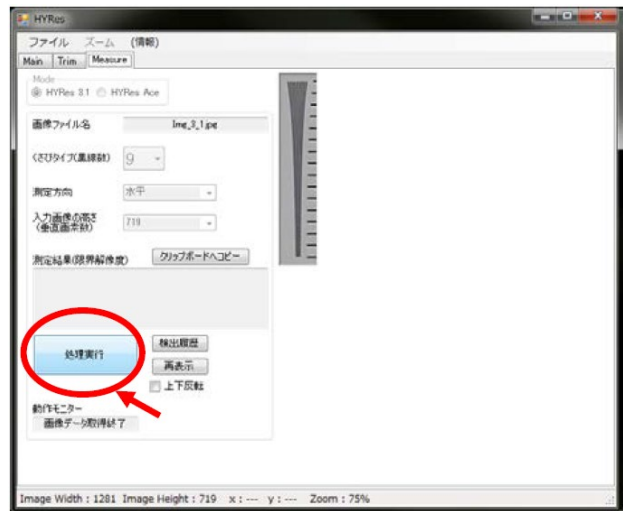


Figure 7. "Measure" tab window at execution after a trimmed image moved

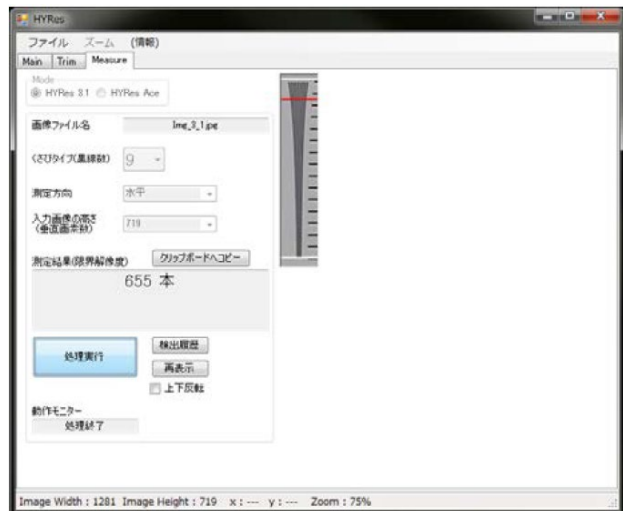


Figure 8. "Measure" tab window at displaying a result

## New features of HYRes IV

Described above is basically common for all HYRes series. In addition, HYRes IV has some new functions below.

### [1] Clipboard copy

After measurement result is displayed in the “Measure” window, if click "Copy to clipboard" button the measurement result will be copied to a clipboard along with the various conditions.

### [2] Contrast graph draw

Although referred to "contrast", it is not genuine contrast but a plot of the amount corresponding to the output signal amplitude. And even as an amplitude characteristic, it is not a formal definition but just a substitute characteristic for reference.

Anyway, a graph somewhat correlated with amplitude response can be drawn, which is shown in Figure 9.

### [3] Batch processing

It is possible to measure a plurality of shot images together at once by trimming the same area.

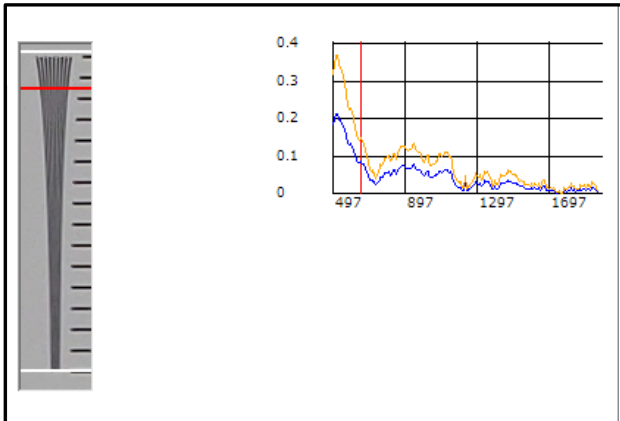


Figure 9. An example of drawing "Contrast graph"

## Conclusion

HYRes, the digital camera visual resolution measurement software, has been renewed to become HYRes IV with some new features. The author as the creator strongly hope it to continue to be even more useful for the industry and camera users.

## References

- [1] ISO12233:2017 Photography - Electronic still-picture cameras - Resolution and spatial frequency responses
- [2] CIPA DC-003 -Translation-2020 "Resolution Measurement Methods for Digital Cameras"

## Author Biography

Hideaki Yoshida received his BS in physics from the Kyoto University (1983). Since then he had worked in Olympus, of which his division has become independent as OM Digital Solutions now. His early proud career was one of the inventing developers for Digital Camera. He contributes CIPA's standardization committee (as a vice chair etc.) and is a technical expert of ISO/TC42 and also a director of SPIJ.