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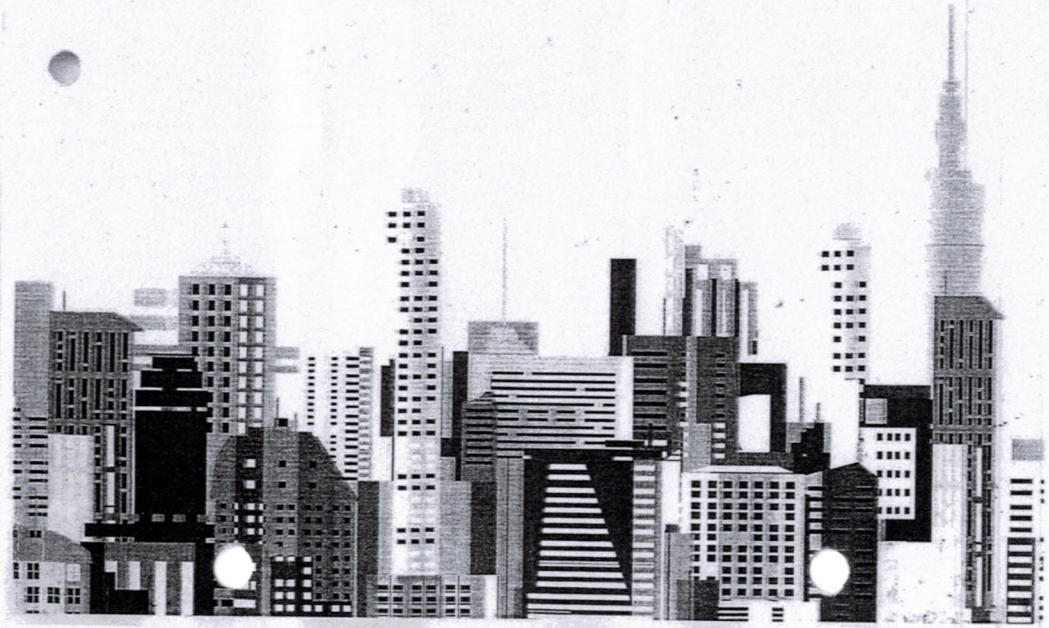

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Assessment of lens sharpness and depth of field based on psychophysical method

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ABSTRACT

This research aims to assess the performance of the lens in terms of image sharpness and acceptable range of Depth of Field (DoF) of three types of lens which are 18-105 mm f/3.5-5.6G ,50 mm f/1.8D ,and 50 mm f/1.4G. The sharpness performance was measured by using the resolution test chart. The acceptable range of Dof was examined by taking photos in five different focal distances which were focus distance ±0, ±10, ± 20 cm. Also, the aperture of photo taking was specified at 8. To evaluate the result, the pairwise comparison method was used to collect the data from ten subjects who were had normal vision or to normal corrected. The performance result of sharpness expression of lens orderly were 50 mm f/1.4G, 50 mm f/1.8D and 18-105 mm f/3.5-5.6G in terms of acceptable sharpness of human eyesight which each lens had different DoF

1. INTRODUCTION

The photos were used since the ancient time. There have been a lot of reasons that people would take a photo to follow their individual objectives including for recording the situations, for beauty, for being the teaching media, for evidences, for research benefits, etc. However, the most important point of photo taking is to be a medium functioning of narrating for the photographer's purposes in order to fluently tell the story to the photo audiences as the Chinese idiom saying that "A picture is worth a thousand words." In the present, people accept that images can be communicated better than other auditory nerves according to the psychologist's research reporting that humans can perceive things by five auditory nerves (eyes, ears, nose, tongue, and body touch. On the other hand, the best perceptive auditory nerve is eyes which are 80 percent perceptible compared to other auditory nerves. So, photos are media which help humans to correctly and quickly distinguish.

Currently, the quantity of using 35 mm single lens DSLR camera is relatively high which can be seen from the growth of Nikon circulation in Thailand of 135,000 or 6,000 million Thai baht. Besides, lenses, another additional device that people usually buy, have different prices. Different lens prices affect an image quality which lenses contrarily express. For the quality or sharpness, the photographers have to wisely choose the appropriate lenses for their works.

A factor resulting in the image sharpness is lens quality which is the most vital for the camera. Whether a photo will have a great quality depends on the lens quality. Lens is a transparent material made of glass or plastic in the circle shape with smooth surface and is usually glazed by the blue or brown solution in order to protect the reflecting or refracting light. Cheap cameras frequently have low quality lens. On the contrary, expensive cameras would use high quality lens and are able to highly transmit the light. How much lens quality will produce crystal-clear image relies on lens material quality, composed techniques, and lens arrangement. As stated, there are a lot of 35 mm single lens DSLR camera users with various sorts. Cameras and lenses, therefore, have diverse prices and qualities. Usage is depended on the photo taking purposes and applications since each photo type needs different sharpness. The researcher, consequently, would like to study the sharpness expression performance and depth of field which are acceptable for the 35 mm single lens DSLR camera.

2. METHODOLOGY

Table 1. Specifications of lens

Lens	Lens Elements	Maximum Aperture	Minimum Aperture	Vibration Reduction System
18-105 mm f/3.5-5.6G	15	3.5-5.6	22-38	Available
50 mm f/1.8D	6	1.8	22	-
50 mm f/1.4G	8	1.4	16	-

The researchers determined the methodology as follow:

Sharpness expression performance

he resolution test chart was taken at 82 cm far from camera. The taken photos were printed out on 8x12 inches photo matte paper. The print out was place in experimental room which covered by 18% gray paper. Subjects were to evaluate the sharpness at center, corner and edge area of the print out. By reporting the highest level where they can discriminate between black line and white area. The specifications of 3 lenses are shown in Table 1.

Acceptable range of DoF

The portriat photos were taken at 5 focus distance (focus distance ±0, ±10, ± 20 cm as shown in Figure 1.) and printed out on 8x12 inches photo matte paper. The acceptable range of DoF were evaluated by pairwise comparison method. The order of pair was randomly selected. Subjects were asked to select the sharper photo from each pair.

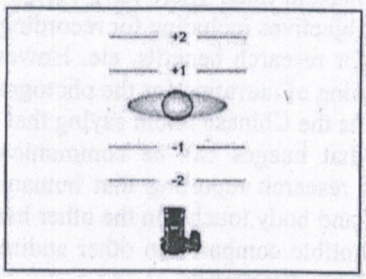

Figure 1. Example of focus distance

3. RESULT

The results of the lens sharpness performance of all three studied lens types carry various sharpness expressions. That is, the lenses which have performance of the highest sharpness performance are 50 mm f/1.4G lens, the 50 mm f/1.8D lens, and 18-105 mm f/3.5-5.6G respectively. The Performance of lens are shown in Table 2.

Table 2. Performance of lens in terms of the image sharpness

Resolution (Line)	18-105 mm f/3.5-5.6G	50 mm f/1.8D	50 mm f/1.4G
Center Area	1230	1380	1400
Corner Area	1200	1320	1400
Edge Area	1100	1240	1320

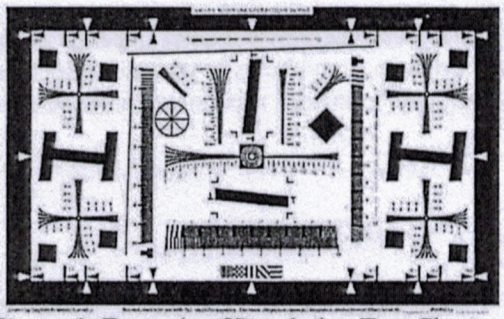

Figure 2. Example of Resolution Test Chart

In the acceptable sharpness length, according to the study, all three types of lens have the sharpness depth of field that is acceptable for human eyesight differently. That is, 50mm f/1.4G has sharpness length that is acceptable for the human eyesight from Focus Distance -20 cm to Focus Distance +20 cm. Next, 50 mm f/1.8D lens has the acceptable human eyesight sharpness length from Focus Distance -10 cm to Focus Distance +20 cm. 18-105 mm f/3.5-5.6G lens has the acceptable human eyesight from Focus Distance to Focus Distance +20 cm.

Table 3. Performance of lens in terms of acceptable range of DoF

Lens	18-105 mm f/3.5-5.6G	50 mm f/1.8D	50 mm f/1.4G
Focus Distance -20 cm	✕	✕	△
Focus Distance -10 cm	✕	△	○
Focus Distance0	○	○	○
Focus Distance +10 cm	○	○	◎
Focus Distance +20 cm	△	○	○

Remark ◎ = "Very good" ○ = "Good" △ = "Acceptable" ✕ = "Poor"

Figure 3. Example of Acceptable range of DoF images from 18-105 mm f/3.5-5.6G (Focus Distance -20cm, Focus Distance -10 cm, Focus Distance 0, Focus Distance +10 cm, Focus Distance +20cm)

4. CONCLUSION

We found that the lenses with the highest performance of sharpness expression is 50mm f/1.4G and then 50mm f/1.8D and 18-105 mm f/3.5-5.6G ED VR respectively. Therefore, ordinary photo taking does not

need the evaluation of the depth of field with the standard chart since the evaluation of the photo's depth of field in the real application will evaluate from photos in overall rather than considering in a specific point. Psychophysical method, hence, can be instead used to evaluate the depth of field in the case that there is no standard chart.

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