Diffraction of a non-coherent light source on polygonal apertures

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1 Introduction

In photography and arts, the quality of a taken photo relies upon the creativity of the photographer, special lighting conditions but also on technical details of the lens and the camera. Often photographers work out special settings of their hardware in order to make their photos unique and of a novel appearance. In some cases, even imperfections of the camera design are utilized to make their photos special. One of this kind is caused by the necessity of the adjustability of the lens aperture. Such an adjustable iris is technically realized by a finite number of blades that are overlaid to leave a regular polygonal opening. The edges in the aperture introduce artificial effects and modify a photo in various ways. One of this well-known phenomena is the appearance of rays of a distant point-like light source in photography or astronomy as a consequence of diffraction at the polygonal aperture of a camera.

In this work, I investigated how parameters of camera apertures affect the occurring diffraction patterns, especially of non-coherent or partially coherent light sources (e.g. lanterns).

2 Experimental Setup

In order to create picutres of different diffraction patterns a LED was used as a light source, which was then photographed using different polygonal apertures of different sizes, which were created by laser cutting to ensure precise polygonal shapes (see fig. 1).

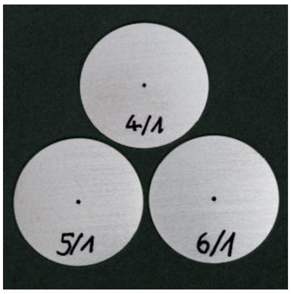
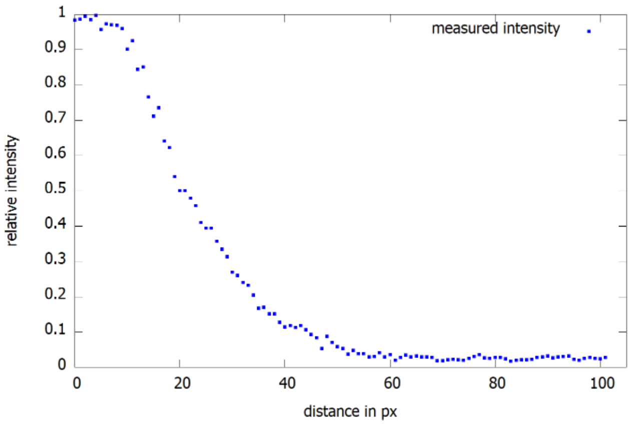


Fig. 1: Polygonal Apertures

Fig. 2: Diffraction patterns of triangular, rectangular and octagonal aperture

3 Results

Using these apertures I was able to observe different numbers of diffraction spikes, created by different apertures (see Fig. 2). By taking the grayscale oft he resulting images I was able to calculate the relative intensity at any point. Herbey I was able to proof that along a diffraction spike the intensity decreases proportional to $\frac{1}{r^2}$.



4 Conclusion

I investigated the behaviour of non-coherent light when passing through an aperture – a phenomenon frequently occurring in photography. I was able to calculate resulting images theoretically and to proof these calculations by various experiments.

5 References

[1] Jiri Komrska: *Simple derivation of formulas for Frauenhofer diffraction at polygonal apertures* (1982)