Using Different Types of Bokeh As A Way to Work with Various Backgrounds in Portrait Photography

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ABSTRACT

The article examines the bokeh technique as a way to neutralize, control and transform the background in portrait photography. This question is important for portrait photography, as well as other types of photography in which the background may dominate over the subjects of photo shooting. The article is based on the theoretical foundations of creating bokeh, the main types of bokeh, their features, advantages and disadvantages are considered. The theoretical conclusions have been verified by experiments using real photographic lenses under various photographic conditions. Examples of lenses that form the types of bokeh under consideration are also given. Comparing different types of bokeh and how they are created is a powerful tool for creating predictable images in a variety of photographic conditions.

1. Introduction

Creative photography, like any art form, has no secondary elements. Any photography contains two main elements - the main subject of the photography (there may be several) and other objects called the background.

Every photographer should pay great attention to both the main subject and the background behind it. When you focus on the main subject, it is easy to forget to take the background into account.

The background can either beautify or break your photo. It is also important that the background does not distract from the main subject of the photo, but rather harmoniously complements it.

The importance of the background in artistic photography has been discussed in almost every photography textbook for many decades. For example, the book "25 Lessons in Photography", published in 1961, says the following "... a photography where the main subject is lost between the gray

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planes of the sky and the greenery located too far away, or a photography overloaded with secondary objects, among which the eye does not immediately find the main one, will be unattractive ..."[1].

The correct reflection of the background is extremely important in one of the most popular genres of photography - portrait photography. The person's face is the main object of attention in this genre of photography.

Often photographers, even with modern photographic equipment, but not sufficiently understanding the fundamental principles of optical image formation, are not able to correctly control the formation of the background image. This is most important for beginning photographers who have not studied the fundamental principles of image formation using optical technologies in sufficient depth, but who believe that modern photographic equipment should itself certainly produce high-quality photographs.

There are a number of ways to create images of background objects with predictable results.

In some cases, for example, when shooting in a studio, the photographer has the opportunity to choose the background for photographing. But, unfortunately, this is not always the case. When shooting portraits on city streets, in parks, and at festive events, the background is often multicolored, bright, and mottled. There are various ways to correctly shoot scenes with such a background, for example, using lenses with a large focal length and high aperture ratio, which allows you to reduce the depth of field and blur the background[2].

At the same time, there are other ways to make a spectacular photo with a colorful and vibrant background. These techniques are commonly known as bokeh techniques.

The aim of this article is to test the hypothesis that different optical designs of different lenses produce images of background objects differently. This could potentially provide the photographer with a powerful technology to create images of background objects with predictable results.

Any conclusions must be based on the relevant theory. The article is based on the theoretical foundations of creating bokeh, the main types of bokeh, their features, advantages and disadvantages are considered. The theoretical conclusions have been verified by experiments using real photographic lenses under various photographic conditions.

The article also provides examples of lenses that produce the types of bokeh under consideration.

An understanding of the distinctive features in the different lenses allows photographers to choose lenses not based on advertising slogans or price, but on an understanding of the optical characteristics of these lenses.

In essence, this makes it possible to dramatically reduce the photographer's costs for purchasing photographic equipment by purchasing only the most optimal photographic lenses. Often, unique but little-known lenses have a lower cost.

2. The bokeh as a way to work with the images of background

The term "bokeh" comes from the Japanese word "boke" (呆け), which means "blur" or "haze".

Bokeh is undoubtedly one of the most popular photographic effects, perhaps because it is powerful yet relatively easy to apply[3].

A review of existing articles devoted to the use of bokeh showed that often these articles reflect only a description of types of bokeh with sample photographs, but without explaining the principles of bokeh formation, such as the article "40 Beautiful Examples of Bokeh Photography"[3], or, on the contrary, are almost entirely devoted to the theory of image formation using lenses, and bokeh is considered as one of the aspects of this, without considering the aesthetic features of the image, such as the article "Theory of bokeh image structure in camera lenses with an aspheric surface"[11] and "Selective Bokeh Effect Transformation"[12].

Many existing articles compare different types of bokeh by an aesthetic of photopictures, but do not compare them by the applicability of different lenses and their technical features to different types of photography.

In this article has been tried to cover this clear research gap.

The term describes the subjective artistic value of the out-of-focus part of the photograph.

The formation of bokeh can be understood through the understanding of circles of confusion. Out of focus, each bright point becomes a circle. The areas outside the focus area are displayed differently on different lenses. With one lens, this disk appears uniformly illuminated, with another, brighter at the edges, and with a third, brighter in the center. Some lenses visually bring these points closer to the camera, while others make them appear further away.

The size of the disk of confusion depends directly on the parameters of the lens and is easily described by mathematical formulas. A short description can be found, for example, in the article "Depth of Field and Bokeh" by H.H. Nasse from the Optical Development Department of Carl Zeiss AG[4].

Every picture element is generated by a large number of beams of light that shine through the aperture and combine in the picture element. In doing so, they form a light cone whose area is the image of the aperture seen from the sensor. This picture of the aperture is called the exit pupil.

The f-number is the ratio of the distance from the image plane to the exit pupil and the diameter of the exit pupil. The angular aperture of the light cone therefore only depends on the f-number[4]:

f-number = DistEP / DiameterEP.

A large aperture (meaning a low f-number) means a truncated light cone, and a small aperture (meaning a higher f-number) means a pointed light cone.

If the sensor surface (yellow line) intersects with the light cone at a certain distance from the point of the cone, the resulting intersection is the circle of confusion marked red in above drawing (Fig. 1).
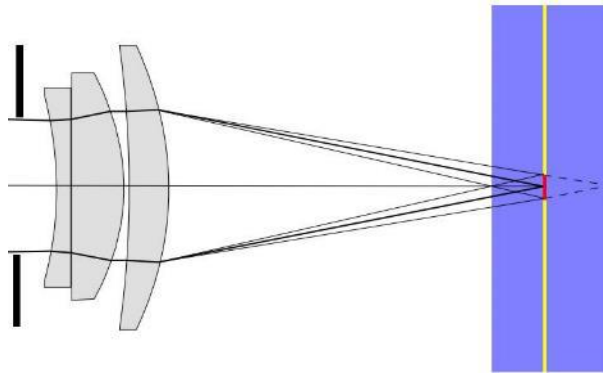

Figure 1. Circle of confusion[5].

The total image-side depth of focus (the blue section of the image space in the diagram above) is twice the product of the diameter of the circle of confusion (z) and the f-number (k)[4]:

depth_of_focus $\approx 2*z*k$.

The unevenness of the shading of the shapes of the circles of confusion is determined by the magnitude of spherical aberration (SA) in the lens. SA is an optical effect that occurs when light entering the lens at different distances from the optical center is refracted more strongly than light passing through the optical center (Fig. 2).
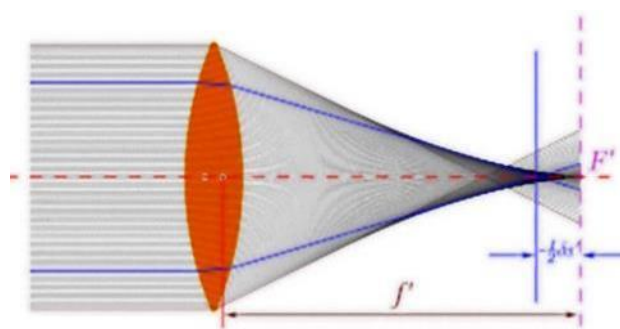

Figure 2. The principle of spherical aberration[5].

Spherical aberration causes uneven distribution of light rays and changes in the hue of the circle.

If the lens is designed perfectly, all light entering the lens, regardless of the distance from the optical center, is focused at a single point - there is no spherical aberration. In a lens devoid of spherical aberration, the circle of confusion will be uniformly shaded across the entire circle. If spherical aberration is not corrected enough, it will result in more light in the center of the circle - a Gaussian light distribution. Out-of-focus circles will be brighter in the center than at the edges. Finally, if the circles collect more light at the edges and spherical aberrations are corrected too much, you will get the so-called "soap bubble" effect in bokeh (Fig. 3).
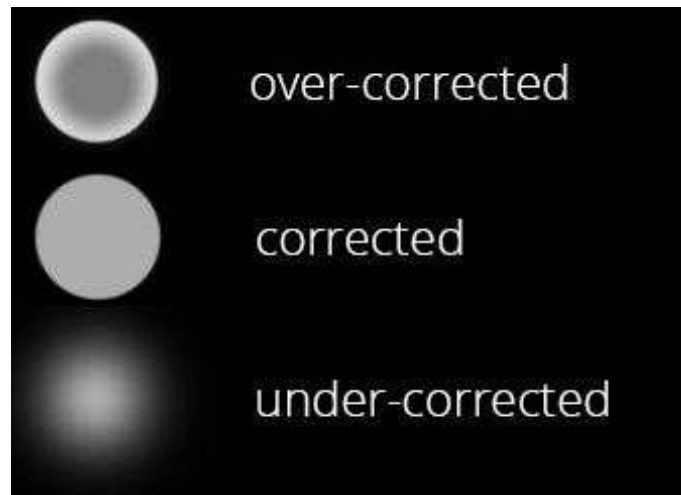

Figure 3. The shape of circles of confusion for different values of spherical aberration[6].

This basic knowledge of the theory behind blur disk formation is necessary to properly understand the causes of the different types of bokeh. And, accordingly, for the predictability of the formation of the desired bokeh patterns in photographs.

Photography is essentially an art, photographers rarely study the strict theories of optical physics and do not like to delve into mathematical formulas.

As a result of studying the sources of information, publications were found in which the main parameters responsible for the intensity (strength) of bokeh were described in terms more understandable to photographers[7]:

1. Focal length of the lens... The longer the focal length of the lens, the easier it is to blur the background and increase the degree of blur.

2. Aperture lens. The larger the relative aperture (the smaller the F number), the easier it is to achieve strong blurring of the image in the non-sharpen area and increase the blur circles outside the depth of field.

3. Aperture View. Typically, when closing, the diaphragm cannot remain as round as when fully open, due to the limited number of aperture blades. When apertures are closed, polygonal figures appear in the blur zone instead of discs (circles).

4. Focus distance... The closer the focuser position is to the MFD (minimum focusing distance), the stronger the blur will be.

5. Optical circuit of a lens, which, in fact, forms an unusual pattern for each lens separately.

6. Background and foreground. It is very important to understand that the blur pattern depends on what will blur. Bright single light sources tend to turn into luminous discs, and a uniform background becomes a soft plastic mess.

So, ultimately, it depends on the lens what bokeh effect you get.

Unfortunately, there is no standard list of all bokeh types.

Typically, photographers distinguish five main types of bokeh[9]:

- Hollywood bokeh (Hollywood Style Bokeh);
- Soap Bubble bokeh;

- Donut bokeh;
- Cream bokeh (Creamcheese Bokeh);
- Swirly bokeh.

In the stage of preparing the information for this article, these types of bokeh were tested using experimental photography with real photo lenses in various photography conditions.

Hollywood Bokeh (Shaped Bokeh) means bokeh, in which glowing circles (disks) are pronounced in the out-of-focus area (Fig. 4). Moreover, it may not be circles, but rectangles, stars, everything, anything… Why Hollywood? Because in Hollywood films, a lot of evening and night scenes are shot in this bokeh style[6].
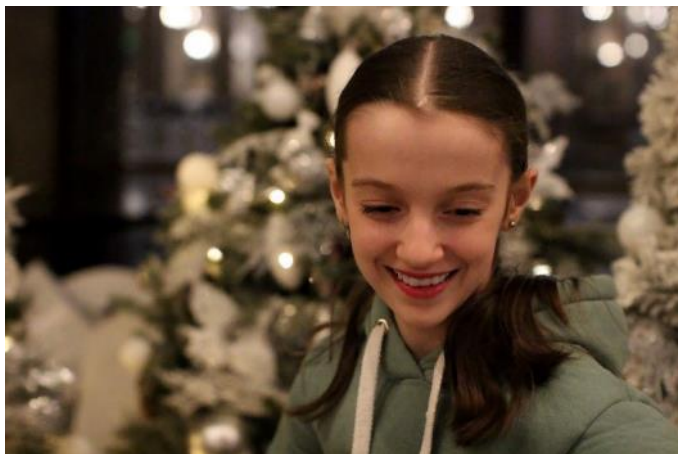

Figure 4. Hollywood Bokeh (Shaped Bokeh).

This is the most common type of bokeh and the vast majority of modern lenses create it.

This type of bokeh can be easily and successfully applied in portrait photography.

The shape of the blur circle directly depends on the shape of the aperture opening. In some lenses, the aperture may have the shape of a six-pointed star, diamond, and other shapes. The blur circles will have the appropriate shape (Fig. 5). As a rule, these are old lenses without autofocus. For example, the Industar-61 and Volna-9 lenses, previously produced in the USSR, have aperture openings in the shape of a six-pointed star.

Figure 5. Bokeh in the shape of a six-pointed star.

Moreover, such a bokeh effect is easy to obtain with almost any form of blur circles. To do this, it is enough to cover the lens like a lid with a piece of cardboard or opaque plastic with a cut-out hole of the required shape[8] (Fig. 6).

Figure 6. Obtaining a bokeh of an arbitrary shape[8].

Soap Bubble bokeh is very cool type of bokeh. It's kind of like Hollywood bokeh, but with a thinner ring that's more pronounced around the edges of the bokeh balls (Fig. 7).

It's beautiful, but also means you're getting a softer lens at times. For this reason, Soap Bubble bokeh cannot be used in all types of portrait photography.

This type of bokeh is typical for lenses such as Canon RF 100mm f2.8 Macro IS L, Meyer Optik Trioplan 50mm f2.9, Meyer Optik Trioplan 100mm f2.8, TTartisan 100mm f2.8 Full Frame.

Figure 7. Soap Bubble bokeh.

Donut bokeh is very peculiar type of bokeh. The out of focus areas appear as rings, like a ring donut (Fig. 8).

Figure 8. Donut bokeh[10].

Donut bokeh is usually only found with reflex lenses–otherwise known as mirror lenses. The distinctive shape of the bokeh comes from the design of the lens and the placement of the reflecting mirror in the center of the image[9].

Both in the past and now, a large number of such lenses are produced.

As a rule, these are telephoto lenses with manual focus and a constant aperture value. Due to the large focal length (from 300 to 1000 mm), such lenses are not very suitable for portrait photography.

Cream bokeh (Creamcheese Bokeh) is absolutely different from other types of bokeh. It is designed to make the blur with a real "blurry" method, without a variety of bright rounds, the blur becomes like a cream in consistency (Fig. 9).

Figure 9. Creamy bokeh.

Creamy bokeh is ideal for portrait photography because it neutralizes any background, even the most colorful ones. But it is very difficult to get creamy bokeh. Very few lens models are capable of creating an image with it. One of the most famous lenses is the Tair-11A 135 mm f2.8 lens, produced in the USSR.

Swirly bokeh is considered one of the most unique types of bokeh. In this bokeh, the blur circles look like a swirling concentric spot around the center of the image (Fig. 10).

Figure 10. Swirly bokeh.

Many people know and associate this type of bokeh with the famous Helios lenses (Helios 40-2 85mm f1.5, Helios 44-2 58mm f2.0, Helios 44-3 58mm f2.0, etc.). These are the most popular lenses previously produced in the USSR. These are simple, reliable and inexpensive lenses that provide an excellent image. However, these lenses have only manual focus and aperture settings and do not have the ability to change the "swirled" character of the pattern in the blur zone.

But there are lenses that allow you to change the "swirled" nature of the pattern in the blur zone (Fig. 11). These are lenses such as Selena 85mm f2.2, Selena 58mm f1.9, New Petzval 85mm f2.2,

Monolens Petzval 104mm f3.0 Tilt-Swirl IRIS. Surprisingly, as unique as these lenses are, so little they are known.

Figure 11. Adjusting of Swirly bokeh.

In some cases, when using lenses with the ability to change the nature of the pattern in the blur zone depending on the distance to the object, the swirly bokeh can change from concentric to radial, with the arrangement of the blur circles in the form of rays diverging from the center of the frame (Fig. 12). This feature must be taken into account when constructing a frame and determining the expected shooting result.

Figure 12. Swirly bokeh - Radial Blur.

This type of bokeh, both Radial Blur and Swirly Blur, has long been successfully used in portrait photography. The nature of the blur zone construction allows you to make a bright accent on a person's face or another object located in the center of the frame. At the same time, the background itself can become an additional artistic element of the frame.

At the same time, a feature of lenses with Swirly bokeh is the low sharpness of the image at the edges of the frame, which limits the possibility of use in some types of portrait photography.

3. Results section

Different types of bokeh provide the photographer with a wide range of possibilities for working with the background in portrait photography, from complete blurring and smoothing when using lenses with Creamy bokeh, to turning it into an additional artistic element of the frame when using lenses with Swirly bokeh.

Most modern autofocus lenses create frames only with Hollywood bokeh.

Other types of bokeh are more typical either for lenses released many years ago, or for modern lenses, but without autofocus systems, digital aperture control, etc. Using such lenses requires the photographer to be able to manually focus and adjust shooting parameters. On the other hand, such lenses are usually simpler, more reliable and cheaper than autofocus ones.

The presented overview of bokeh types can be briefly summarized in the form of a table (Table 1).

Table 1 | Using different types of bokeh in portrait photography.

Type of bokeh	Applicability in portrait photography	Lens prevalence	Difficulty of using
Hollywood bokeh	Widely used	Widespread	Easy
Soap Bubble bokeh	Used	Little used	Easy
Donut bokeh	Hardly used	Widespread	Difficult
Cream bokeh	Widely used	Very rare	Easy
Swirly bokeh.	Used	Little used	Difficult

Based on this table, we can conclude that photographers have a wide range of different types of bokeh at their disposal. Each of the types of bokeh considered has its own strengths and weaknesses, depending on the photographic equipment used and the shooting conditions.

Based on these studies, it can be concluded that Hollywood bokeh and Cream bokeh are the most applicable for portrait photography. But at the same time, other types of bokeh can also be used with certain limitations.

4. Conclusion

Understanding the principles of image formation in different lenses opens up wide possibilities for predictable image formation of background objects.

In general, we can conclude that bokeh as a method is a very powerful tool in the hands of a photographer, capable of broadly revealing the creative potential of portrait photography, emphasizing a person's face as the central subject of photography and neutralizing or transforming the background as a secondary element of the portrait.

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