Chapter

Geometric Analysis of Ophthalmic Lens by Backward Method and Optical Simulation

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Abstract

This chapter will show the optical models of ametropia and presyopia by backward method (BM). The design activity of ophthalmic lens involves relatively simple, often elementary geometric optics. In general, ophthalmic lens design is given by tracing the light from the object to the image plane, i.e., the retina. And this can be called the forward method (AM). By BM, the position of the object and image is interchanged, i.e., retina plays the role as object. Using BM gives an alternative way to know how the eye works as a lens, and the retina now acts as the object tells more information for the correction of ametropia and presbyopia for its curve shape and the location. Applying this BM geometric analysis, we can see the correction of ametropia by correction lens, i.e., spectacle, is to fulfill the needs to put the object at the conjugate places of retina formed by the myopic and hyperopic eye. For verification, the optical simulation by Zemax is applied to simulate the image forming processing, i.e., the conjugation between the retinal and it counter parts. Similarly, this geometric analysis can be applied to analyze the progressive addition lenses (PALs) by the revised BM.

Keywords: geometry optics, ophthalmic lens, ametropia, presyopia, simulation

1. Introduction

In general, optical image forming is to trace light ray from object to image shown in **Figure 1**, i.e., from the left to the right which represents the object and image spaces respectively [1, 2]. And this can be called the forward method (FM). This chapter shows that the retinal of the eye plays the role as the object, and the light ray is traced from the right to the left compared to the FM. Since the ray racing is formed from the right to the left, i.e., backward method, this is named as BM. By BM, it will be analytically examined the ametropia and presbyopia.

At retinal, its edge zones in curved facing to object with closer distance compared with the central zone. In BM, it traces the light in an offense controversial way as the retinal acts now as the object rather than an image as usual. Using BM, it gives another way to look after how human's eye traces the light from the object to sit at the retina. But now, light rays emerge from the retinal is traced to the image plane where is at infinity as emmetropia or at the designated one as ametropia. Applying this unconventional geometry analysis, we can see the correction of ametropia by correction lens, i.e., spectacle, is to fulfill the needs to put the object at the

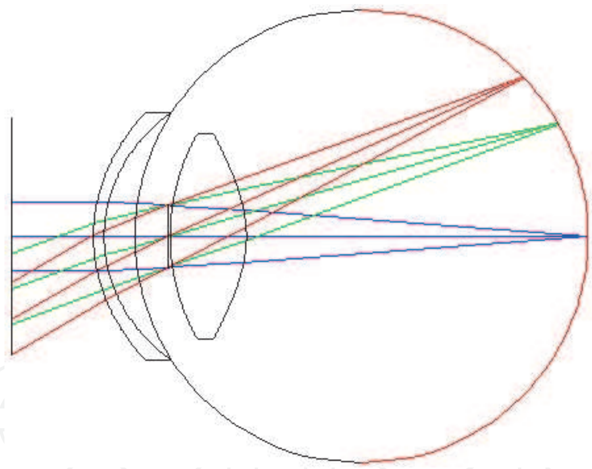

Figure 1.
Forward method of retinal image forming of emmetropic eye with field angle varied by 0, 20, and 30°.

conjugate places of the retina formed by the myopic and hyperopic eye [3]. Similarly, this geometric analysis will be applied to analyze the progressive addition lenses (PALs) [4] by the revised BM.

As mentioned in the fundamental infrastructure of the object and image layout [1]. The location and size of the image formed by a given optical system can be determined by locating the respective images of the sources making up the object. Here **Figure 2** shows the methodology of backward method of retinal imaging forming of emmetropic eye.

Figure 1 shows the conventional forward method of retinal image forming where retinal serves as the image. And **Figure 2** shows the backward method of retinal image forming where retinal serves as an object. By the BM idea, the object distance is finite and its shape is curve rather than plane, this can be an alternative way to realize the way of image forming by emmetropic or ametropic eye.

The following sections will give a rigorous analysis of BM, and the optical simulation by Zemax will accompanied for ophthalmic lens maker to have a clue to design a suitable spectacle for the glass wear. The data sheets of emmetropic eye are shown in **Tables 1** and **2** which represented the construction data of FM and BM of emmetropic eye.

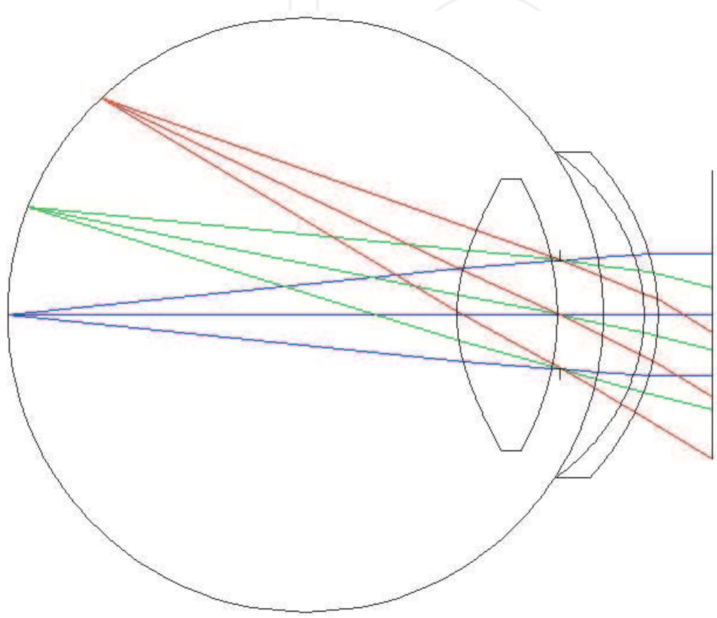

Figure 2.
Backward method of retinal image forming of emmetropic eye with object height varied by 0, 4, and 8 mm.

Surf: type		Comment	Radius	Thickness	Glass	Semi-diameter		Conic
*	Standard		Infinity	Infinity		Infinity	U	0.000
1	Standard		Infinity	4.000		5.764		0.000
2*	Standard	Cornea	7.800	0.520	Cornea	6.000	U	−0.500
3*	Standard		6.700	1.500	Aqueous	6.000	U	−0.300
4	Standard		11.000	1.600	Aqueous	11.000	U	0.000
*	Standard	Pupil	Infinity	0.100	Aqueous	1.500	U	0.000
6*	Standard	Lens	10.000	3.700	Lens	5.000	U	0.000
7*	Standard		−6.000	16.580	Vitreous	5.000	U	−3.250
IMA	Standard	Retina	−11.000	—	Vitreous	11.000	U	0.000

When an aperture is defined on a surface, ZEMAX will display an asterisk "" symbol next to the surface number.*

Table 1.
*Optical data of forward method of retinal image forming of emmetropic eye (*next to the surface number means an aperture is defined on this surface).*

Surf: type		Comment	Radius	Thickness	Glass	Semi-diameter		Conic
*	Standard	Retina	11.000	16.580	Vitreous	8.000		0.000
1*	Standard	Lens	6.000	3.700	Lens	5.000	U	−3.000
2*	Standard		−10.000	0.100	Aqueous	5.000	U	0.000
STO	Standard	Pupil	Infinity	1.600	Aqueous	2.000	U	0.000
4	Standard		−11.000	1.500	Aqueous	11.000	U	0.000
5*	Standard	Cornea	−6.700	0.520	Cornea	6.000	U	−0.300
6*	Standard	Subject eye	−7.800	2.000		6.000	U	−0.500
IMA	Standard		Infinity	—		5.340		0.000

When an aperture is defined on a surface, ZEMAX will display an asterisk "" symbol next to the surface number.*

Table 2.
Optical data of backward method of retinal image forming of emmetropic eye.

2. Geometric analysis of ametropia

The function of ophthalmic lens to correct vision can be analysis on the basis of elementary of geometry. In geometric analysis, an object and the image of the object created by any optical system are said to be conjugate to one another. In a nonaccommodating emmetropic eye, a distant object is focus on the retina as shown in **Figure 1**.

2.1 Myopia

If the eyes' optical elements do not create conjugant between the retina and a distance object, ametropia exists. In the myopic eye, the image of a distant object is not on the retina but located in front of it. **Figure 3** shows an −10 D myopic eye whose axial distance is 20.28 mm compared with 16.58 mm of emmetropic one shown in **Table 1**, as eye axis increases by 0.37 mm, the diopter of the myopic eye increases by −1.00 D [5].

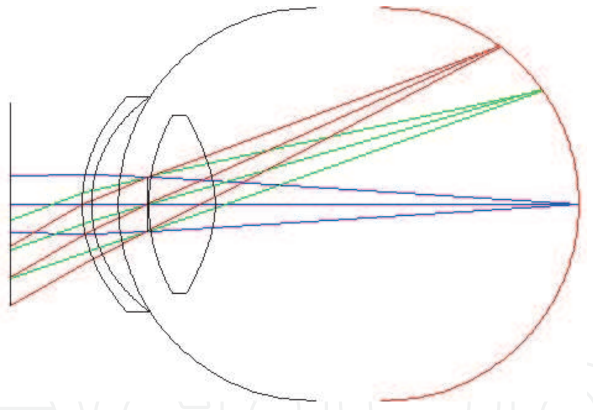

Figure 3.
Layout of −10 D myopic eye.

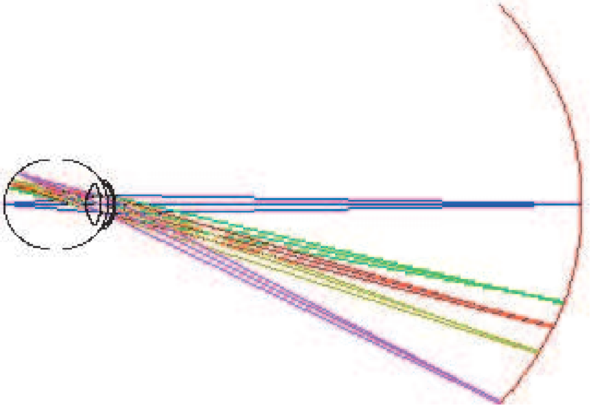

Figure 4.
−10 D myopia ray trace form optical simulation by BM.

If the retina of an eye is thought by BM as an object, the image of the retina formed by the optics of Eye will be located at the far point plane [6], i.e., the conjugate plane of the retina. Following the backward method (BM), in the emmetropic eye, the far point plane is located at optical infinity as shown in **Figure 2**. But in the myopic eye, the far point plane is not located at infinity but somewhere in front of the eye. And this can be simulated by optical simulation by Zemax shown in **Figure 4**.

This can also be explained graphically as the retina is located at a bit longer distance than the focal length of the myopic eye. The far point plane is real, inverted, and relative huge. And the higher the degree of myopia, the closer the far point plane is to the eye as shown in **Figures 5** and **6**.

This can be explained by "Newtonian" form of the image Eq. (1), we can see:

$$x' = -\frac{f^2}{x} \tag{1}$$

where x and x' are the distances from focal point to the object and image, respectively, and f is the focal length of the optics of eye.

In the case of lower degree of myopia, it means the retina is in front of the focal point of the optics of eye, i.e., $x < 0$, and $x \cong 0$. Keep in mind, the sign is still valid in an alternative way by BM. From Eq. (1), we can see the conjugant image distance is real, i.e., $x' > 0$, and inverted, indicated by **Figures 5**–**8**.

Optical simulation by BM can also verify this phenomenon as illustrated in **Figures 7** and **8**, with −5 and −10 D myopia, respectively.

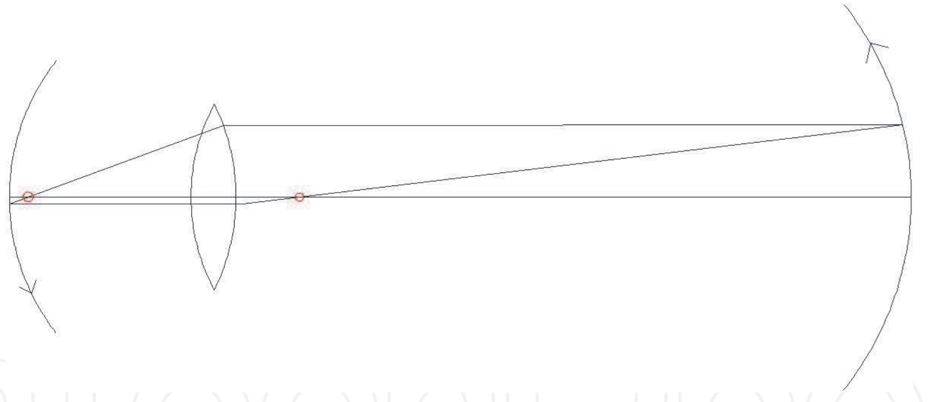

Figure 5.
Far point plane of low degree myopic eye. It is real, inverted, and relatively huge.

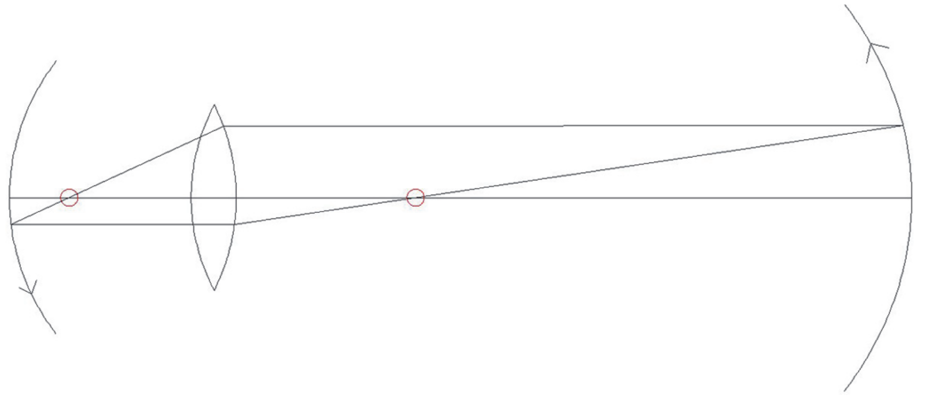

Figure 6.
Far point plane of high degree myopic eye.

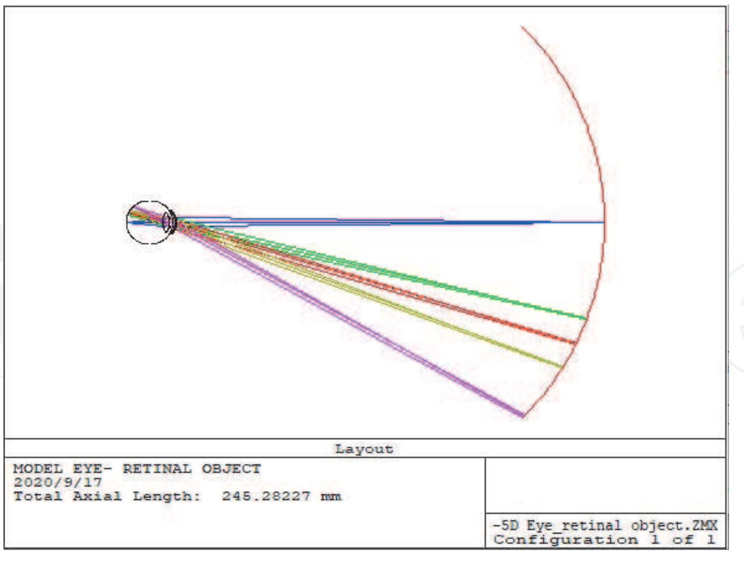

Figure 7.
Ray tracing of −5 D myopic eye by BM.

The magnification of the image of the retina is determined by Eq. (2):

$$m = \frac{f}{x} \tag{2}$$

This means the image size of the retina is relatively huge as $x \cong 0$. And this shows the reason why an emmetropic or lower degree of myopia can look easily the

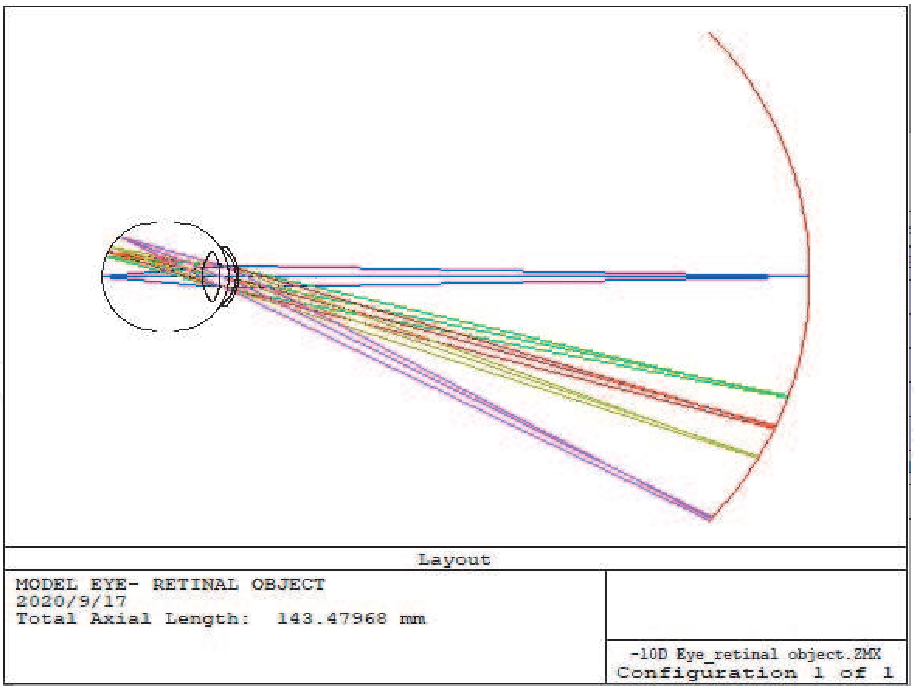

Figure 8.
Ray tracing of −10 D myopic eye by BM.

sightseeing because the image plane of the retina is approximately as a plain with relatively large scale. As the degree of myopia is increased, i.e., x is getting longer, the image size of the retina is decreased by Eq. (2) as m is inverse proportional to x. This makes the field of view of high degree myopia be restricted to a relative small scale. The optical simulation proves this shown in **Tables 3** and **4**.

Concerning the image quality of BM of myopic eye ray trace, we can also see an interesting phenomenon indicating the distortion changed with the curvature of the image plane of the retina, i.e., the shape of viewing object. **Figures 9** and **10** show the scale of the curvature of the retina's image decreased from −140 to −70 mm to get a corrected undistorted image, i.e., distortion ≒ 0.2%.

From the above discussion, we can see that the scale and the curvature of the image plane changing from −5 to −10 D myopic eye are related to the factor of 2 as expected by Eq. (2). And Eq. (1) gives a clue to locate the places of far point plane; the thickness from eye to the image plane is 219.432 and 115.780 mm related to −5 and −10 D myopia, respectively.

Surf: type		Comment	Radius	Thickness		Glass	Semi-diameter		Conic
*	Standard	Retina	11.000	18.430		Vitreous	8.000		0.000
1*	Standard	Lens	6.000	3.700		Lens	5.000	U	−3.000
2*	Standard		−10.000	0.100		Aqueous	5.000	U	0.000
STO	Standard	Pupil	Infinity	1.600		Aqueous	2.000	U	0.000
4	Standard		−11.000	1.500		Aqueous	11.000	U	0.000
5*	Standard	Cornea	−6.700	0.520		Cornea	6.000	U	−0.300
6*	Standard	Subject eye	−7.800	219.432	M		6.000	U	−0.500
IMA	Standard		−140.000	—			99.932		0.000

When an aperture is defined on a surface, ZEMAX will display an asterisk "" symbol next to the surface number.*

Table 3.
Optical data of −5 D myopic eye by BM (image semi-diameter: 99.932 mm).

Surf: type		Comment	Radius	Thickness		Glass	Semi-diameter		Conic
*	Standard	Retina	11.000	20.280		Vitreous	8.000		0.000
1*	Standard	Lens	6.000	3.700		Lens	5.000	U	−3.000
2*	Standard		−10.000	0.100		Aqueous	5.000	U	0.000
STO	Standard	Pupil	Infinity	1.600		Aqueous	2.000	U	0.000
4	Standard		−11.000	1.500		Aqueous	11.000	U	0.000
5*	Standard	Cornea	−6.700	0.520		Cornea	6.000	U	−0.300
6*	Standard	Subject eye	−7.800	115.780	M		6.000	U	−0.500
IMA	Standard		−70.000	—			45.389		0.000

When an aperture is defined on a surface, ZEMAX will display an asterisk "" symbol next to the surface number.*

Table 4.
Optical data of −10 D myopic eye by BM (image semi-diameter: 49.389 mm).

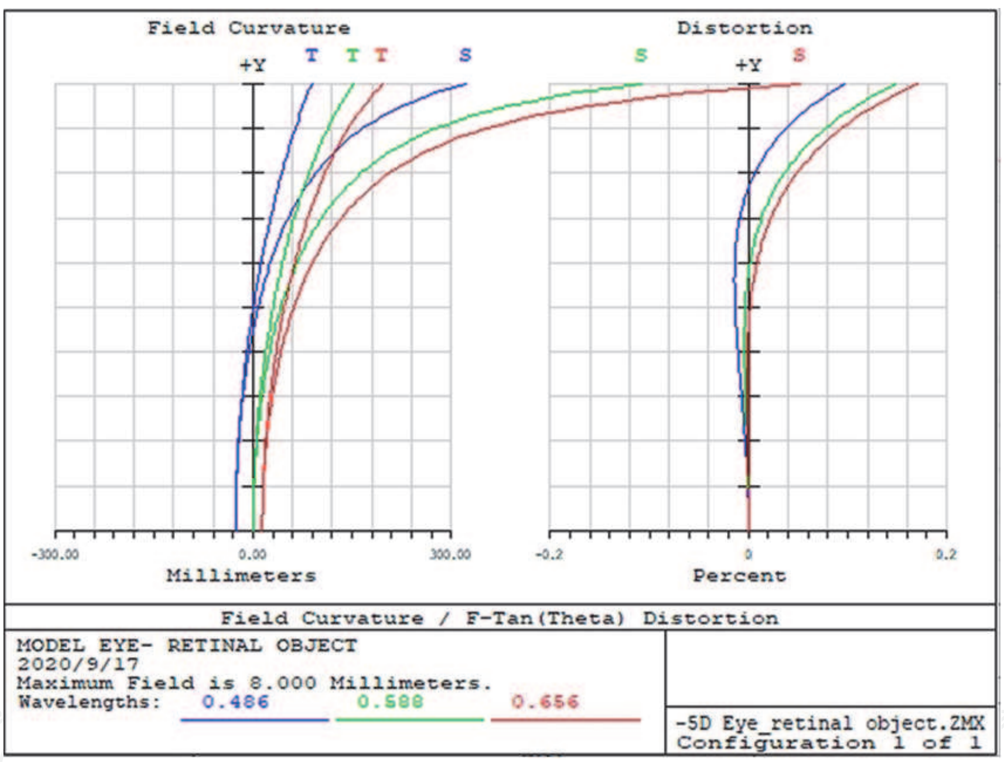

Figure 9.
Field curvature and distortion of −5 D myopic eye with corrected curvature of image plane of retina by BM.

The correction of myopia is to add the concave lens to let the distance object sit on the far point plane, and the design of the spectacle whose secondary focal plane is placed to coincide with the myopic eye's far point plane, as shown in **Figure 11** for the correction of −5 D myopia.

Table 5 shows the optical datasheet of −5 D myopia correction, and the object distance, object curvature, and object height are got from **Table 3** by BM.

We can see the spectacle is designed whose second focal point is coincide with the far point distance (219.432 mm), object's curvature is set by 140 mm, and the object height is 99.232 mm which is same as the image's semi-diameter in **Table 3**. Then the field curvature and distortion are well corrected by indication from **Figure 12**. It shows how BM can give a way to design an correction spectacle by finding the construction data from itself.

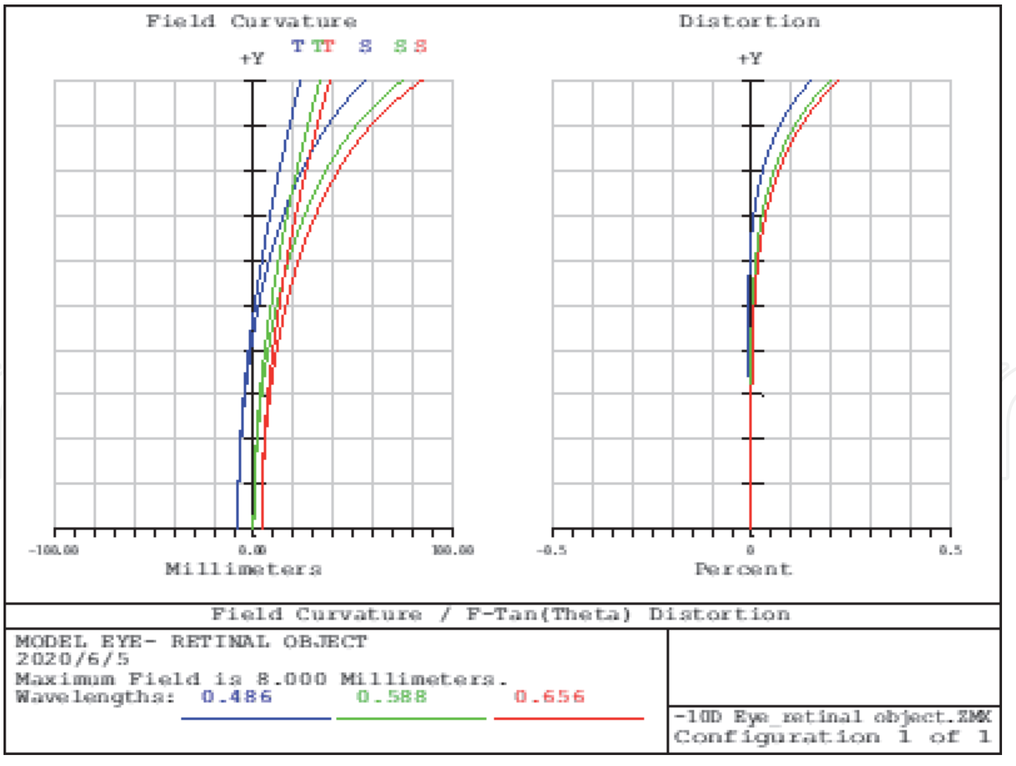

Figure 10.
Field curvature and distortion of −10 D myopic eye with corrected curvature of image plane of retina by BM.

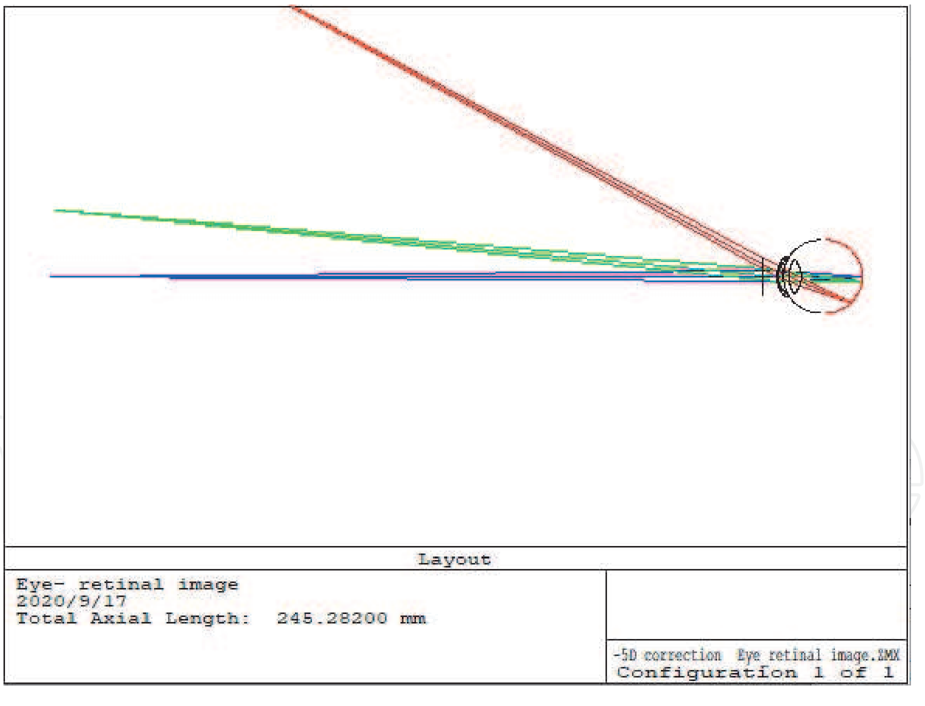

Figure 11.
Correction of −5 D myopia with 99.232 object height.

2.2 Hyperopia

In the hyperopic eye, the image of a distance object is not on the retina but located behind of it as shown in **Figure 13**.

In hyperopic eye, by BM the far point plane is virtual and located behind the eye in a virtual, erected, and relative large scale form because the retina is located at a bit shorter distance than the focal length of hyperopic eye. The higher degree of the

Surf: type		Comment	Radius	Thickness	Glass	Semi-diameter		Conic
*	Standard		140.000	215.432		0.000	U	0.000
1	Standard		Infinity	4.000		5.488		0.000
2*	Standard	Cornea	7.800	0.520	Cornea	6.000	U	−0.500
3*	Standard		6.700	1.500	Aqueous	6.000	U	−0.300
4	Standard		11.000	1.600	Aqueous	11.000	U	0.000
*	Standard	Pupil	Infinity	0.100	Aqueous	1.500	U	0.000
6*	Standard	Lens	10.000	3.700	Lens	5.000	U	0.000
7*	Standard		−6.000	18.430	Vitreous	5.000	U	−3.250
IMA	Standard	Retina	−11.000	—	Vitreous	11.000	U	0.000

When an aperture is defined on a surface, ZEMAX will display an asterisk "" symbol next to the surface number.*

Table 5.
Optical data of −5 D myopia correction.

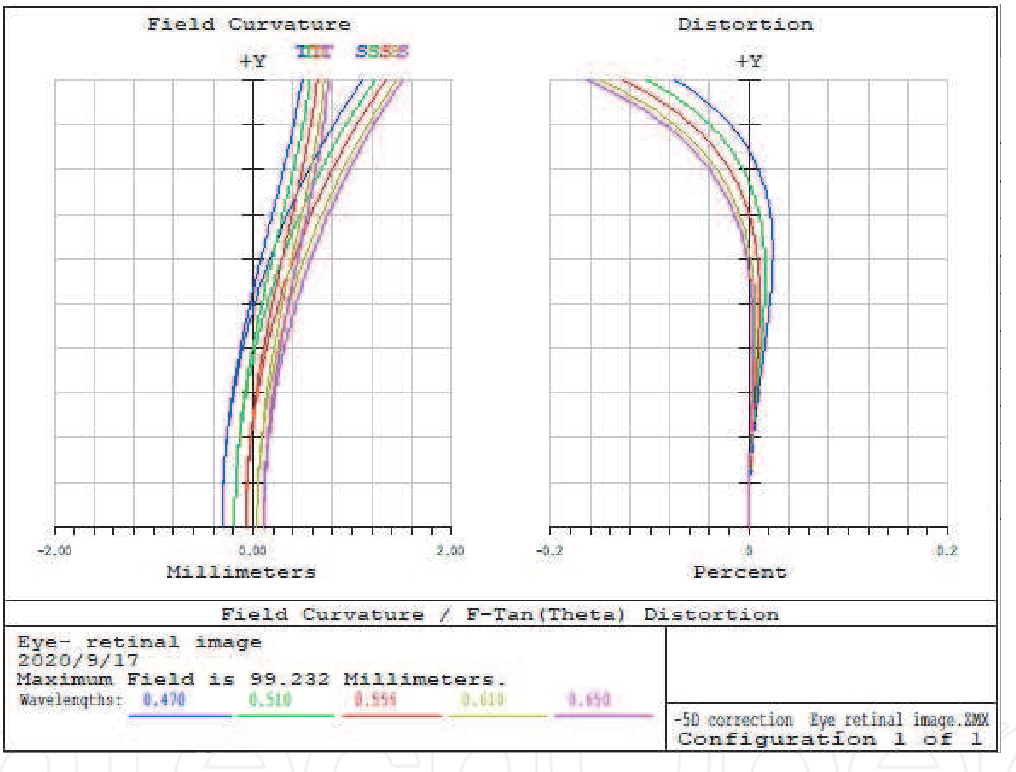

Figure 12.
*Field curvature and distortion of −5 D myopic eye with well correction by putting the far point at the designated data from **Table 3** by BM.*

hyperopia, the closer the far point plane is to the eye as shown in **Figures 14** and **15** and the **Tables 6** and **7** for the image distance changed from −178.364 to −83.003 mm respected with +5 to +10 D hyperopia.

The above optical simulation can also be graphically illustrated by **Figures 16** and **17**. It shows by using Eq. (1), we get $x' < 0$, and the far point plane which is the conjugant image of the retina is behind the eye as the retina is sit inside of the focal point of the optics of eye, i.e., $x > 0$.

The correction of hyperopia is to add the concave lens to let the distance object sit on the far point plane, and the design of the spectacle whose secondary focal plane is placed to coincide with the hyperopic eye's far point plane, as shown in **Figure 18** for the correction of +5 D myopia.

Table 8 shows the optical datasheet of +5 D hyperopia correction, and the object distance, object curvature, and object height are got from **Table 6** by BM.

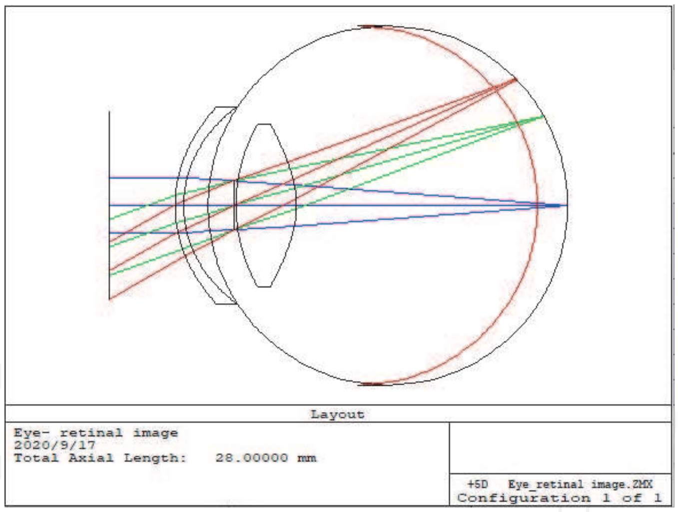

Figure 13.
+5 D hyperopic eye with 1.85 mm [5] shorter axial distance.

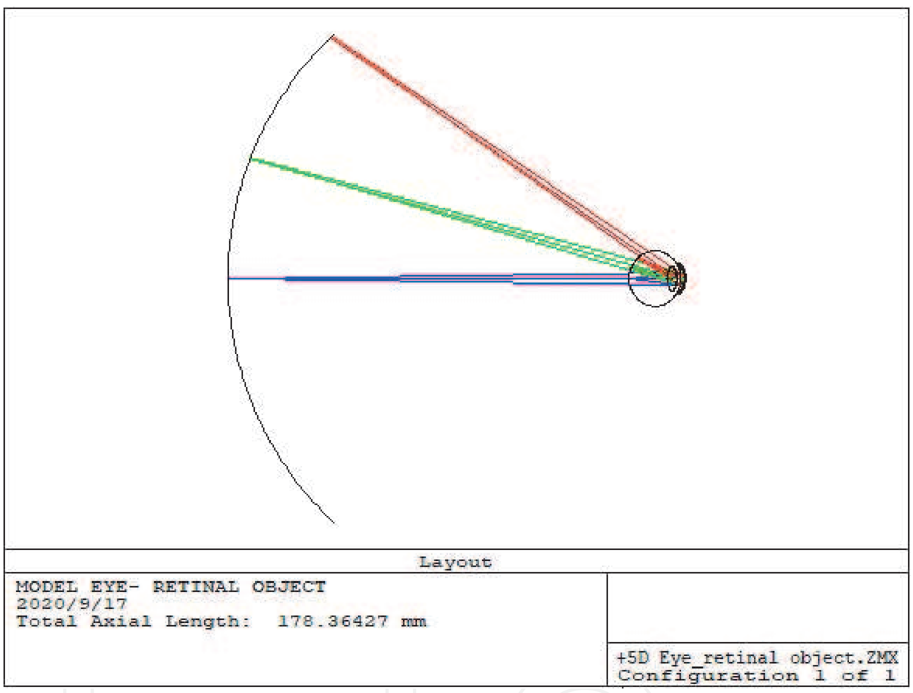

Figure 14.
Far point plane of +5 D hyperopic eye by BM.

We can see the spectacle is designed whose second focal point is coincide with the far point distance (−178.364 mm), object's curvature is set by −130 mm, and the object height is 94.996 mm which is same as the image's semi-diameter in **Table 3**. Then the field curvature and distortion are well corrected by indication from **Figure 19**. It shows how BM can give a way to design an correction spectacle by finding the construction data from itself.

3. Geometric analysis of presbyopia

The need to wear spectacles to see near objects is a result of presbyopia [7]. And this is different from the cases of hyperopia whose object is assumed at infinity. Presbyopia is a condition associated with aging in which the eye exhibits a progressively diminished ability to focus on near objects. Multifocal spectacle lenses or progressive addition lenses (PALs) are primarily used in the treatment of presbyopia [8].

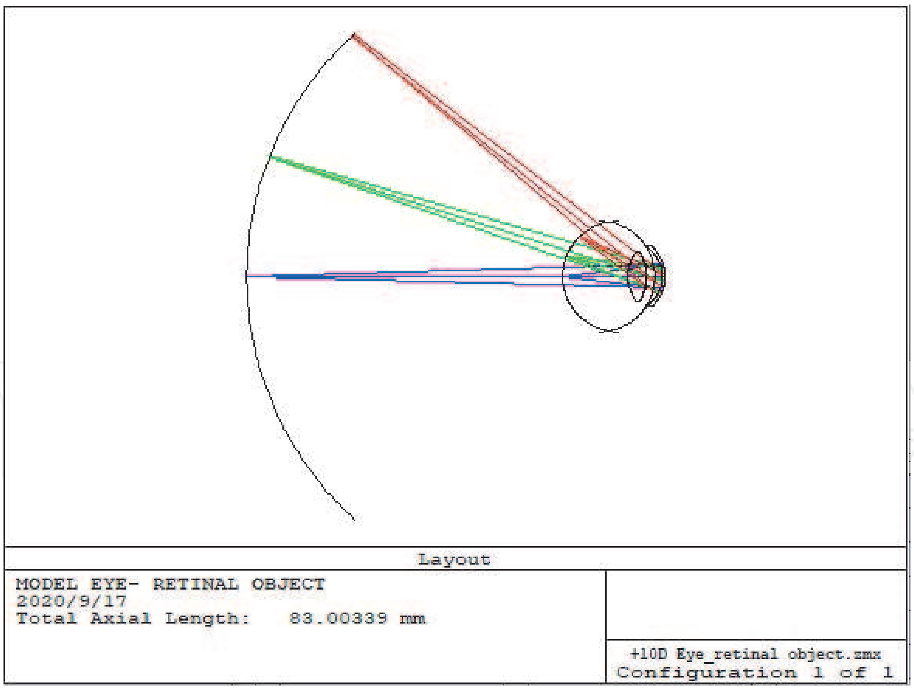

Figure 15.
Far point plane of +10 D hyperopic eye by BM.

Surf: type		Comment	Radius	Thickness		Glass	Semi-diameter		Conic
*	Standard	Retina	11.000	14.730		Vitreous	8.000		0.000
1*	Standard	Lens	6.000	3.700		Lens	5.000	U	−3.000
2*	Standard		−10.000	0.100		Aqueous	5.000	U	0.000
STO	Standard	Pupil	Infinity	1.600		Aqueous	2.000	U	0.000
4	Standard		−11.000	1.500		Aqueous	11.000	U	0.000
5*	Standard	Cornea	−6.700	0.520		Cornea	6.000	U	−0.300
6*	Standard	Subject eye	−7.800	−178.364	M		6.000	U	−0.500
IMA	Standard		130.000	—			94.996		0.000

When an aperture is defined on a surface, ZEMAX will display an asterisk "" symbol next to the surface number.*

Table 6.
Optical data of +5 D myopic eye by BM (image semi-diameter: 94.996 mm).

Surf: type		Comment	Radius	Thickness		Glass	Semi-diameter		Conic
*	Standard	Retina	11.000	12.880		Vitreous	8.000		0.000
1*	Standard	Lens	6.000	3.700		Lens	5.000	U	−3.000
2*	Standard		−10.000	0.100		Aqueous	5.000	U	0.000
STO	Standard	Pupil	Infinity	1.600		Aqueous	2.000	U	0.000
4	Standard		−11.000	1.500		Aqueous	11.000	U	0.000
5*	Standard	Cornea	−6.700	0.520		Cornea	6.000	U	−0.300
6*	Standard	Subject eye	−7.800	−83.003	M		6.000	U	−0.500
IMA	Standard		65.000	—			48.329		0.000

When an aperture is defined on a surface, ZEMAX will display an asterisk "" symbol next to the surface number.*

Table 7.
Optical data of +10 D myopic eye by BM (image semi-diameter: 48.329 mm).

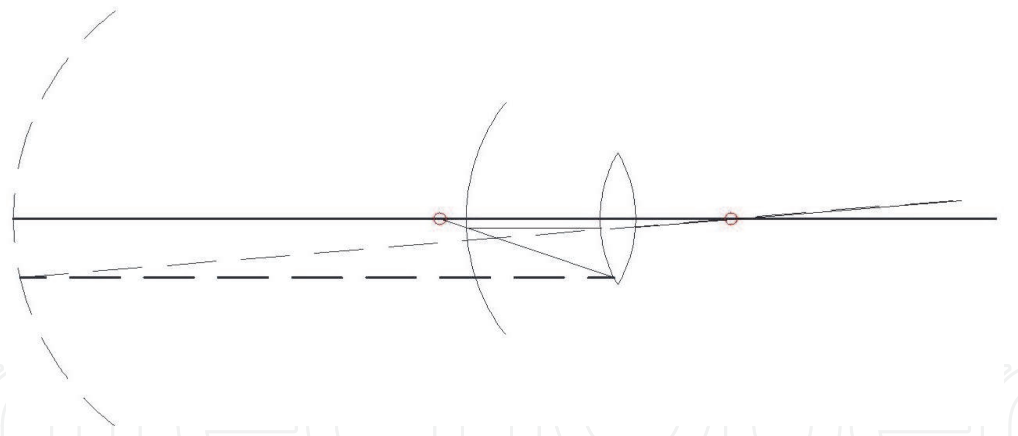

Figure 16.
Far point plane of low degree hyperopic eye by BM. It is virtual, erected, and relatively huge.

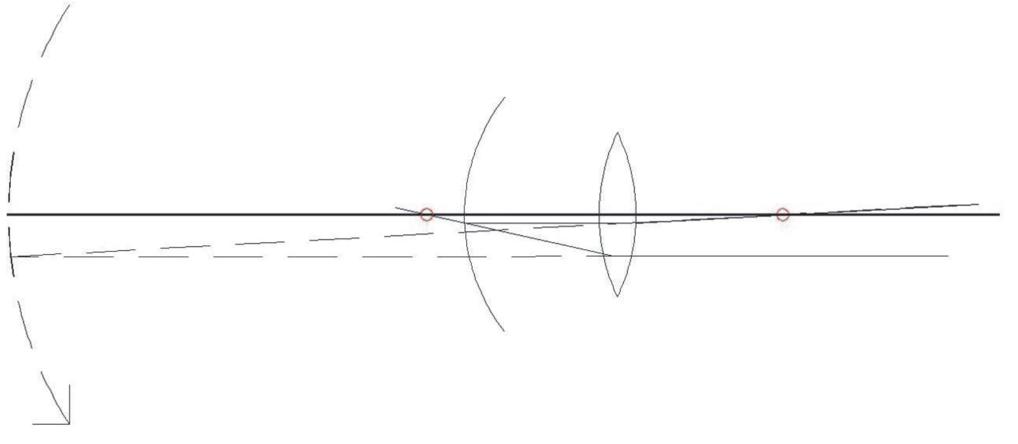

Figure 17.
Far point plane of high degree hyperopic eye by BM.

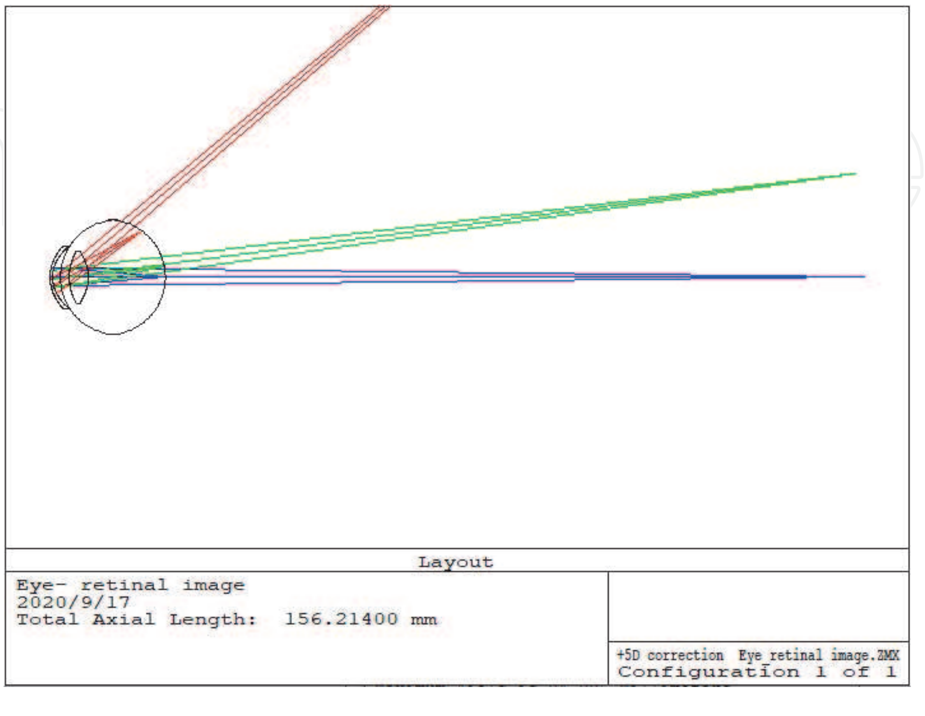

Figure 18.
Correction of +5 D hyperopia with 94.996 mm object height.

Surf: type		Comment	Radius	Thickness	Glass	Semi-diameter		Conic
*	Standard		−130.000	−156.214		0.000	U	0.000
1*	Standard	Cornea	7.800	0.520	Cornea	6.000	U	−0.500
2*	Standard		6.700	1.500	Aqueous	6.000	U	−0.300
3	Standard		11.000	1.600	Aqueous	11.000	U	0.000
*	Standard	Pupil	Infinity	0.100	Aqueous	1.500	U	0.000
5*	Standard	Lens	10.000	3.700	Lens	5.000	U	0.000
6*	Standard		−6.000	14.730	Vitreous	5.000	U	−3.250
IMA	Standard	Retina	−11.000	—	Vitreous	11.000	U	0.000

When an aperture is defined on a surface, ZEMAX will display an asterisk "" symbol next to the surface number.*

Table 8.
Optical data of +5 D hyperopia correction.

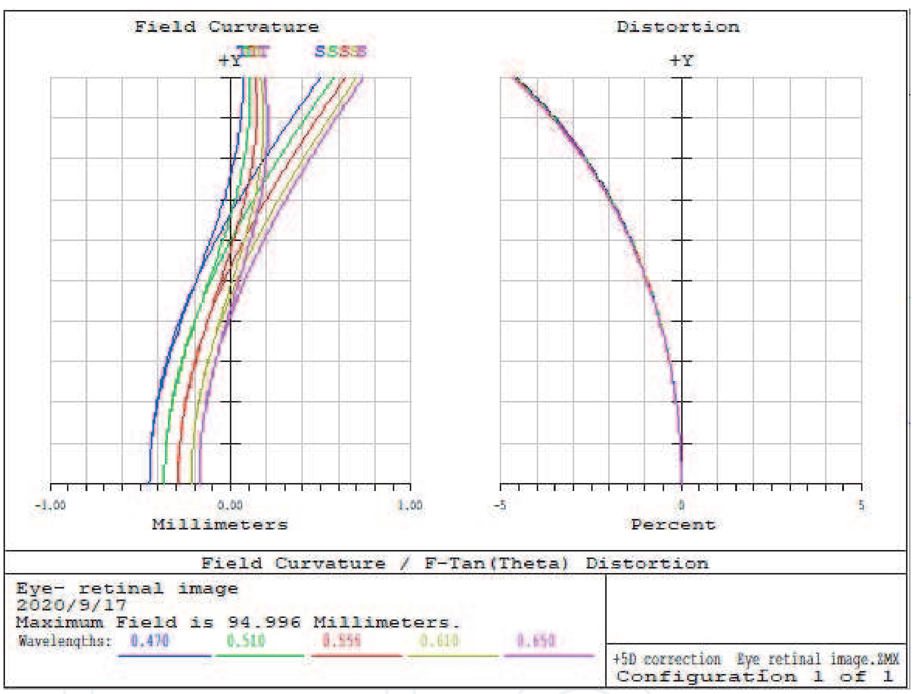

Figure 19.
*Field curvature and distortion of +5 D hyperopic eye with well correction by putting the far point at the designated data from **Table 6** by BM.*

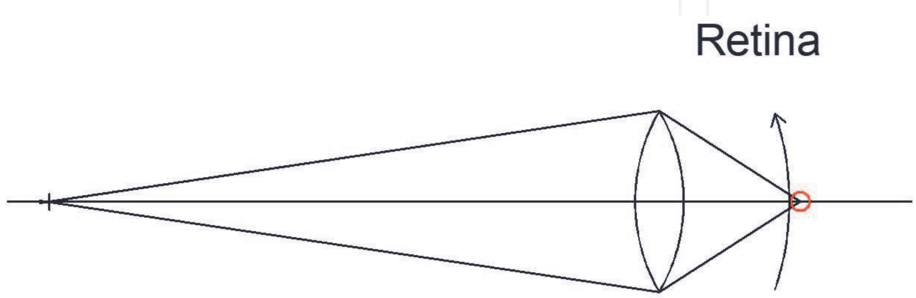

Figure 20.
Presbyopia at the distant object distance, and the image point (red dot) is assumed as the quasi focus.

Using the developed BM in Section 2 and Eq. (1), we can see how the variation of x' along with x shown in **Figures 20–22** [3] corresponding to the finite distances as the nearer object corresponding a longer focus error. The revised BM was

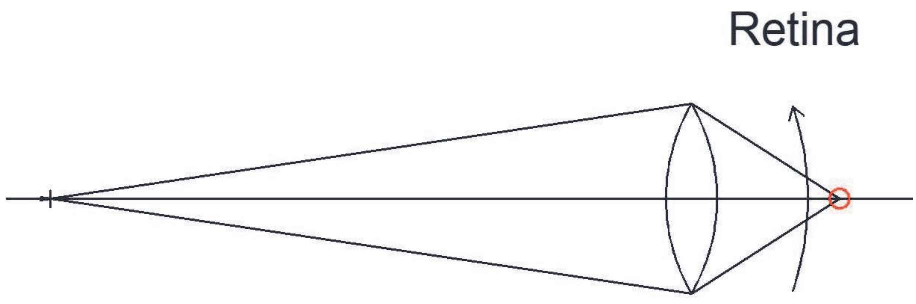

Figure 21.
Presbyopia at the intermediate object distance, and the image point (red dot) is assumed as the quasi focus.

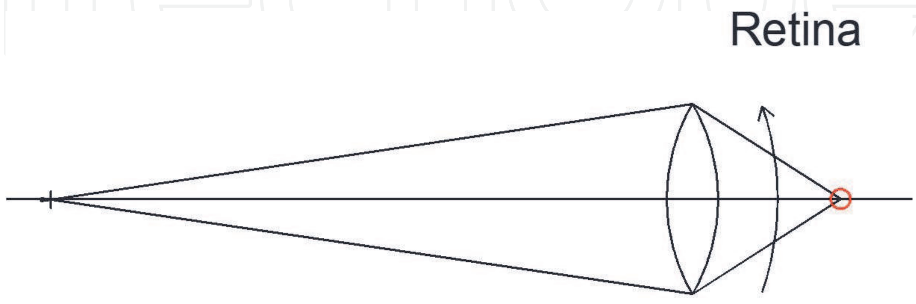

Figure 22.
Presbyopia at the near object distance, and the image point (red dot) is assumed as the quasi focus.

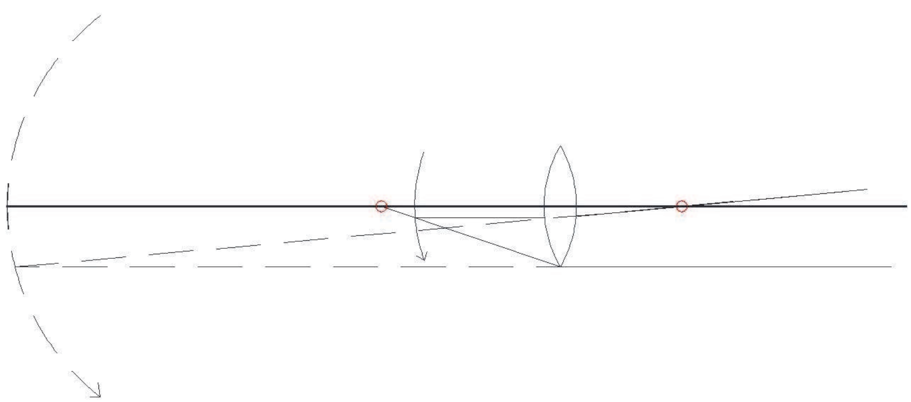

Figure 23.
Quasi far point plane of presbyopia.

introduced, and the position of the image point was assumed as the "quasi focus" of the presbyopic optics.

In presbyopic eye, by BM the quasi far point plane is located behind the retina similar with hyperopia shown in **Figure 23**. And we can see each object distance results a corresponding quasi far point plane.

Choosing the object distance as 500 mm, and setting the curvature of the eye lens with 15 mm modified from 10 mm because of the aged effect losing the accommodation of eyes power, the focus error resulted to 1.628 mm shown in **Figure 24** and **Table 9**.

By BM, the optical simulation gives much more information of the presbyopia with 1.628 mm focus error, i.e., quasi far point plan distance, image height, and curvature of the image, illustrated in **Figure 25** and **Table 10** with object height varied by 0 and 4 mm.

Then the correction of presbyopia with 1.628 mm focus error can be design by putting the quasi far point plan at the second focal point of the convex lens illustrated in **Figure 26** and **Table 11** choosing the data from **Table 10**.

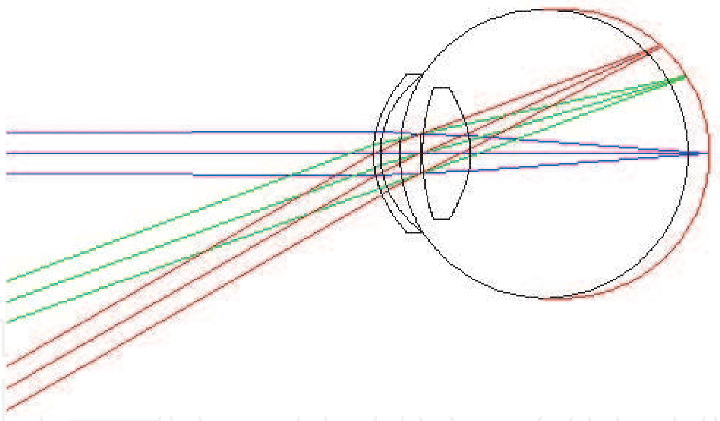

Figure 24.
Presbyopia with 1.628 mm focus error.

Surf: type		Comment	Radius	Thickness		Glass	Semi-diameter		Conic
*	Standard		Infinity	500.000			0.000	U	0.000
1*	Standard	Cornea	7.800	0.520		Cornea	6.000	U	−0.500
2*	Standard		6.700	1.500		Aqueous	6.000	U	−0.300
3	Standard		11.000	1.600		Aqueous	11.000	U	0.000
*	Standard	Pupil	Infinity	0.100		Aqueous	1.500	U	0.000
5*	Standard	Lens	15.000	3.700		Lens	5.000	U	0.000
6*	Standard		−6.000	16.580		Vitreous	5.000	U	−3.250
7	Standard		−11.000	1.628	M	Vitreous	11.000	U	0.000
IMA	Standard	Retina	−11.000	—		Vitreous	11.000	U	0.000

When an aperture is defined on a surface, ZEMAX will display an asterisk "" symbol next to the surface number.*

Table 9.
Optical data of presbyopia with 1.628 mm focus error.

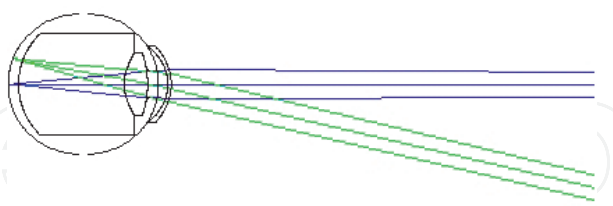

Figure 25.
Quasi far point plan of presbyopia with 1.628 mm focus error.

The image quality of correction of presbyopia of focus error with 1.628 mm is illustrated in **Figure 27** whose field curvature and distortion are well corrected.

4. Conclusion and discussion

From Sections 2 and 3, BM gives another point of view to explore the essence of image forming of eye for getting detail information of image forming of ametropia and presbyopia. And the results of optical simulation provide not only the qualitative but quantitative analyses which can be used in the design of ophthalmic lens

Surf: type		Comment	Radius	Thickness		Glass	Semi-diameter		Conic
*	Standard	Retina	11.000	1.628		Vitreous	4.000		0.000
1	Standard		11.000	16.580		Vitreous	8.000	U	0.000
2*	Standard	Lens	6.000	3.700		Lens	5.000	U	−3.000
3*	Standard		−15.000	0.100		Aqueous	5.000	U	0.000
STO	Standard	Pupil	Infinity	1.600		Aqueous	2.000	U	0.000
5	Standard		−11.000	1.500		Aqueous	11.000	U	0.000
6*	Standard	Cornea	−6.700	0.520		Cornea	6.000	U	−0.300
7*	Standard	Subject eye	−7.800	541.714	M		6.000	U	−0.500
IMA	Standard		−350.000	—			123.642		0.000

When an aperture is defined on a surface, ZEMAX will display an asterisk "" symbol next to the surface number.*

Table 10.
Optical data of presbyopia with 1.628 mm focus error.

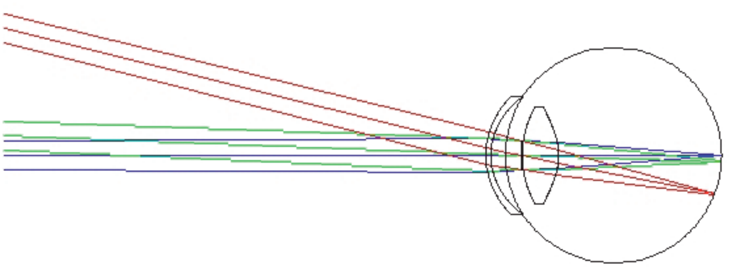

Figure 26.
Layout of correction of presbyopia with 1.628 mm focus error.

Surf: type		Radius	Thickness	Glass	Semi-diameter		Conic
*	Standard	350.000	516.086		0.000	U	0.000
1*	Standard	7.800	0.520	Cornea	6.000	U	−0.500
2*	Standard	6.700	1.500	Aqueous	6.000	U	−0.300
3	Standard	11.000	1.600	Aqueous	11.000	U	0.000
*	Standard	Infinity	0.100	Aqueous	1.500	U	0.000
5*	Standard	10.000	3.700	Lens	5.000	U	0.000
6*	Standard	−6.000	16.580	Vitreous	5.000	U	−3.250
IMA	Standard	−11.000	—	Vitreous	11.000	U	0.000

When an aperture is defined on a surface, ZEMAX will display an asterisk "" symbol next to the surface number.*

Table 11.
Optical datasheet of correction of presbyopia with 1.628 mm focus error.

such as the object distance, object height, and curvature of the object. We can also summarize the optical characteristics of ametropia listed in **Table 12**.

Similarly, the optical characteristics of presbyopic eye are listed in **Table 13**.

Applying BM, it is easy to perceive the difference between the myopia and the hyperopia. The conjugant plane of the retina formed by myopia is real and inverted, then the distance object is imaged on this conjugate plane by a concave lens to redirect the object placed on the secondary focal plane of the lens where is the far

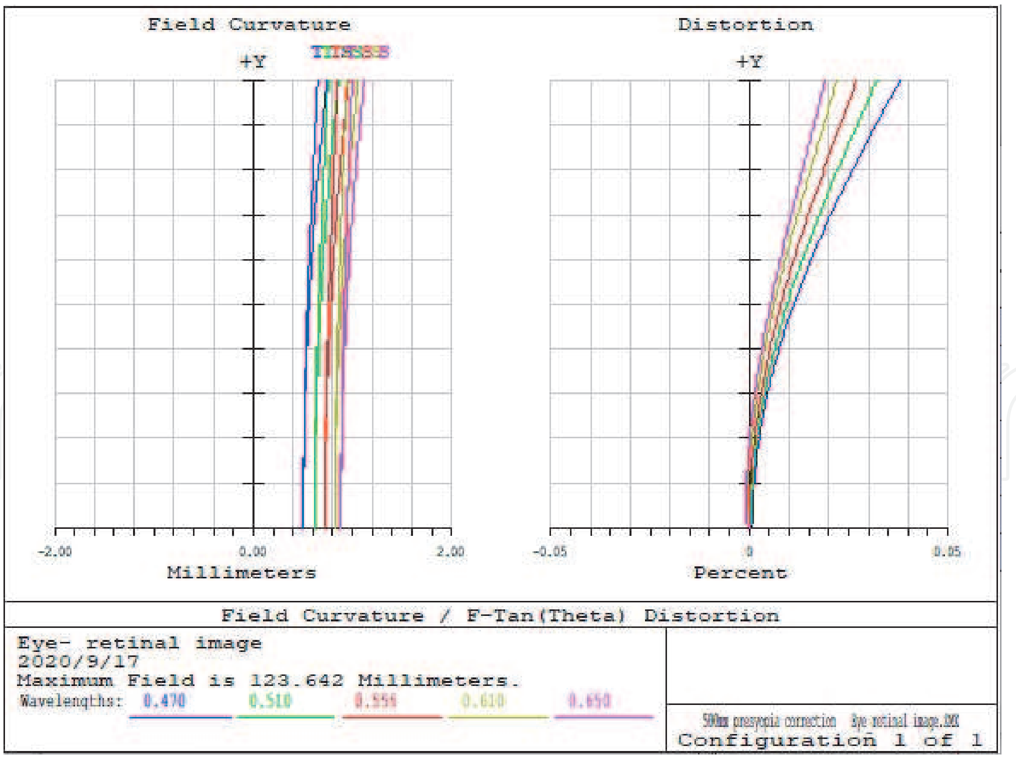

Figure 27.
Field curvature and distortion of presbyopia of focus error with 1.628 mm.

Properties / Ametropia	Retina position (object at infinity)	Position of far point plane	Type of far point plane	Type of spectacle
Myopia	Behind the focus	In front of the eye	Real, inverted	Concave lens
Hyperopia	In front of the focus	Behind the eye	Virtual, erected	Convex lens

Table 12.
Properties of ametropia.

Properties / Ametropia	Retina Position (object at infinity)	Position of far point plane	Type of far point plane	Type of spectacle
Presbyopia	In front of the quasi focus	Behind the eye	Virtual, erected	Convex PALs

Table 13.
Properties of presbyopia.

point plane of myopia. But the conjugate plane of the retina formed by hyperopia is virtual and erected, then the distance object is imaged by adding a convex lens to let the distance object lie on secondary focal plane of the lens. Eventually, either myopia or hyperopia, the image formed on the retina is inverted just like the emmetropia. And the presented chapter uses the developed BM and series graphs and tables to explain how the correction lenses fulfill these requirements by BM and optical simulation.

We can also see the object height, object curvature are critical to get a better image performance for minimizing the field of curvature and distortion either in ametropia and presbyopia. And this can be useful for ophthalmic lens manufacture to make a better fit spectacle to the glass wearer.

In conclusion, this chapter gives a rigorous analysis of image formation of eye BM. Apparently, the far point plan of ametropia and quasi far point plan of presbyopia indicate a helpful information to design a better fit spectacle concerning the object height and its shape. Suppose this will give an innovation of spectacle design. And the concept and the procedures presented in this chapter is going to be patented.

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