Eye Model-Ray trace

Use a paraxial raytrace to determine the Gaussian properties of the eye model from the earlier problem (ϕ, f_F, f_R', F, F', P, P'; do not trace rays to determine the nodal point).

Do your answers agree with Gaussian reduction?
Dimensions are in mm. The front of the eye is in air.

<table>
<thead>
<tr>
<th></th>
<th>r</th>
<th>t</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7.8</td>
<td>3.6</td>
<td>1.336</td>
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<tr>
<td>2</td>
<td>10.0</td>
<td>3.6</td>
<td>1.413</td>
</tr>
<tr>
<td>3</td>
<td>-6.0</td>
<td>3.6</td>
<td>1.336</td>
</tr>
</tbody>
</table>

Solution

Trace a forward ray and a reverse ray – both parallel to the axis at a height of 1.

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th></th>
<th>F'</th>
</tr>
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<tbody>
<tr>
<td>r</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>0</td>
<td>7.8</td>
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<td>-6.0</td>
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<tr>
<td>t</td>
<td>?</td>
<td>3.6</td>
<td>3.6</td>
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<tr>
<td>n</td>
<td>1.0</td>
<td>1.336</td>
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</tbody>
</table>

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</tr>
</thead>
<tbody>
<tr>
<td>-ϕ</td>
<td>-0.04308</td>
<td>-0.0077</td>
<td>-0.01283</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t/n</td>
<td>15.31</td>
<td>2.695</td>
<td>2.548</td>
<td>12.69</td>
<td></td>
</tr>
</tbody>
</table>

Forward Ray

| y    | 1.0 | 1.0 | 0.8839 | 0.7568 | 0     |
| nu   | 0.0 | -0.04308| -0.04988| -0.05960|       |
| u    | 0.0 |     |       | -0.04461|       |

Reverse Ray

| y    | 0.0 | 0.9126 | 0.9672 | 1.0 | 1.0 |
| nu   | 0.05959| 0.02028| 0.01283| 0.0 |     |
| u    | 0.05959|     |       | 0.0 |     |
Forward Ray:

\[
\frac{V'F'}{n_3} = 12.69\text{mm}
\]

\[
V'F' = 16.96\text{mm}
\]

\[
u_3' = -0.04461
\]

\[
y_3' = 0.7568\text{mm}
\]

Reverse Ray:

\[
VF = -15.31\text{mm}
\]

\[
u_1 = 0.05959
\]

\[
y_1 = 0.9126\text{mm}
\]

Reverse Ray: Object space is in air

\[
VF = -15.31\text{mm}
\]

\[
u_1 = 0.05959
\]

\[
y_1 = 0.9126\text{mm}
\]

\[
\phi = \frac{n_1 u_1}{y_3} = .0596/\text{mm}
\]

\[
y_3 = 1
\]

\[
f_E = \frac{1}{\phi} = 16.78\text{mm}
\]

\[
f_F = -16.78\text{mm}
\]

\[
d = VP = VF - f_F = 1.47\text{mm}
\]
Forward Ray: Image space is in an index $n_3 = 1.336$.

\[ V'F' = 16.96 \text{mm} \]
\[ u_3' = -0.04461 \]
\[ y_3' = 0.7568 \text{mm} \]

\[ \phi = \frac{-n_3u_3'}{y_1} = 0.0596/\text{mm} \quad n_3 = 1.336 \quad y_1 = 1 \]

\[ f_R' = \frac{n_3}{\phi} = 22.41 \text{mm} \]

\[ d' = V'F' - f_R' = -5.45 \text{mm} \]

Eye Model

\[ \phi = 0.0596/\text{mm} \]

\[ f_E = 16.78 \text{mm} \quad f_F = -16.78 \text{mm} \quad f_R' = 22.41 \text{mm} \]

\[ d = 1.47 \text{mm} \quad PP' = 0.28 \text{mm} \]

\[ d' = -5.45 \text{mm} \]