Plenoptic Principal Planes

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Plenoptic Cameras

Plenoptic cameras are the future of photography because of the completeness of captured data.
R5 – Low cost 3D-focus cameras.
Raytrix presents the new economic 4D lightfield camera series.
Learn more about the new R5 ▷

R11 – Highend 3D-focus cameras.
Raytrix presents the new state-of-the-art 4D lightfield camera series with incredible performance.
Learn more about the new R11 ▷
The only camera that captures life in living pictures.

Reserve a camera
Integral (Plenoptic) Cameras

Lippmann
1908
Integral (Plenoptic) Images
Integral (Plenoptic) Images
Integral (Plenoptic) Images
Integral (Plenoptic) Images
Gauss discovered that the matrix for *any* optical transform can be written as a product of some appropriate *translation, lens, and translation* again.
\[
L(f)T(D)L(F) = \begin{bmatrix}
1 - \frac{D}{F} & D \\
\frac{D}{fF} - \frac{1}{f} - \frac{1}{F} & 1 - \frac{D}{f}
\end{bmatrix}
\]

\[
T(y)L(\Phi)T(x) = \begin{bmatrix}
1 - \frac{y}{\Phi} & x + y - \frac{xy}{\Phi} \\
-\frac{1}{\Phi} & 1 - \frac{x}{\Phi}
\end{bmatrix}
\]
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\end{bmatrix}
\]

\[
\frac{1}{\Phi} = \frac{1}{f} + \frac{1}{F} - \frac{D}{fF}
\]

Bottom left matrix element
First principal plane can be far in front of the main lens (negative $x$), establishing optical equivalence between plenoptic cameras.

\[
\Phi = \frac{Ff}{F + f - D}
\]

\[
x = \frac{DF}{f + F - D}
\]

\[
y = \frac{Df}{f + F - D}
\]
Parameters

Keplerian case:
Microlenses equivalent to negative lenses

\[ f = 750 \mu m \]

\[ F = 140 mm \]

\[ d = 250 \mu m \]

\[ D = 144.5 mm \]
Conclusions

Keplerian case:
Microlenses equivalent to negative lenses in front

Galilean case:
Microlenses equivalent to positive lenses behind

Put the camera in physically impossible places

Microlenses are better quality than lenses because they are smaller and have proportionally smaller aberrations. In aberrations there is no equivalence!