Radial Distortion

magnification/focal length different for different angles of inclination

Can be corrected! (if parameters are know)
Radial Distortion

magnification/focal length different for different angles of inclination

pincushion (tele-photo)

barrel (wide-angle)
Radial Distortion

magnification/focal length different for different angles of inclination

Can be corrected! (if parameters are known)
Radial Distortion

straight lines are not straight anymore

barrel dist.
pincushion dist.

Radial Distortion

- We have assumed that lines are imaged as lines
- Not quite true for real lenses
  - Significant error for cheap optics and for short focal lengths

Scene \[\rightarrow\] Image \[\rightarrow\] Corrected image
Radial distortion

- Due to spherical lenses (cheap/wide angle)
- Model: (following Tsai 1987 et al.):

\[ \begin{align*}
\vec{p} &= \frac{1}{Z} R^{-1} \ast K \ast \begin{pmatrix}
\begin{bmatrix} C \ R_w \ C \ t_w \end{bmatrix} \\
0,0,0,1
\end{pmatrix}
\end{align*} \]

\[ R(x, y) = (1 + K_1(x^2 + y^2) + K_2(x^4 + y^4) + ...) \begin{bmatrix}
x_{rad} \\ y_{rad}
\end{bmatrix} \]

\[ p = \frac{1}{Z} \begin{pmatrix}
1/\lambda & 0 & 0 \\
0 & 1/\lambda & 0 \\
0 & 0 & 1
\end{pmatrix} MP \]

\( \lambda \) is a polynomial function of \( \hat{r}^2 \overset{\text{def}}{=} \hat{u}^2 + \hat{v}^2 \), i.e., \( \lambda = 1 + \kappa_1 \hat{r}^2 + \kappa_2 \hat{r}^4 + \ldots \).
Radial distortion example
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Useful Links

Demo calibration (some links broken):
• http://mitpress.mit.edu/e-journals/Videre/001/articles/Zhang/CalibEnv/CalibEnv.html

Bouget camera calibration SW:
• http://www.vision.caltech.edu/bouguetj/calib_doc/

CVonline: Monocular Camera calibration:
• http://homepages.inf.ed.ac.uk/cgi/rbf/CVONLINE/entries.pl?TAG250