### Definition

Distortion is a variation of magnification with object size, or field angle. This produces a change in magnification along the image plane. It is an inability of a system to image rectilinear objects correctly.

### Notes

1. A distorted image can still be stigmatic, so image is sharp and unblurred, but warped.
2. Distortion is rotationally symmetric.
3. Forcing a wide FOV into a narrow space will produce distortion (Fish Eye Lens).
4. A lens has no inherent distortion. It arises solely from a stop shift.
5. Position of image does not change.

### Formulas

- **Wavefront Aberration:**  \( W_{311} r^3 \cos \theta \)
- **Seidel Coefficient:**  \( S_V = \sum_{\text{All Surfaces}} \frac{\overline{A}}{A_i} [(S_{III})_i + (S_{IV})_i] \)

Relation:  \( W_{311} = \frac{1}{2} S_V \)

If \( W_{311} > 0 \)  \( \rightarrow \) Barrel (Positive) Distortion

If \( W_{311} < 0 \)  \( \rightarrow \) Pincushion (Negative) Distortion

### Minimizing and Correcting

1. Place pupil, or stop, as close to lens as possible.