Simulating Camera Calibration Using Brown’s Radial Distortion Model

# Introduction

Camera calibration is a necessary step in analyzing camera-captured images. *Effects* such as unnatural, depths, compression, or stretching of an image occur as an unavoidable by product of current technology – in particular the type of lens utilized in the capture of the image [1]. Radial distortions are one of the possible effects an engineer tackles in these images; Brown’s Radial Lens Distortion Model (BRLDM) looks to adjust effected images and make them appear more naturally to the human persevere[[1]](#footnote-1). The BRLDM can be expressed through the following system of equations[[2]](#footnote-2):

|  |  |
| --- | --- |
|  | Eq. 1 |

where

|  |  |
| --- | --- |
|  | Eq. 2 |
|  | Eq. 3 |
|  | Eq. 4 |

and , , and represent normalized, distorted, and center values respectively.

Throughout this paper a sample image from a video game will be used as a benchmark for the artificial image distortion and undistortion algorithms that have been programmed in a Jupyter Notebook [2]. To highlight the different effects of radial distortion, *pincushion* and *barrel* distortions will be compared to -values used in equation (1), and noting the performance of the primary undistortion in the case of only using , and , and finally all three -values. By doing so, a high-level guideline will be generated to predict the sign (positive or negative) of the -values when an engineering applies these algorithms in practice.

Moreover, qualitative and quantitative comparison between two undistortion algorithms will be done – one algorithm serves as an approximation in cases of small distortion and another that depends on heavy computational power and numerical solution methods to solve non-linear systems which are inherently difficult and sometimes unreliable to solve. The paper will conclude with a discussion on the real-world applications of image distortions as a whole and where radial lens distortions are most prominent.



Figure 1: Benchmark image that will primarily be analyzed in this paper.

* Quick statement for the motivation of camera calibration
* Present brown’s radial distortion model
* Summarize what will be covered

# [Artificial Image Distortion](http://localhost:8888/lab#Artifical-Image-Distortion)

Placeholder

# I[mage Correction: Undistorting Images](http://localhost:8888/lab#Image-Correction:-Undistorting-Images)

Placeholder

# Real-World Implications

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# References

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| [1] | M. S. Banks, E. A. Cooper and E. A. Piazza, "Camera Focal Length and the Perception of Pictures," US National Library of Medicine National Institutes of Health, 1 January 2014. [Online]. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4114730/. [Accessed 8 April 2020]. |

1. The idea of perception versus reality is an interesting, yet out of scope topic for purposed of this paper. [↑](#footnote-ref-1)
2. It should be noted that the presented model is not complete, it assumed there is no tangential distortions, which will briefly be discussed later. [↑](#footnote-ref-2)