Scoring and Correcting Geometric Distortions in Images

Tanay Mehta, Boris Treskunov, Grace Wang, Joseph Zhong
Faculty Advisor: Kostas Daniilidis

Abstract & Motivation
Premise: For a variety of reasons, images are often geometrically distorted
- Ex: Wide angle lenses, differing camera angles, panoramic shots, manual photo editing
Goal: Develop (i) an algorithm and (ii) a tool to analyze geometrically distorted images
Use cases: misrepresentation of space available for rent or purchase in online real estate marketplaces (AirBnb, Craigslist, Trulia, etc)

Methodology
Radial Distortion Detection → Edge Detection
Radial Distortion Classification & Scoring
Distortion Correction → Panoramic Stitching Detection
Focal Length Analysis → FOV Calculations

Focal Length Analysis
Grouping parallel line segments produces vanishing points, which are used to compute the focal length and field of view.

Edge & VP Detection
LSD (Line Segment Detection): gradient-based detection
Hough: heuristic-based detection (requires user guesses)

Scoring Technique
Image Test Set:
Manual Scoring Variables:
- radial distortion, focal length, panoramic, camera angle, overall distortion.
Programmatic Scoring Variables:
- radial distortion coefficient, focal length, field of view

Convergence of optimal weighting
Application of optimal weighting to programmatically scored images

Radial Distortion
\[
r \approx \sqrt{x^2 + y^2} \\
(x_u, y_u) = \frac{(x_d, y_d)}{1 + A x_u^2} \\
Ax_u + By_u + C = 0
\]

Panoramic Stitching

Results
1) Scoring Technique - returns scores from 0-100, which on average, is within 5 of the manual score
2) Benchmarking - we took a manual test set in multiple locations and benchmarked against that set
3) Correction - in the case of panoramic stitching

Application: Browser Extension
Chrome extension that scrapes images and scores them (0-100)