Fundamentals Of Image Processing And Interpretation

Code:

[Part 1]

[Part 2]

Assignment #2 Report

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A. Computing Vanishing Points:

1. **What is the minimum and maximum number of finite vanishing points that can be found from all possible images of a Rubik's cube? Explain.**

✱The minimum number of finite vanishing points is 3.
➤This is because a Rubik's Cube has three sets of parallel lines corresponding to its three major axes, and each set of parallel lines converges to a distinct finite vanishing point in the image.
✱The maximum number of finite vanishing points is also 3.
➤This is because, regardless of the orientation or position of the Rubik's Cube in space, it maintains its basic cubic structure with three pairs of parallel lines along its major axes.

2. **Is there a relation between number of visible faces and vanishing points? Explain with reasoning and experiments.**

✱Yes, there is a relationship between the number of visible faces of a Rubik's Cube and the number of vanishing points in an image.
➤The key factor is that each visible face contributes parallel lines that converge to a vanishing point in the image. If we can see more faces, we have more sets of parallel lines, thus leading to more vanishing points.

3. **Can you find 4 vanishing points in Rubik's cube images? If yes, demonstrate with an image. If no, explain your reasoning.**

No, in images of a standard Rubik's Cube, you typically cannot find four vanishing points. This is because a Rubik's Cube has a fixed geometric structure with three major axes, and each axis contributes one set of parallel lines that converges to a vanishing point. Therefore, under normal circumstances, the maximum number of vanishing points you can observe in images of a Rubik's Cube is three.

4. **Can you find a configuration with at least one vanishing point outside the image? If yes, demonstrate with an image. If no, explain your reasoning**

✱No, it is not possible to find a configuration where at least one vanishing point is outside the image.
➤This is because the vanishing points are determined by the converging lines in the image, and those lines originate from the edges of the visible faces of the cube,
To clarify, while the convergence point (vanishing point) may conceptually extend beyond the image, the actual point of convergence remains within the image frame, so from a technical standpoint, the vanishing point itself is still within the image boundaries.

B. Fundamental Matrix Estimation

We had the matching points determined manually via this collab link

1. **Display the epipolar lines. Comment on how can you interpret the accuracy of the estimated matrix from the visual results.**

Observing parallel epipolar lines in both the normalized and unnormalized cases might raise concerns visually. However, validation results showing 0.0, indicate that the fundamental matrix accurately represents the geometric relationship between the images.

2. **Normalize the data and recompute the fundamental matrix. Does it improve the accuracy? Explain your reasoning**

Normalization did not visibly alter the parallel nature of the epipolar lines. However, the validation results of 0.0 for both normalized and unnormalized cases suggest that the accuracy of the fundamental matrix remains consistent. In this context, the initial matching points seem well-behaved, and normalization did not lead to a significant improvement in accuracy. The validation results reinforce that the estimated matrix accurately captures the geometric relationship between the images.