CMSC 426, Computer Vision
Homework 1
Due on: 11:59:59PM on Tuesday, February 27th

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Overview

The following questions relate to the concepts used in Project 2: automated panorama stitching. Understand them, and you'll better understand how your code works– and more easily debug it when it doesn't!

Questions

1. **Image warping and invertible transformations** [1]

   Given a digital image, and an invertible transformation $\tilde{\mathbf{H}}$ of the form

   $$\tilde{p}' \equiv \tilde{H}\tilde{p}$$

   we would like to compute the warped image whereby each point in the original image is transformed to its new location. This type of image warping is exactly what the Matlab `imwarp` function does, for example.

   We could envision a somewhat straightforward algorithm for performing this image warp: for each location $\tilde{p}$ in the original image, compute the nearest pixel location of the transformed point $\tilde{p}'$ in the warped image, and copy the color found in $\tilde{p}$ into the warped image at location $\tilde{p}'$.

   However, the vastly preferable algorithm is to loop over the *destination* pixels $\tilde{p}'$ in the warped image, and use the inverse transformation $\tilde{H}^{-1}$ to identify the nearest pixel $\tilde{p}$ in the source image and copy the color from that source pixel to the destination.

   What is the difference between the two approaches? Why is the second one preferable? **30 Pts**

[1] Borrowed with love from Matt Zucker's E27 @ Swarthmore.

2. **RANSAC**

   We know that RANSAC is a non-deterministic algorithm, hence knowing some statistics about RANSAC is advantageous. We are mainly concerned about the probability of success of RANSAC.

   (a) Consider that the probability of picking a good set of points (we pick 4 points in panorama stitching) is p_g. What is the probability of success after N iterations? **13.333... Pts**

   (b) Given that only 50% of point matches are good, and given 4 points picked to estimate homography: how many iterations are needed to have a 95% probability of success? *Note! p_g is not .5: think carefully what the value of p_g will be.* **13.333... Pts**

   (c) Given 100 feature points identified in two images, how many possible combinations of 4 point pairs can one pick? By what order of magnitude does performing RANSAC improve over brute-force (i.e. trying all possible 4 point combinations)? **13.333... Pts**

3. **Homography Estimation**

   How many points are needed to estimate the homography between 2 images? What does this signify, conceptually? *Hints: Think of this mathematically, by writing the projection equation, or think of it as losing a degree of freedom when adding each constraint.* **30 Pts**

Submission Guidelines

Please submit a PDF of your answers. Show all work and explain clearly. **Answers must be typeset in Latex, Word, LibreOffice, etc.– handwritten answers will not receive credit!**

Collaboration Policy

You are restricted to discuss the ideas with at most two other people. For the full honor code, refer to the CMSC426 Spring 2018 website.