ECE 561 Machine Vision
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Homework 1: Projection & Reconstruction

Note: Homework should be done individually but discussion is encouraged. If you must use your phone to scan your work please use a proper digital scanning app to maintain legibility. This particular assignment requires the use of a digital camera. The report shall contain images, psedo-code and output of your algorithms. Homework is out of 10pts. You may pick **one** of the following 10 point problems:

1. A Manual 3D Scanner (10pts)
   (a) (1pts) Pick a salient object in your vicinity. Using a digital camera, take a stereo image of a single object. That is, take two pictures from slightly different camera positions. Ideally, the object takes up a large portion of the frame.
   (b) (1pts) Manually identify and label visually a few sparse corresponding points in both pictures. You will need to identify the image coordinates of these points as well.
   (c) (3pts) Recover the camera parameters using the essential or fundamental matrix using 8-point algorithm (You can assume one of your camera is fixed at origin with rotation matrix to be identity). Include pseudocode.
   (d) (5pts) Recover the sparse 3D cloud points of the object from your marked points. Show results for both:
      i. linear optimization
      ii. non-linear optimization (*hint: You may use Matlab's* `fminunc` *or* `lsqnonline` *toolbox.*)
2. Primitive Panorama Stitching (10pts)
   (a) (1pts) Pick a wide-angle scene you would like to capture. Using a digital camera, take two images from the same position but with different angles. Ideally, there will be some overlap between the two images.
   (b) (3pts) Find the SIFT-key points and descriptors for both the images (*hint: You may use open source code and package*).
   (c) (3pts) Match the correspondence points. Include pseudocode. Show visually these matched pairs of points.
   (d) (3pts) Run RANSAC to estimate homography and stitch the two images together and include the final image in your report.