ADIPCV Assignment

February 22, 2017

For instructions regarding running code, kindly refer to the `README.md` file attached.

1 Computing Homographies

In the first part, the keypoints can be selected manually using the GUI. Homography matrices are computed with respect to the first image (*Nov 17*), and applied. The computation of the homography is done by using Direct Linear Transform (DLT), solving the equation $\mathbf{AH} = \mathbf{0}$. $\mathbf{H}$ is computed by calculating the null space of $\mathbf{A}$, the eigenvector corresponding to the smallest eigenvalue.

Applying the homography matrix is done by using $\mathbf{X} = \mathbf{Hx}$ in the homogeneous coordinate space, and taking into consideration the boundary conditions.

2 Using SIFT

The keypoint selection is conducted using SIFT. In order to remove outliers, *Lowe's ratio test* is used to only use the keypoints that are closer to each other. Post this, the homography computation and application follow the same scheme as the earlier section.

3 Scene Summarization

Each of the images are projected with respect to the first image, and differences are calculated between the applied images. These differences can be used to assess the growth in every consecutive image. Since pixel wise differences may not reflect true changes due to factors such as **illumination**, it could be prudent to alternatively apply a mean shifting, histogram equalization, or utilize the gradients instead to visualize the scene changes.

4 Vanishing Points & Affine Rectification

The vanishing line is computed using points selected by the user in a GUI driven program. Points are selected on parallel lines in the same plane, basically in the following manner:

1. Select 8 points, 2 each on 2 sets of parallel lines
2. The points of intersection of these lines is computed
3. Following this, the vanishing line can be computed.

These intersection computations are basically a series of cross products.

Post this, the vanishing line $< l_1, l_2, l_3 >$ can be used to find the affine rectification matrix as:

$$\mathbf{H} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ l_1 & l_2 & l_3 \end{bmatrix} \tag{1}$$