

# Homework 3 : Due March 23, 2007

CS 593 / 791

March 12, 2007

## 1 Principal Axes

### 1.1 Compute centroids and translation vector

Load the sample images `p1.mat`, `p2.mat`. Compute the centroid of each image ( $\mathbf{c}(p) = E_p[\mathbf{x}]$ ) and report the coordinates. From these coordinates estimate the translation between the 2 images.

### 1.2 Compute covariance matrices

Compute the covariance (2nd moment) matrix ( $cov(p) = E_p[(\mathbf{x}-\mathbf{c})(\mathbf{x}-\mathbf{c})^T]$ ) of the image intensities.

### 1.3 Compute principal axes and rotation angle

Compute the eigenvalue decomposition and the principal axes of each image. Estimate the angle of rotation between the 2 images.

### 1.4 If you are in CS 791

Using the translation and rotation parameters computed above, obtain image `p3` by transforming image `p2` (Use `imtransform`) into the coordinate system of `p1`. Display the difference image `abs(p3-p1)`.

## 2 Mutual Information

### 2.1 Construct the Joint Histogram

Load the sample images `t1.mat`, `t2.mat`. Construct the joint histogram for pair  $(t1, t2)$ . Display the histogram as a grayscale image.

### 2.2 Compute Mutual Information

Compute the mutual information for the image pair above using Equation (1) from the paper "Multimodality Image Registration by Maximization of Mutual Information".

### 2.3 Transformation

Graph the mutual information against the transformation parameters described below:

#### 2.3.1 Translation

Let  $t2'(x, y, t_x) = t2(x + t_x, y)$ . Plot  $I(t1, t2')$  against  $t_x \in [-5, 5]$  in 1 pixel increments.

#### 2.3.2 Rotation About the Center of the Image

Let  $t2'(x, y, \theta)$  be the image `t2` rotated by  $\theta$  degrees about the center of the image (use `imrotate`). Plot  $I(t1, t2')$  against  $\theta \in [-10^\circ, 10^\circ]$  in 1 degree increments.