IT523: Digital Image Processing
Lab - 1: Spatial Image transformations

Read Help for: `imread`, `imshow`, `uint8`, `double`, `imagesc`, `surf`, `mesh`.

1. Write a MATLAB function `myresize.m` which can scale an input image to a given size (M, N). Show a couple of results and compare with output from MATLAB function `imresize.m`.

2. Write a MATLAB function `myrotate.m` which can rotate an input image at any user specified angle. Show a couple of results and compare with output from MATLAB function `imrotate.m`.

3. Let the corner points of the input image be denoted by $p_{in}^k = (x_k, y_k), 0 \leq k \leq 3$. We want to map this image to the region enclosed by $p_{op}^k = (u_k, v_k), 0 \leq k \leq 3$, via an affine transformation. Determine the number of corner points of the output image to be specified to uniquely determine (give proper justification) the affine transformation. Under what conditions will the solution be unique? Write a MATLAB function `myaffine.m` that takes in an input image and the appropriate corner points of the output image and outputs the desired output image. Note that this automatically gives you a method to figure out the affine transformation to be applied on the input image to obtain another given image.

4. You might have come across phones that are able to create caricatures of an image, as shown in Figure 1 below. Both these distortions are examples of what is called

Figure 1: (left) Original, (center) Barrel distortion, (right) Pincushion distortion

the *fisheye* effect, which is nothing but a non-linear spatial image transformation. The equation for this effect is

$$x_u = (x_d - x_c)\left(1 + k\left(\frac{r}{r_{max}}\right)^2\right)$$
$$y_u = (y_d - y_c)\left(1 + k\left(\frac{r}{r_{max}}\right)^2\right)$$

where $(x_u, y_u), (x_d, y_d)$ are the coordinates of pixels with origin being the center of the original and distorted image respectively, (x_c, y_c) are the coordinates of the distortion center which you may assume to be the image center, r is the Euclidean distance between (x_d, y_d) and (x_c, y_c), and $k \in \mathbb{R}$ is the distortion parameter. Write a MATLAB function `myfisheye.m` that takes in the input image and k and produces the distorted image as the output. Note that creating caricatures is not the only purpose of the fisheye equation. Practically, a lot of lenses introduce such distortion.

Submission instructions

1. Write a report with answers, plots and figures (under corresponding question number), only in LaTeX.

2. Name your report as `Id_No_Lab1.pdf`. Submit only a single zip file per group (named `ID_No_Lab1`) containing following files and folder: `myrotate.m`, `myresize.m`, `myfisheye.m` and `Report_IDno` (containing `IDno_Lab1.tex` and other required files for compilation, for example image files.) on `courses.daiict.ac.in`. Email submissions will **not** be accepted under any circumstances.

3. Your report and code should contain names and Id numbers of your group members. In the report title specify what software/language/tool you have used to write codes: MATLAB/C++ OpenCV/C++ CImg/Octave.

4. Do not include codes in the report and comment your code properly.

5. **Submission deadline: 21:00 hrs, Friday,** 24^{th} **January, 2014**. The deadline on the Moodle webpage behaves as a random variable, so make sure you submit well in advance.