Interventional Medical Image Processing (IMIP) SS 2014

Exercise 1

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SVD

John, Jack and Joe own a small company called CS Inc. which operates in the field of medical imaging. Their recent project is to build a system which estimates the position and orientation of a patient table in a C-arm setup. Therefore, a calibration phantom can be mounted on the table at a fixed position. Then, an acquisition of the calibration phantom is performed and based on these images the position and orientation of the phantom should be computed. John, Jack and Joe decide to use two different phantoms: A metal bar aligned to the main axis of the table to get the table orientation and a metal parabola fixed at the top of the table to estimate the center.

1 Simulation data

Unfortunately, John Jack and Joe have no access to a C-arm system. So they are required to simulate the data. On the exercise webpage you can find example images.

1. Write a Matlab function that creates a bar phantom image. The function call should be `I=barphantom(slope, intercept)`
2. Write a Matlab function that creates a parabola phantom image. The function call should be `I=parabolaphantom(a,b,c)`

Drawing a line or a parabola is not so different to drawing a circle. As you did the Matlab tutorial, you should know how to draw a circle in an image. If not, have again a look at the matlab-introduction exercise sheet. Useful commands are: `ndgrid, imnoise,fspecial,imfilter`.

2 Slope and center extraction

Using the acquired images, the system should determine the slope of the bar and the vertex of the parabola. As John, Jack and Joe haven't heard about Hough-transform yet, they decide to use SVD for computing the slope and the vertex, respectively.

1. Write some Matlab code that extracts the coordinates of the pixles on the phantom

2. Write a Matlab function that computes slope and intercept of the line given its pixel coordinates. The function call should be `[slope,intercept]=barParameters(xcoords,ycoords)`
3. Write a Matlab function that computes center and radius of the parabola given its pixel coordinates. The function call should be `[vertex]=parabolaParameters(xcoords,ycoords)`

Useful commands are: `svd` (of course!), `im2bw,graythresh`. For the line, think about a parametrization that has no singularity.

If you want to start with Exercise 2 first, you can use the example images. The slope for the line is $m = 0.5$ and the intercept is $t = 1.5$. The parameters of the parabola are $a = 0.3, b = -10, c = 1200$.