

Homework 1: CMSC 426 2005  
Handed out Feb 02 Due back Feb 14.in class  
Handwritten+printouts only (no email submissions)  
No late submissions.

If you have to miss class for any reason, drop off the assignment in my mailbox before class on the 14th

Spend half an hour playing with Matlab.

Use the following help commands:

1) help inside the program : E.g.

```
>> help edge
```

2) pdf help files (either on the web or locally )

<http://www.mathworks.com/>

3) html help (type `helpdesk` inside the program)

See the demo of Matlab and the image processing toolbox by typing

```
>> demo
```

If you have access to the image-processing toolbox, view its demo as well.

Figure out how you can print homework output and results from Matlab

“M” files are Matlab scripts or functions.

It is a good idea to do most of your work in a script file so that you can avoid a lot of typing.

For the homework problems below you will need to submit script/function files and figures (if required).

1) Create random vectors 'a' and 'b' of length 10 and a square matrix 'A' of dimension 10×10 by using the `rand` command.

```
a=rand(10,1), etc.
```

Execute the following commands

```
a*b
```

```
a.*b
```

```
a*b'
```

Explain what these commands do

2) Colon notation

Execute the following commands

```
1:10 a(1:5) a(4:9)+b(1:6) 0.1:0.1:100
```

3) Create a projection matrix for a camera with focal length 50 mm, and  $320 \times 240$  picture elements (pixels) of size  $30 \mu\text{m} \times 30 \mu\text{m}$  each.

What is the focal length in pixels of the camera?

Assume that the camera center is at the origin of world coordinates (see the picture below)

Assume that the line perpendicular to the imaging plane of the camera, and passing through the camera center is the z axis.

- a) Assume you are imaging a circle that is centered at the point  $(0,0,250\text{mm})$  and of radius  $50\text{mm}$ . Draw (by hand) the image the circle makes when it is
- fronto-parallel to the imaging plane (i.e., it is entirely in the  $z=250\text{ mm}$  plane).
  - A diameter of the circle is parallel to the  $x$  axis while the diameter perpendicular to the first one makes an angle of  $45$  degrees with the  $z$  axis
  - What shape does the circle project to in each case? Can you prove what the most general shape the projection of a circle can have is?
- b) Assume you are imaging a cube in the world of side  $10\text{ cm}$  that is located at a distance of  $50\text{ cm}$  from the camera center. Using the camera projection methods discussed in class, compute the coordinates of the cornets of the image points of the cube.
- when the cube sits on the  $x$ - $z$  plane and is “fronto-parallel” to the camera, and is bisected by the  $z$  axis.
  - when the cube from case i is translated (moved) to its left by  $10\text{ cm}$ .
  - When the cube sits on the  $x$ - $z$  plane and is rotated by  $45$  degrees, so that one edge is parallel to the  $y$  axis.
  - Any one other configuration of your choice
- c) Repeat exercise *b* in Matlab, and draw your output images using the function `plot`

## Image point

