

CEG4311 Digital Image Processing
Computer Assignment (Lab) 0
Oct. 4, 2001

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Objective: To generate an image with 128 lines and 256 columns consisting of a zone plate with local horizontal frequency varying from -64 to +64 c/ph and vertical frequency varying from 0 to +64 c/ph. To display this image and to save it as a TIFF file.

Theory: The amplitude scale has not been specified. I will make maximum use of the scale from 0 to 1. The x coordinate runs from 0 to 2 ph and the y coordinate from 0 to 1 ph. I will place the origin of the zoneplate at coordinate (1,0). Thus the mathematical expression for the zoneplate is

$$f(x, y) = 0.5 + 0.5 * \cos(\pi((x-1)^2 + y^2)/r^2)$$

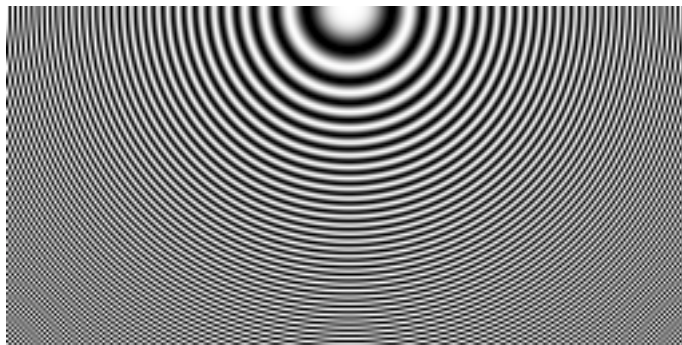
The maximum local vertical frequency will occur when $y = 1$, with value $1/r^2$ which should be 64 c/ph. Thus $r^2 = 1/64$. It is clear that this gives the correct values for maximum local horizontal frequency when $x = 0$ and $x = 2$. Thus the zoneplate to be generated is

$$f(x, y) = 0.5 + 0.5 * \cos(64\pi((x-1)^2 + y^2)), \quad 0 \leq x < 2, \quad 0 \leq y < 1$$

Method: I generated a 128 by 256 matrix in MATLAB containing the desired zone plate. I made use of the `meshgrid` function to generate the desired x and y values with spacing $1/128$. The image was displayed using `imshow` and saved in TIFF format using `imwrite`. The MATLAB code I wrote to carry this out follows:

```
MATLAB code for Computer experiment 1, CEG4311
%F. Gauss 2001-10-04
x = 0:1/128:2-1/128; % 256 x values from 0 to 2 in steps of 1/128
y = 0:1/128:1-1/128; % 128 y values from 0 to 1 in steps of 1/128
[X,Y] = meshgrid(x,y);
Z = .5 + .5*cos(64*pi*((X-1).^2 + Y.^2)); % generate the zoneplate
imshow(Z) % display the image
imwrite(Z,'zoneplate.tif') % save the image as a TIFF file
```

Result: The program ran correctly and generated the image shown below.



(Note: In your report, you need not include all images that you generated. You can describe in words the resulting image in most cases, and include a few particularly interesting examples, perhaps marking by hand certain features of note.)

Discussion: The zoneplate image contains some interference patterns that I don't fully understand. The printed version of the zoneplate in my report looks different than the one on my screen due to limitations of my printer.

Conclusion: It is possible to generate this useful test pattern with only a few statements in MATLAB. The zoneplate is a useful test pattern to evaluate many imaging systems.

(Note: Hand in a paper copy of your report. No disk should be handed in. You will be interviewed in the lab about some aspect of your report to demonstrate your understanding of what is in the report.)