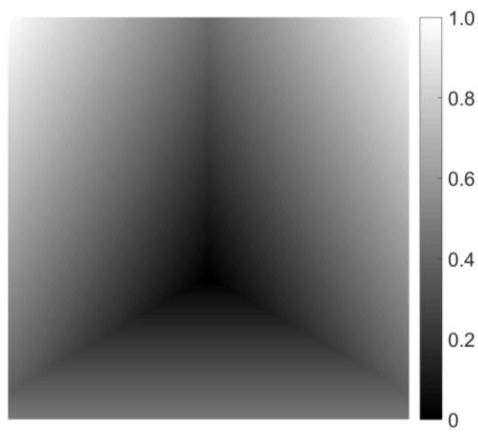
In this assignment, you will develop a code in MATLAB to generate spatially-variant lattices. Start with the following header:

```
% HW9.m
%
% Homework #9
% ECE 53922 -- 21ST CENTURY ELECTROMAGNETICS

% INITIALIZSE MATLAB
close all;
clc;
clear all;

% UNITS
degrees = pi/180;

% OPEN FIGURE WINDOW WITH WHITE BACKGROUND
fig = figure('Color','w');

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%% DASHBOARD
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

% UNIT CELL PARAMETERS
a   = 1;
Nxu = 512;
Nyu = Nxu;

% GRID PARAMETERS
Sx = 10;
Sy = Sx;
NRESLO = 10;
NRESHI = 10;

% SVL PARAMETERS
NP = 21;
NQ = NP;
```

Problem #1: Build a Grayscale Triangle Unit Cell

This homework will use an equilateral triangle unit cell centered inside a square unit cell. In order to spatially vary the fill factor, the starting unit cell should be grayscale as shown below. Add a section to your code to build and visualize this grayscale unit cell.

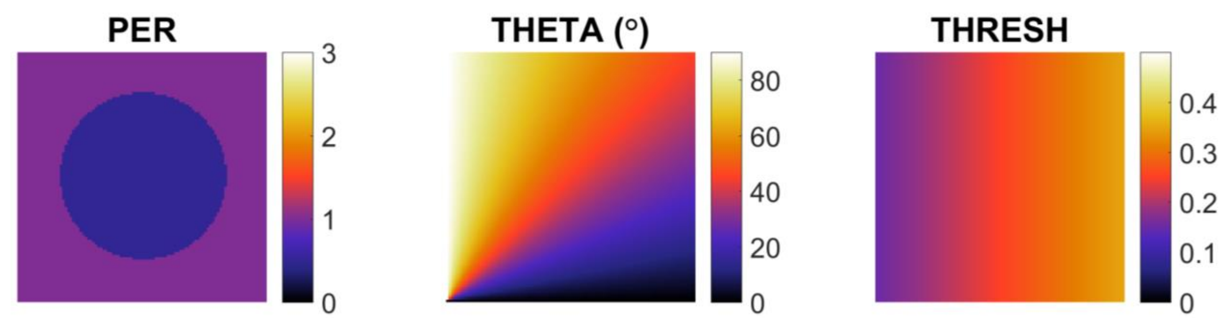


Problem #2: Calculate Grids

Add a section to your code to calculate the parameters for both the low-resolution and high-resolution grids. Report your values of `dx`, `Nx`, `Ny`, `dy`, `dx2`, `Nx2`, `Ny2`, and `dy2`.

Problem #3: Generate Input Maps for Spatial Variance

Add a section to your code to generate the following input maps for your algorithm. Period `PER` should be set to 0.5*a* inside a centered-circle of radius 3.33*a* and to *a* everywhere else. The orientation `THETA` should fan from 90° to 0° in the manner shown below with the center of the fan located at the lower left portion of the grid. The threshold parameter `THRESH` should taper linearly from 0.15 on the left to 0.35 on the right.



Problem #4: Generate List of Planar Gratings

Add a section to your code to decompose the high-resolution grayscale unit cell into a set of 9×9 planar gratings, but don't forget to change back to 21×21 planar gratings after this problem. Visualize the magnitude of the Fourier coefficients. Visualize the grating vector expansion to convey the magnitude and direction for each planar grating.

Problem #5: Generate Spatially-Variant lattices

For the following lattices, use 21x21 planar gratings and visualize both the analog lattice and binary lattice.

Lattice #1 – Uniform Lattice

Generate a uniform lattice by setting `PER` to *a*, `THETA` to 0°, and `THRESH` to 0.3 at all points on the grid.

Lattice #2 – Spatially-Variant Threshold Only

Generate a spatially-variant lattice from the input maps created in Problem #3, but set `PER` to *a* and `THETA` to 0° at all points on the grid.

Lattice #3 – Spatially-Variant Period Only

Generate a spatially-variant lattice from the input maps created in Problem #3, but set `THETA` to 0° and `THRESH` to 0.3 at all points on the grid.

Lattice #4 – Spatially-Variant Orientation Only

Generate a spatially-variant lattice from the input maps created in Problem #3, but set `PER` to a and `THRESH` to 0.3 at all points on the grid.

Lattice #5 – Spatially-Variant Everything

Generate a spatially-variant lattice using all of the input maps created in Problem #3.