CS2035b Data Analysis and Visualization - Lab 06

General Lab Instructions to Help Labs Run Smoothly

- Read through the lab instructions **before** coming to the lab.

- Do any required pre-lab preparation.

- Bring a **printed** copy of the lab instructions to the lab.

Overview and Preparation

This (and all subsequent) labs will be using MatLab 2016b as installed in the Health Sciences 14 and 16 general computing labs. You must attend this lab in HSB14 or HSB16 in order to get assistance from the TA. Attendance will be taken. You can use your UWO login/password to login to these machines. Lab submission is to be done via Owl. Remember, labs are worth 10% of the total grade for this course (there are 11 labs in total, you must do 8 to receive full marks).

Upon completion of this lab, you should have done the following in the MatLab environment:

- Created a script file, lab06.m, containing the MatLab code to run the animation required for this lab.

- Submit this script file via owl by 11:55pm on day of the lab. There is no need to submit a diary file or any image (jpg) files. Also, there is no need to compress your script file as it will be quite small.

Exercise: 2D Surface Animation

This lab requires you to compute and display a Sine Gabor animation, where the orientation of the Sine Gabor changes over time. The Sine Gabor equation (in a simple form) can be given as:

$$f(x, y) = e^{(-(x^2+y^2)/(2\sigma^2))} \ \sin(2 * \pi(x\omega_x + y\omega_y)) \tag{1}$$

which can be vectorized as:

```
Z=exp(-(X.^2+Y.^2)/(2.0*sigma2)).*sin(2*pi.*(X*omega_x+Y*omega_y)).
```

The Sine Gabor is simply a Gaussian multiplied by a Sine function. Given `xmin` and `xmax` and `ymin` and `ymax` values (typically the same in two dimensions) and a `step` increment, we can generate the `x` and `y` ranges for plotting. One way to generate `X` and `Y` use `meshgrid` might be:

```
xmin=-10;
ymin=-10;
xmax=10;
ymax=10;
step=0.25;
x=xmin:step:xmax;
y=ymin:step:ymax;
[X,Y]=meshgrid(x,y);
```

We also need `zmin` and `zmax` values for the `z` range for plotting.

Give an angle θ_{deg} is degrees (and it radian version θ_{rad}) we can compute ω_x and ω_y as:

$$\omega_x = \cos(\theta_{rad}) \tag{2}$$

and

$$\omega_y = \sin(\theta_{rad}). \tag{3}$$

The effect of θ_{rad} is to oriented the Gabor in the direction specified by $(\cos(\theta_{rad}), \sin(\theta_{rad}))$.

The task to be completed for this is to animate this surface from $\theta_{deg} = 0°$ through $\theta_{deg} = 360°$ by some angle increment $\Delta\theta_{deg}$ (for example, $1°$ or $5°$). You can use `mesh(X,Y,Z)` or `surf(X,Y,Z)` to render each surface.

One set of parameters that work for this animation are: `xmin=-10`, `ymin=-10`, `zmin=-1`, `xmax=10`, `ymax=10` and `zmax=1` with `step=0.25`. For these values, a value of $\sigma = 2.0$ works well. You'll need to pause the animation as it will be too fast without a pause (`pause(0.2)` works fine). To ensure the axis of the plot remains constant over time, you will need to use `axis([xmin xmax ymin ymax zmin zmax])` to keep the axis constant. Note that if you use `print` to save some or all of your plots as `jpg` files the animation will slow down so much it will no longer be much of an animation! Finally, for each plot you should display the angle in θ_{deg} using `text`. Plot the angle information (in degrees) at coordinates

`(x,y,z)=(0.9*xmin,0.9*ymax,0.9*zmax)`. Use an appropriate fontsize and font type to print your string. These parameters are only suggestions, you can try different values to get a better display. To perform the animation, simply display the meshed image on the same window for angles going from 0° to 360°. Do not use a `figure` command when displaying the images to ensure the previous image is written over by the current image in the same figure window.

Note that the Sine Gabors at 45° and 135° and at 90° and 180° are perpendicularly oriented relative to each other. Figure 1 shows the surfaces at 45°, 90°, 135° and 180°:
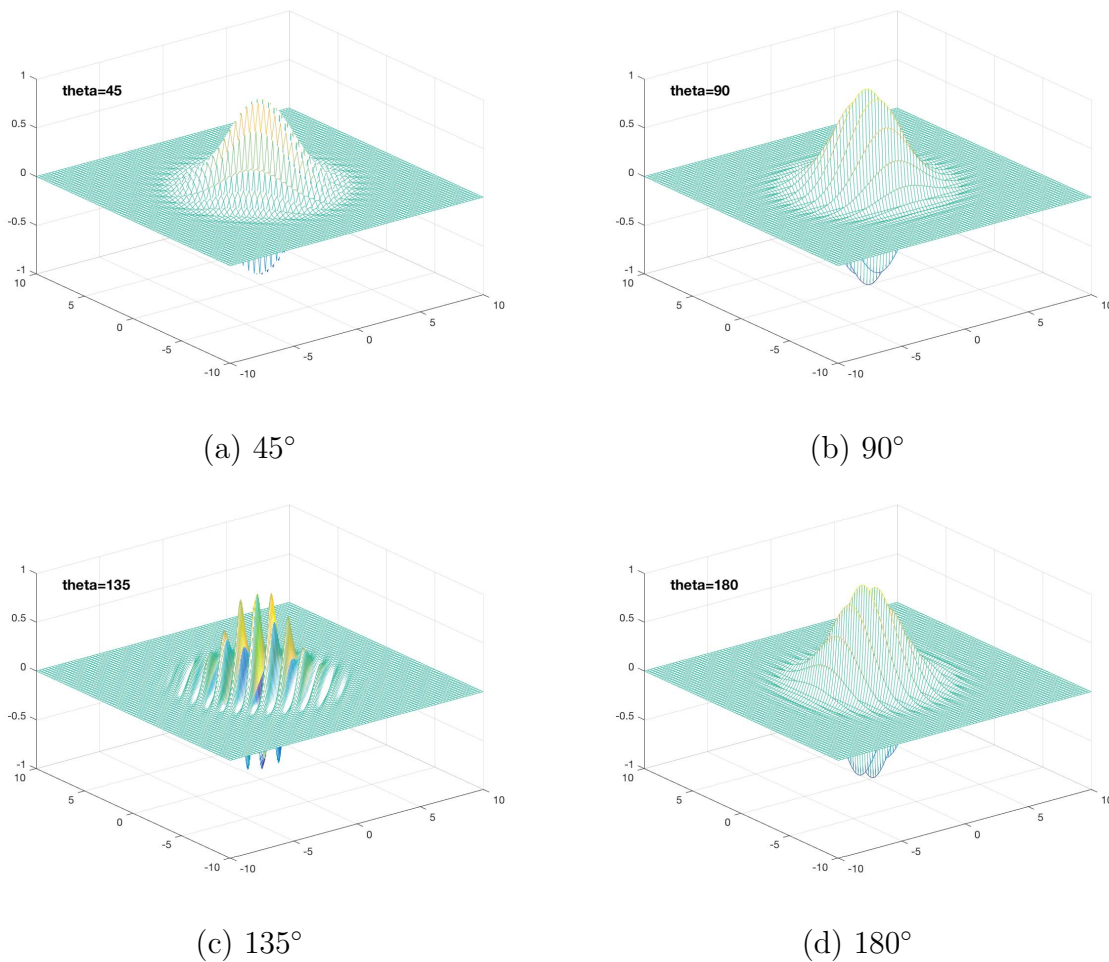
(a) 45°

(b) 90°

(c) 135°

(d) 180°

Figure 1: (a) 45°, (b) 90°, (c) 135° and (d) 180° oriented Sine Gabors.