# lm

October 26, 2016

## 0.1 Assignment - 3

### 0.1.1 Author: Tony Joseph

```
In [2]: '''
        The Leung-Malik (LM) Filter Bank, implementation in python

        T. Leung and J. Malik. Representing and recognizing the visual appearance o
        materials using three-dimensional textons. International Journal of Compute
        Vision, 43(1):29-44, June 2001.

        Reference: http://www.robots.ox.ac.uk/~vgg/research/texclass/filters.html
        '''

        import numpy as np
        import cv2
        import matplotlib.pyplot as plt
        import scipy
```

```
In [3]: %matplotlib inline
```

```
In [4]: def gaussian1d(sigma, mean, x, ord):
            x = np.array(x)
            x_ = x - mean
            var = sigma**2

            # Gaussian Function
            g1 = (1/np.sqrt(2*np.pi*var))*(np.exp((-1*x_*x_)/(2*var)))

            if ord == 0:
                g = g1
                return g
            elif ord == 1:
                g = -g1*((x_)/(var))
                return g
            else:
                g = g1*(((x_*x_) - var)/(var**2))
                return g
```

```
In [5]: def gaussian2d(sup, scales):
            var = scales * scales
            shape = (sup,sup)
            n,m = [(i - 1)/2 for i in shape]
            x,y = np.ogrid[-m:m+1,-n:n+1]
            g = (1/np.sqrt(2*np.pi*var))*np.exp( -(x*x + y*y) / (2*var) )
            return g
```

```
In [6]: def log2d(sup, scales):
            var = scales * scales
            shape = (sup,sup)
            n,m = [(i - 1)/2 for i in shape]
            x,y = np.ogrid[-m:m+1,-n:n+1]
            g = (1/np.sqrt(2*np.pi*var))*np.exp( -(x*x + y*y) / (2*var) )
            h = g*((x*x + y*y) - var)/(var**2)
            return h
```

```
In [7]: def makefilter(scale, phasex, phasey, pts, sup):

            gx = gaussian1d(3*scale, 0, pts[0,...], phasex)
            gy = gaussian1d(scale,   0, pts[1,...], phasey)

            image = gx*gy

            image = np.reshape(image,(sup,sup))
            return image
```

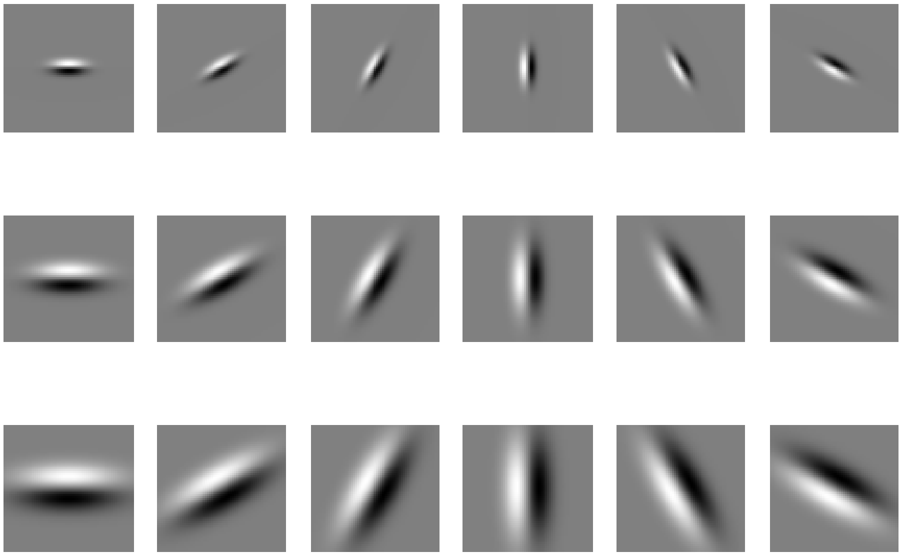
```
In [8]: def makeLMfilters():
            sup     = 49
            scalex  = np.sqrt(2) * np.array([1,2,3])
            norient = 6
            nrotinv = 12

            nbar  = len(scalex)*norient
            nedge = len(scalex)*norient
            nf    = nbar+nedge+nrotinv
            F     = np.zeros([sup,sup,nf])
            hsup  = (sup - 1)/2

            x = [np.arange(-hsup,hsup+1)]
            y = [np.arange(-hsup,hsup+1)]

            [x,y] = np.meshgrid(x,y)

            orgpts = [x.flatten(), y.flatten()]
            orgpts = np.array(orgpts)

            count = 0
            for scale in range(len(scalex)):
                for orient in range(norient):
                    angle = (np.pi * orient)/norient
                    c = np.cos(angle)
                    s = np.sin(angle)
                    rotpts = [[c+0,-s+0],[s+0,c+0]]
                    rotpts = np.array(rotpts)
                    rotpts = np.dot(rotpts,orgpts)
                    F[:,:,count] = makefilter(scalex[scale], 0, 1, rotpts, sup)
                    F[:,:,count+nedge] = makefilter(scalex[scale], 0, 2, rotpts, su
                    count = count + 1

            count = nbar+nedge
            scales = np.sqrt(2) * np.array([1,2,3,4])

            for i in range(len(scales)):
                F[:,:,count]   = gaussian2d(sup, scales[i])
                count = count + 1

            for i in range(len(scales)):
                F[:,:,count] = log2d(sup, scales[i])
                count = count + 1

            for i in range(len(scales)):
                F[:,:,count] = log2d(sup, 3*scales[i])
                count = count + 1

            return F
```

```
In [9]: F = makeLMfilters()
        print F.shape
```

```
(49, 49, 48)
```

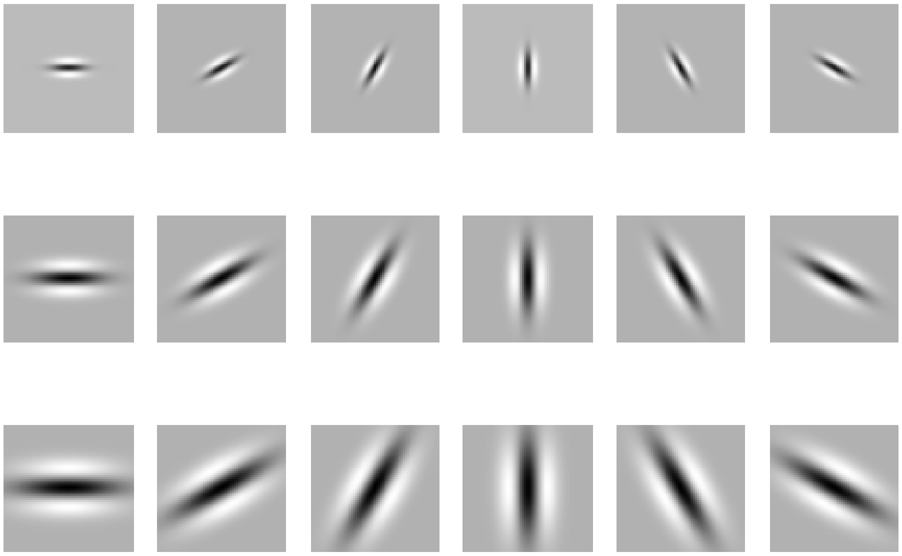
## 0.2 First order derivative Gaussian Filter

```
In [10]: for i in range(0,18):
             plt.subplot(3,6,i+1)
             plt.axis('off')
             plt.imshow(F[:,:,i], cmap = 'gray')
```



### 0.3 Second order derivative Gaussian Filter

```
In [11]: for i in range(0,18):
             plt.subplot(3,6,i+1)
             plt.axis('off')
             plt.imshow(F[:,:,i+18], cmap = 'gray')
```



## 0.4 Gaussian and Laplacian Filter

```
In [12]: for i in range(0,12):
             plt.subplot(4,4,i+1)
             plt.axis('off')
             plt.imshow(F[:,:,i+36], cmap = 'gray')
```