**fDeep learning for visual computing by NPTEL**

**Dr. Debdoot Sheet (IIT Kharagpur)**

<https://www.youtube.com/watch?v=kBrUaCFhQM0&list=PLAGFg6QiEHgGVNLseInZeZzSgLWVwmn2h>

**lec02 on feature extraction**

noise: uncertainty in image sensor

texture: local variation in intensity due to tissue heterogeneity

structural vs statistical textures

: considering a medical photo of a liver, using MRI or ultrasound

structural: MRI shows the structure

statistical: autocorrelation function, optical transforms, digital transforms, textural (“edgeness”) edginess, structural element, gray tone co-occurrence, run lengths, and autoregressive models

Family of Texture Metrics

Texture is at the top of the hierarchy with two branches:

1) Structural includes the three following:

i. Local Binary Patterns

ii. Fourier Coefficients

iii. Wavelets

2) Statistical includes the following two:

i. Co-occurrence matrices

ii. Orientation histogram

In further detail:

1) Structural includes the three following:

i. Local Binary Patterns (~9:00)

Get an 8-bit number that comprehends the value of the image; the central unit gets a value and using a 3x3 grid, it is centered. Those around it are valued such that if they are greater than or equal to the center value, they get a 1 otherwise they get a 0. This yields, again, an 8-bit integer which can be understood as a sequence of values moving clockwise around the central value.

i.e.

10 12 09

06 07 19

07 10 16

Yields 1, 1, 1, 1, 1, 1, 1, 0 starting from 10 going to 12, 9, 19, 16, 10, 7, and then 6.

P0 = 254

*Shift to Circular Shifts*

This is also used considering an image rotation. In the video, this integer is changed to P7 = 127

ii. Textures from Fourier Coefficients and Fourier Features

(~13:00) Consider three distinct parts of an image. Take a DFT ([Wang](http://eeweb.poly.edu/~yao/EL5123/lecture6_2D_DFT.pdf); [Maurer on Conjugate Symmetry](http://cs.ecs.baylor.edu/~maurer/CSI5346/ConjugateSymmetry.pdf)) of the image, multiply it, take the inverse DFT, and then you will get the image with frequencies only in the selected band.

iii. Wavelets Texture Descriptors (~15) are combinations of harmonics and individual harmonics

(~16:15) Laws Masks

Level: L5 = [1, 4, 6, 4, 1]

Edge: E5 = [-1,-2, 0, 2, 1]

Spot: S5 = [-1, 0, 2, 0,-1]

Wave: W5 = [-1, 2, 0,-2, 1]

Ripple: R5 = [1,-4, 6,-4, 1]

Take cross product between transposition ([Wiki](https://en.wikipedia.org/wiki/Transpose)) of one of these and one of the other arrays.

Then use the following 5 x 5 matrix grid as a kernel of a convolution and then traverse over it to find the features.

-Gabor Wavelets are useful for finger prints and iris patterns. (~19)

.. contains Gaussian product

.. Sinusoidal

(x0 , y0) = centroid of receptive field

(*e*0, v0) = spatial frequency

(σ /std dev , β / type II error) = std. dev of elliptical Gaussian

2) Statistical includes the following two:

i. Co-occurrence matrices (~21:30): small region has matrix of values 8x8 size.

Energy summation

Entropy summation

Contrast summation

ii. Orientation histogram (~24:30) is an analysis of angles by means of gradients.

[Analysis of Texture course by Lundervold](https://cds.ismrm.org/protected/11MProceedings/files/ISMRM2011-8016.pdf)

**Lec03 hands-on feature extraction with Python 2.7**