CS4232 Lab Week 8

Lab Content

[This Week]

- GLCM-based Texture Analysis
- Laws Filters
- Gabor Filters

GLCM

- Grey-level Co-occurrence Matrices
  - Co-occurrence matrix methods are based on the repeated occurrence of some gray-level configuration in the texture;
  - This configuration varies rapidly with distance in fine textures and slowly in coarse textures.

$$\Phi_{d,\theta}(i,j) = \sum_{u=1}^{U}\sum_{v=1}^{V} \rho(x(u,v),x(u',v'),i,j)$$

$$\rho(x(u,v),x(u',v'),i,j) = \begin{cases} 1 & \text{If } x(u,v) = i \text{ and } x(u',v') = j \\ 0 & \text{other wise} \end{cases}$$

$$x = \begin{bmatrix} 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 \\ 0 & 2 & 2 & 2 \\ 2 & 2 & 3 & 3 \end{bmatrix} \Rightarrow \phi_{1,0^o}(x) = \begin{bmatrix} 2 & 2 & 1 & 0 \\ 0 & 2 & 0 & 0 \\ 0 & 0 & 3 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

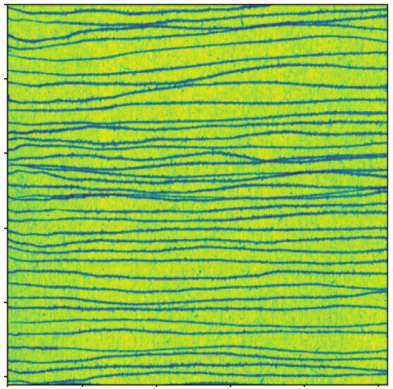
Functions to be applied on GLCM matrices:

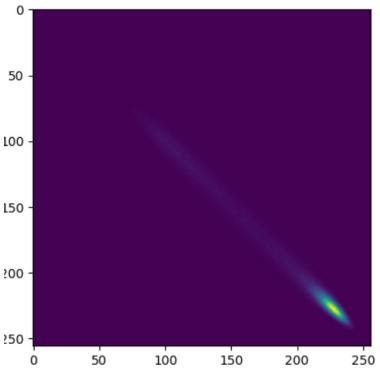
$$
\begin{cases}
f_1 = \text{Maximum} = Max_{i,j}(\Phi(i,j)) \\
f_2 = \text{Energy} = \sum_{i,j} \Phi(i,j)^2 \\
f_3 = \text{Entropy} = -\sum_{i,j} \Phi(i,j) log(\Phi(i,j)) \\
f_4 = \text{Correlation} = \sum_{i,j} \frac{(i-\mu_i)(j-\mu_j)\Phi(i,j)}{\sigma_i \sigma_j} \\
f_5 = \text{Inverse Difference Moment} = \sum_{i,j} \frac{1}{1+(i-j)^2} \Phi(i,j) \\
f_6 = \text{Inertia} = \sum_{i,j} (i-j)^2 \Phi(i,j)
\end{cases}
$$

- If the element values of the co-occurrence matrix are similar, the energy is small, indicating a fine texture; if some values are larger and some are smaller, the energy is larger, indicating a uniformly changing texture.

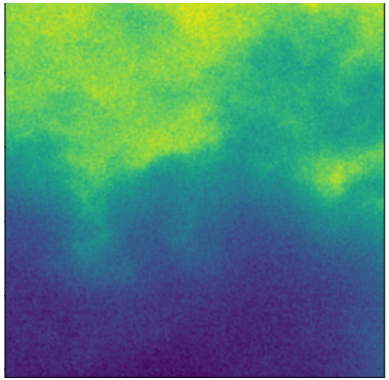
Example

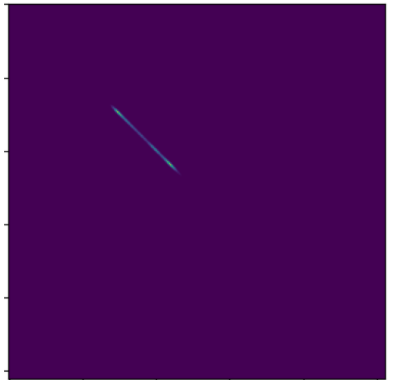
(F1,F2) =(1005.0, 76882028.0)





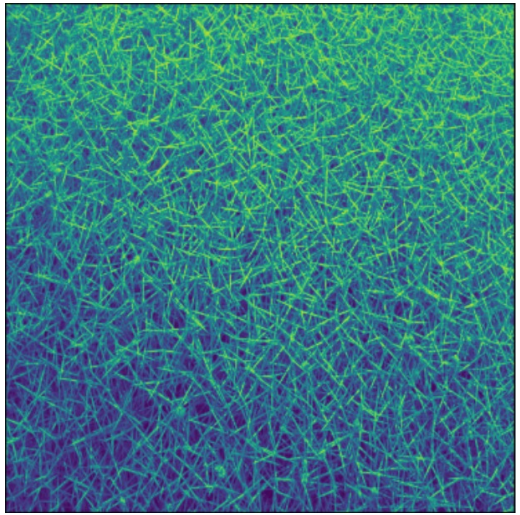
(F1,F2) = (7975.0, 896106400.0)

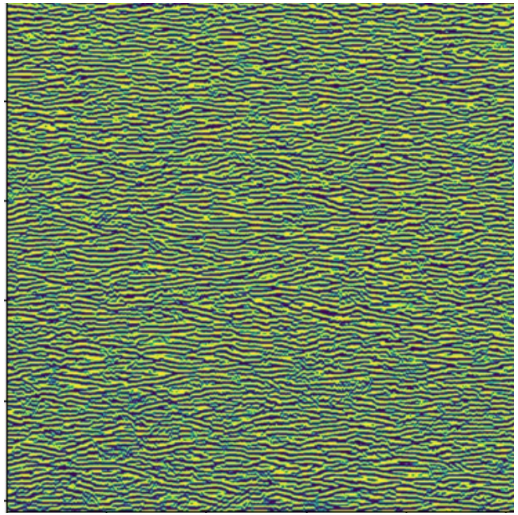


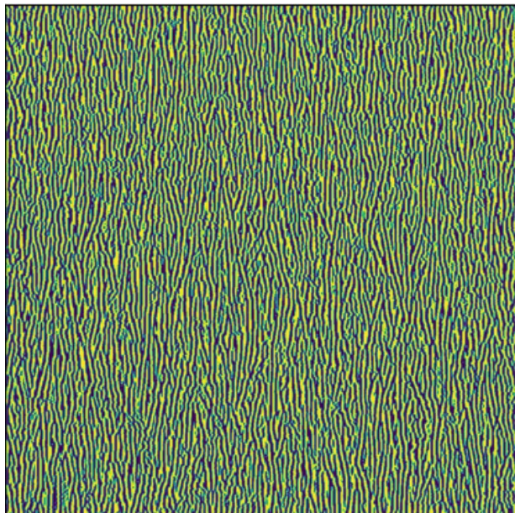


Gabor Filters:

- Gabor filters are a representation of the conversions of an image using filters that apply different variations of scales and orientations.







End of Lab