

Medical Image Processing for Interventional Applications

Written Exam

13.02.2020

60 minutes, 60 points

Gaussian

- a) Prove the following:

$$(g_{\sigma_1} * g_{\sigma_2})(x) = g_{\sigma_3}(x)$$

(Note: All the necessary formulae were given)

Image Enhancement

- a) Given: $f(x) = f(x+h) - f(x)$
What is the above edge detection called?
What is the main disadvantage of it?
- b) Describe the steps in Structure tensor?
- c) Given:

$$H_s = \begin{pmatrix} \frac{\partial^2 I(\mathbf{x}, s)}{\partial x^2} & \frac{\partial^2 I(\mathbf{x}, s)}{\partial x \partial y} \\ \frac{\partial^2 I(\mathbf{x}, s)}{\partial y \partial x} & \frac{\partial^2 I(\mathbf{x}, s)}{\partial y^2} \end{pmatrix}$$

Write the properties of rank of the above?

Deep Learning

- a) What is the name of non-linearity? Give one example? What is the name of algorithm we use in backward pass?
- b) Why do we use Sparsity based denoising autoencoder?
- c) Draw U-net and explain briefly its parts? Specify one difference between U-net and autoencoder?

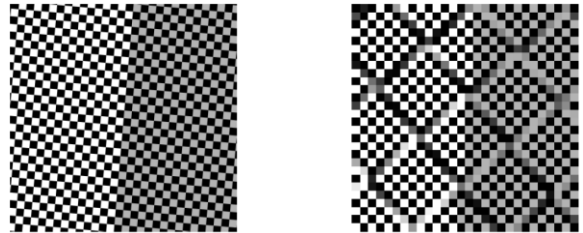
Super Resolution

- a) Given:

$$f_{m,n} = \iint f(x,y)h(x-m\Delta x, y-n\Delta y)dx dy + \epsilon(x)$$

What is $f(x, y)$, $h(x, y)$ and $\epsilon(x)$?

- b)



Name the above effect?

Why it occurs?

How to resolve it?

Calculus

$$2f(x)^2 + \frac{a}{2}e^{2bx}f'(x) + 2x^2f'(x)$$

a, b \in constants

- a) Find the minimum of the above equation $f_0(x)$? (14 points!)