



CIS*4720 Image Processing and Vision
Winter 2023, Assignment 3 Part 1/2

Your submission must include the statement below, followed by your signature:
“I have read and understood the Academic Misconduct section in the course outline.
I assert this work is my own.”

All answers must be justified in a clear, concise and complete manner.

1.

M and N denote two positive real numbers.

The image f_a is the total function from $[0, M] \times [0, N]$ into \mathbb{R} defined by

$$f_a(x, y) = 255 \left[\frac{1}{2} + \frac{1}{2} \cos \left(\frac{Mx + Ny}{M^2 + N^2} \pi \right) \right].$$

What is the range of f_a ? Show that the edge points lie on a straight line segment S :

a) Use the gradient approach. Calculate the Euclidian norm of the gradient and the gradient direction at any edge point. Plot S . What is the direction $\theta \in [0, \pi)$ of S ?

b) Use the Laplacian approach.

NOTE

$$\frac{\partial f_a}{\partial x}(x, y) = -\frac{255}{2} \frac{M\pi}{M^2 + N^2} \sin \left(\frac{Mx + Ny}{M^2 + N^2} \pi \right)$$

$$\frac{\partial f_a}{\partial y}(x, y) = -\frac{255}{2} \frac{N\pi}{M^2 + N^2} \sin \left(\frac{Mx + Ny}{M^2 + N^2} \pi \right)$$

$$\frac{\partial^2 f_a}{\partial x^2}(x, y) = -\frac{255 M^2 \pi^2}{2 (M^2 + N^2)^2} \cos \left(\frac{Mx + Ny}{M^2 + N^2} \pi \right)$$

$$\frac{\partial^2 f_a}{\partial y^2}(x, y) = -\frac{255 N^2 \pi^2}{2 (M^2 + N^2)^2} \cos \left(\frac{Mx + Ny}{M^2 + N^2} \pi \right).$$