PH 2021 - ECL 2 – Mini project – June 2020

"Double slit experiment" can be considered as one of the earliest experiments that supported quantum mechanical principles. It demonstrated that light and matter can display characteristics of both classically defined waves and particles. This experimental setup is commonly referred to as the "Slit experiment" because it can be done either using a single or double slit.

Problem 1: Single and Double slit diffraction in 1-Dimension

STUDY AND LEARN RELEVANT FORMULAE BEFORE STARTING THE SIMULATION.

Obtain diffraction patterns for the single and double slit experiment using relevant equations. Use following parameters for simulations. Assume that the intensity at the central maximum (center of the diffraction pattern) is a unity. i.e. Intensities are normalized.

Part A: For the single slit

Slit width = 12 μm
Wavelength of the light ray = 480 nm
Distance from the slit to the screen = 3 m
Angle to the furthest away point from the central maximum = $\pi/8$

Part B: For the double slit

Slit width = 30 μm
Distance between two slits = 0.15 mm
Wavelength = 480 nm
Distance from the slit to the screen = 3 m
Angle to the furthest away point from the central maximum = $\pi/50$

(You may change these values to observe the changes in the diffraction pattern)

You are entitled to submit your OCTAVE / MATLAB files along with the graphs obtained for this problem.

Problem 2: Single and Double slit diffraction in 2-Dimensions

READ ABOUT HOW FOURIER TRANSFORM IS RELATED TO DIFFRACTION.

I. You are given an image of a single slit ('single_slit.bmp'). Read this image using appropriate MATLAB / Octave syntax(es).

II. Identify and state MATLAB / Octave syntaxes for extracting spectral information from an image.
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III. Extract a single bit-map layer from the image provided and submit your result.
(Hint – Extracting a single bit-map layer can be from any channel of the RGB spectrum.)

IV. Identify and state MATLAB / Octave syntax for Fourier transformations.
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V. Obtain the 2D far field diffraction pattern for the single slit and submit your result. Note that the maximum intensity should be in the center of the plot.

VI. Obtain a horizontal cross section of the line where the intensity pattern can be observed. Plot this in a 1D plot.

VII. Compare your plot with the plot obtained in Problem 1 Part A and comment on the results.
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VIII. Hence obtain the double slit diffraction pattern using the provided image ('double_slit.bmp'). (Hint – Follow the same procedure you used for the single slit.)

IX. Compare your plot with the plot obtained in Problem 1 Part B and comment on the results.
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You are entitled to submit your OCTAVE / MATLAB files along with the graphs obtained for this problem.