Homework01

Computational Physics

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1 Homework

1. **The Mandelbrot Set.**
   If we define the point is a good point when the iterations exceed 400, and I set the coarse grid value N is 400 (which means I will perform the iteration for all values of $c = x + iy$ on an 400×400 grid), I can get the following image of the Mandelbrot set with black and white:

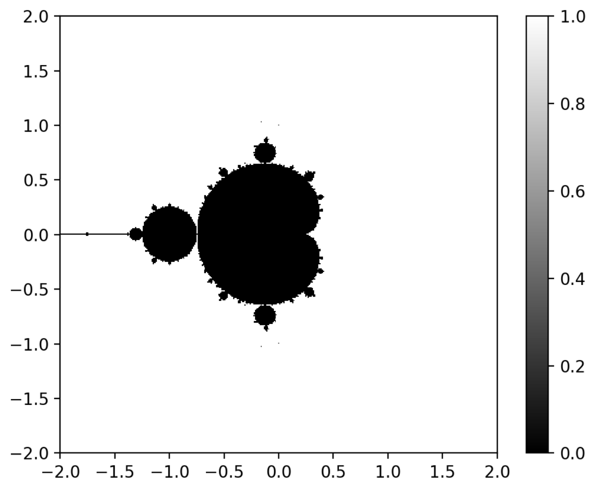

Figure 1.1: The Mandelbrot Set in black and white

Then, if I increase the maximum iteration number to 1000 and the coarse grid value to 1000, and plot the number of iterations with "jet" schemes, I can get the following figure:

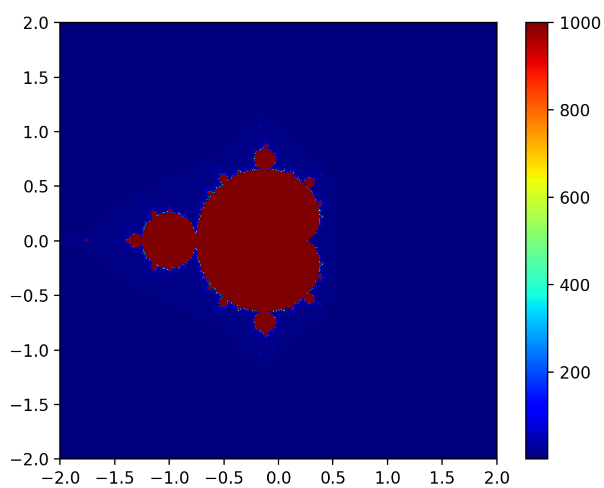

Figure 1.2: The Mandelbrot Set (Iteration Number) using "jet" schemes.

2. **Least-Squares Fitting and the Photoelectric effect**
For problem (a), (b), and (c), I can get the final figure with the data and a straight line that runs through them. To find the best fitting line, we can calculate the quantities E_x, E_y, E_{xx}, and E_{xy},

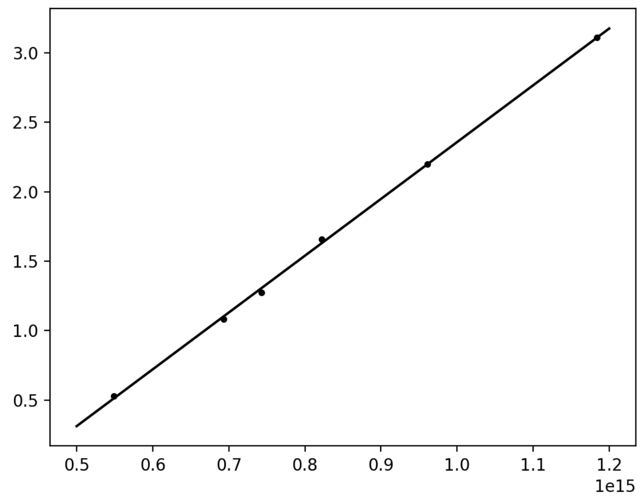

Figure 1.3: The Millikan's data points and the best-fit line.

using the definitions given in the descriptions in the problem:

$$\begin{gathered} E_x = 8.25 \times 10^{14},\ E_y = 1.64 \\ E_{xx} = 7.22 \times 10^{29},\ E_{xy} = 1.52 \times 10^{15} \\ m = 4.09 \times 10^{-15},\ c = -1.73 \end{gathered} \tag{1.1}$$

The quantity m is corresponding to the μ term in the photoelectric effect function, so we can calculate Planck's constant from Millikan's experiments:

$$h = m \times e = 6.54934022835 \times 10^{-34} \tag{1.2}$$

And the accepted value (from *Wikipedia*) is $h_{accept} = 6.626176 \times 10^{-34}$. The error and the relative error are:

$$\epsilon = 0.077 \times 10^{-34} \tag{1.3}$$

$$\epsilon_r = 1.16\% \tag{1.4}$$