ME 5311 ASSIGNMENT 1 JACOB IVANOV

The Burning Ship fractal is described by the following iterative equation:

$$z_{n+1} = \Big(|\Re[z_n]|^2 + \mathbf{i}|\Im[z_n]|\Big)^2 - c \tag{1}$$

A point c is considered to be part of the Burning Ship Set if $\lim_{n\to\infty}[z_n]$ is bounded. A numerical algorithm was implemented in Julia that iterates Eq. (1) 200 times, and considered $|z_{200}| < 200$ to be part of the Burning Ship Set. The results of which are shown in Fig. 1 below, on the region $x \in [-2, +2]$ and $y \in [-2, +2]$:

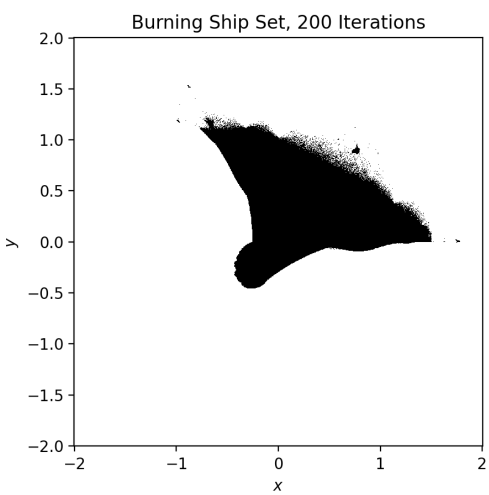

Figure 1. Burning Ship Set, Region 1

However, this binary distinction makes for a rather uninteresting plot compared to showing the iteration at which z_n is no longer bounded. Defining $c = x + \mathbf{i}y$, and a new function $N(c) = N(x + \mathbf{i}y) = n$ where $|z_n| > 200$, by taking the natural logarithm of this n, we obtain Fig. 2 below.

burning_ship.png

Figure 2. Burning Ship Contour, Region 1

As a fractal, the structure is self-similar at any scale, which can be seen if we repeat this procedure on an arbitrary new region, in this case, $x \in [-1.25, -0.75]$ and $y \in [1.25, 1.75]$.

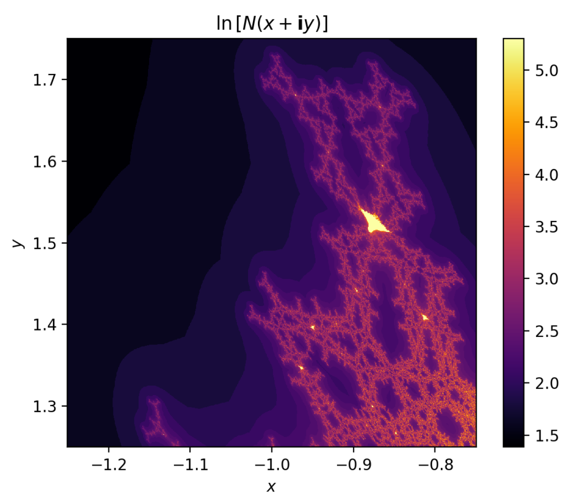

Figure 3. Burning Ship Contour, Region 2

1. Notes

The assignment details encouraged concise code, specifically calling for <50 lines. Though the final product `burning_ship.jl` was 73 lines, where the main procedure is the first 50 lines, this was due to comments, and toggled sections to produce Fig. 1-3 above. Excluding these, the pre-plotting section is roughly 30 lines with reasonable spacing.

One additional technical note is that Julia is column-major, whereas Python Numpy is row-major. As a result, where Julia passes the relevent array to `PyPlot.jl`, it is transposed.