CHAPTER 7

FRACTALS

7.1 Overview

This project aims at generating famous fractals in the complex plane. These fractals will be part of the 'chaosbrot family' which result from simple iteration relations. The most famous one is the also the simplest and is called the Mandelbrot set. Of course, this project involves visualisation of this uncommon mathematical objects.

If we consider a complex number c and compute the following series:

$$z_{n+1} = |z_n|^2 + c \tag{7.1}$$

the number c is said to belong to the set of Mandelbrot if

$$\lim_{n\to\infty} |z_n| < \infty. \tag{7.2}$$

If this test is performed for all the numbers in the complex plane, the famous Mandelbrot figure arise. Different series lead to different fractals, such as:

$$z_{n+1} = |z_n|^2 + p(\mathrm{Re}(z)\mathrm{Im}(z)) + c \tag{7.3}$$

where the Mandelbrot set corresponds to $p = 0$.

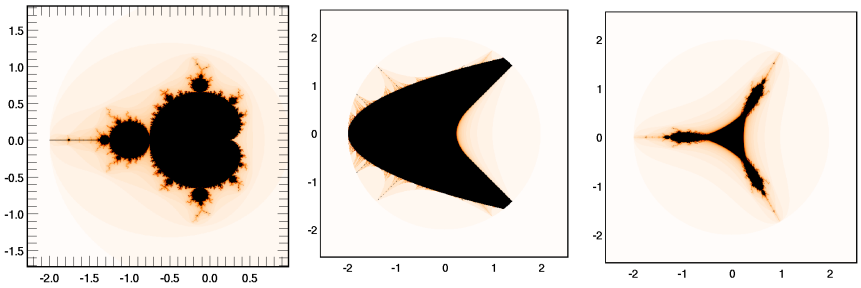

Figure 7.1: Three type of fractals. Black pixels correspond to points in the complex plane which belong to a fractal set. The leftmost one is the Mandelbrot set.

7.2 Technique

The project relies on complex arithmetic which can be treated through the complex.h library or built from scratch. The recursion relation 7.1 and the condition 7.2 must be applied with caution : infinity is meaningless in computer science, thus arbitrary thresholds must be chosen, maybe after some experimentations.

7.3 Goals

Construct and displays the Mandelbrot set in the complex plane. Practically the result should be a plane, filled with 0 and 1, stating if a point belongs or not to the fractal set. Once this code is functionnal, construct other fractals ensemble following the same route. For example, one could look after the 'Chaosbrot' family.

7.4 Bibliography

1. *Wikipedia* `http://en.wikipedia.org/wiki/Mandelbrot_set` and references therein

2. *Wikipedia* `http://en.wikipedia.org/wiki/Complex.h` for the complex library