Abstract

Fractals are self similar images. A part of the fractal, when magnified, looks like the complete image. IFS (Iterated Function Systems) are one of the techniques to generate fractals. IFS uses a set of affine transforms to generate a fixed point which is the image. This Thesis explores the use of non-linear transforms to generate fractals. Non-linear fractals are generated using transforms including power, sine, cosine and log. Difference based technique, which is equivalent to IFS is used in this Thesis. Difference based fractal generation technique is more intuitive than IFS. Point based fractal generation techniques have been extended to lines and polygons. We see the presence of non-linear fractals based on lines and polygons. Non-linear fractals are also generated using variable scaling factors. Union and difference of two or more fractals is demonstrated in this Thesis. Morphing of two different fractals is also explored in this Thesis.

In the traditional linear method, the points move in a linear fashion and introducing curvature is difficult. The non-linear fractals are generated when the point moves as a non-linear function of the previous point. A program to generate a non-linear fractal is similar to that of a linear fractal in terms of the number of iterations, convergence and complexity. Curvature can be generated in a more realistic way in a non-linear difference based fractal. Non-linear fractals are also self-similar. A part of a non-linear fractal when magnified gives a picture which is similar to the whole, thus maintaining the property of a fractal. We can also visualize the magnification of curvature in different parts of the image. The non-linear transforms can also be applied to any graphical image. The time taken to generate the images is similar to the ones using linear transforms.

Non-linear fractals can be used in designing complex figures in a simple way. These fractals can be used in designing textures for fabrics and objects. The size of the code required to create fractals is less when compared to that of a normal graphic image.
The second part of the Thesis deals with fractal compression based on difference between the range and domain pixels. This difference based technique compresses images with comparable compressed sizes with respect to partitioned iterated function systems (PIFS) [1] based fractal compressing techniques. Use of non-linear transforms to compress the image is also demonstrated. Finally, a randomized algorithm using variable scaling factors is used to compress images giving comparable figures of quality and compression with respect to PIFS. The time taken to compress and decompress images using non-linear fractals is found to be more as the functions are more complex than linear ones and take more time to be computed.