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The Mathematics of Fractal Art: Using a Derived Cubic Method and the Julia Programming Language to Make Fractal Zoom Videos

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Abstract : Fractals can be found everywhere, whether it be the shape of a leaf or a system of blood vessels. Fractals are used to help study and understand different physical and mathematical processes; however, their artistic nature is also beautiful to simply explore. This project explores fractals generated by a cubically convergent extension to Newton's method. With this iteration as a starting point, a complex plane spanning from -2 to 2 is created with a color wheel mapped onto it. Next, the polynomial whose roots the fractal will generate from is established. From the Fundamental Theorem of Algebra, it is known that any polynomial has as many roots (counted by multiplicity) as its degree. When generating the fractals, each root will receive its own color. The complex plane can then be colored to indicate the basins of attraction that converge to each root. From a computational point of view, this project's code identifies which points converge to which roots and then obtains fractal images. A zoom path into the fractal was implemented to easily visualize the self-similar structure. This path was obtained by selecting keyframes at different magnifications through which a path is then interpolated. Using parallel processing, many images were generated and condensed into a video. This project illustrates how practical techniques used for scientific visualization can also have an artistic side.

Keywords : fractals, cubic method, Julia programming language, basin of attraction
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