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Nova fractals

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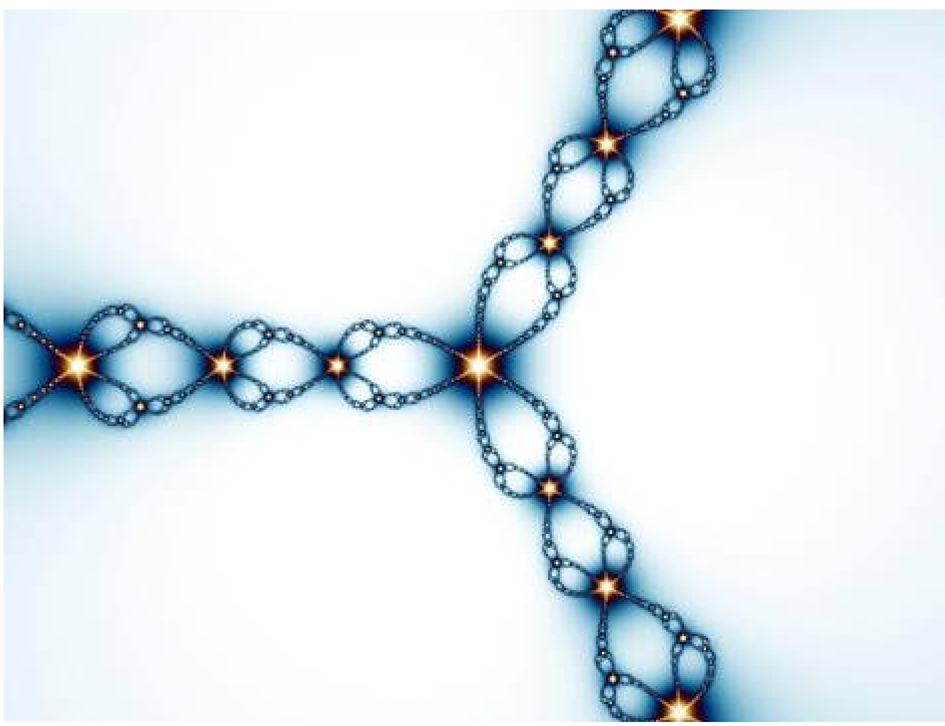
Hi. I'll try to remember as much as I can about this…I have not touched it for quite a few years.

The Newton fractals and the Nova fractals are based on iterative methods to numerically solve equations. They are very closely related (in fact, the Newton method is a special case of the method used to make the Nova fractals). The math is explained (very briefly) here: http://www.hpdz.net/TechInfo/Convergent.htm

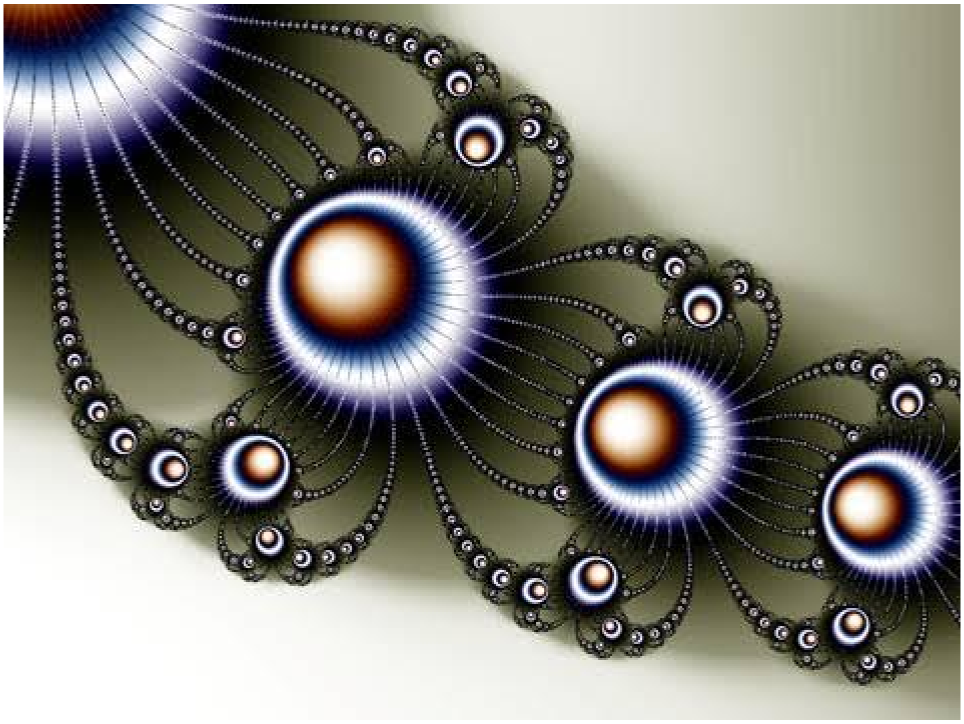
In either case, the coloring has to do with the number of steps it takes for the iteration to converge to some solution, or actually to within some small tolerance close to a solution. I think the stopping criterion I used was whether two consecutive steps are closer than some small value.

Both types of fractals depend on choosing an equation to solve. The most common images of Newton-type fractals come from trying to solve x^3=1 in the complex number plane. I don't know if you're familiar with how that works, but there are three solutions to that in complex numbers.

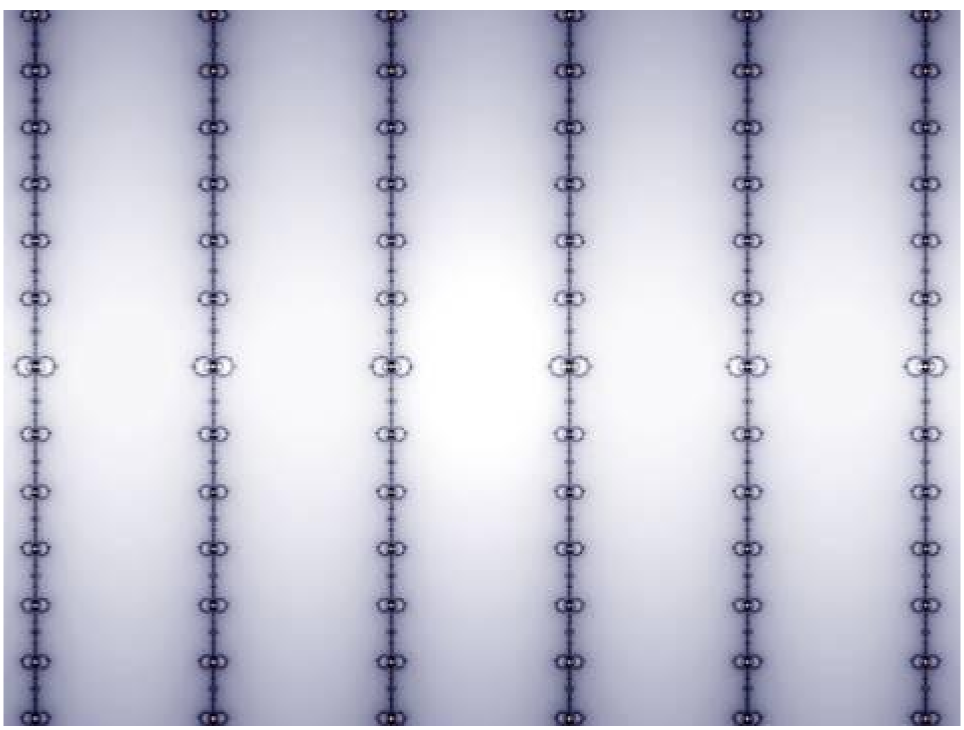
Here is an example of that, applying Newton's method to solving x^3 = 1:



This image comes from trying to solve x^10=1 (zoomed in a bit)

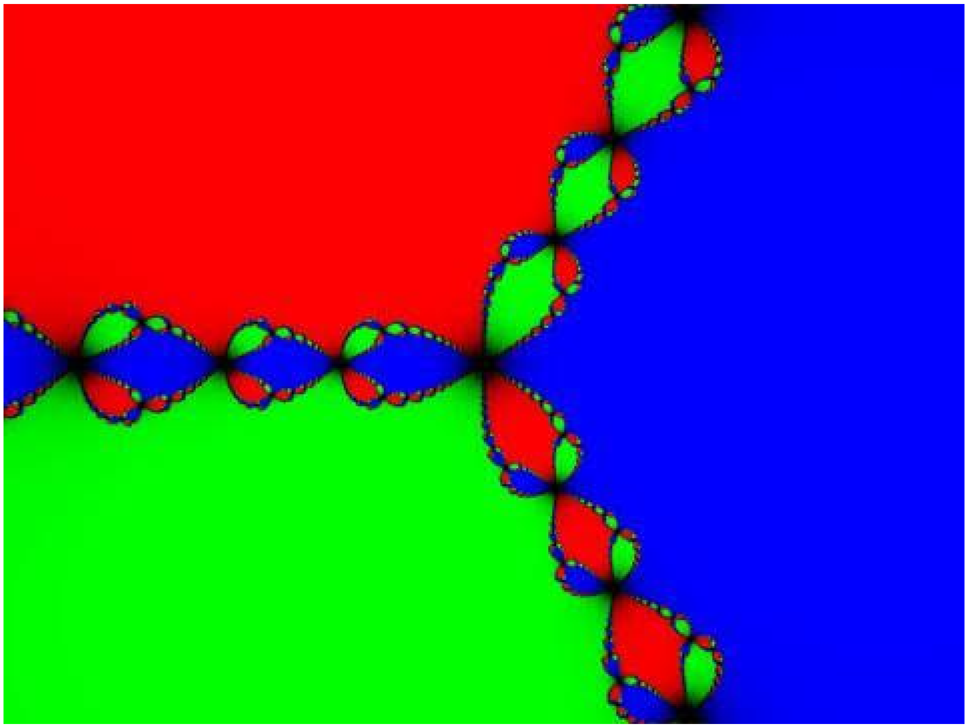


And this one from trying to solve sin(x)=0:



So, you can see that you get quite different images depending on which function you feed into the method. But all these images just show how fast the method converges, not solution what it converges to.

In addition to coloring based on how fast the convergence happens, you can modify the coloring based on which of those three solutions it converges to. My program originally did not do that, and could only generate images like the one above. I modified it to be able to change coloring based on which solution it found, and you get things like this:



The color at each point represents which of the three possible solutions that point will converge to.

Those images are from here: http://www.hpdz.net/StillImages/Newton-Halley.htm and there's a bit more information on how this works there too.

The Nova family of fractals is very similar, just using a slightly different numerical method to find the solutions. The original Nova fractal was made by using that same x^3=1 function, trying to find its solutions in the complex number plane. It works the same way, more or less, but has another parameter that changes how fast the iterations converge to the solution. It's doing the same thing, just a little differently. I don't think I made any images of the Nova fractal with coloring showing which solution it converges to, but it's the same idea – just change the color palette based on where the method ends up converging. Take a look here: http://www.hpdz.net/StillImages/Nova.htm

Finally, the smooth gradients are obtained by applying the method described here: http://www.fractalforums.com/programming/smooth-colouring-of-convergent-fractals/

I won't try to summarize that. It's kind of complicated and my memory of the details is not very fresh.

I hope that answers your question! Thanks for your interest, and feel free to write if you have any other questions.

Mike

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