Beauty in Algorithms

It took the introduction of fractals and chaos theory to get Bruce Shapiro interested in motion control. While conducting medical research on his PC, Shapiro began computing images of the Mandelbrot Set on his computer. He was intrigued by the fact he could use an algorithm to compute the value of each pixel on screen to create beautiful images.

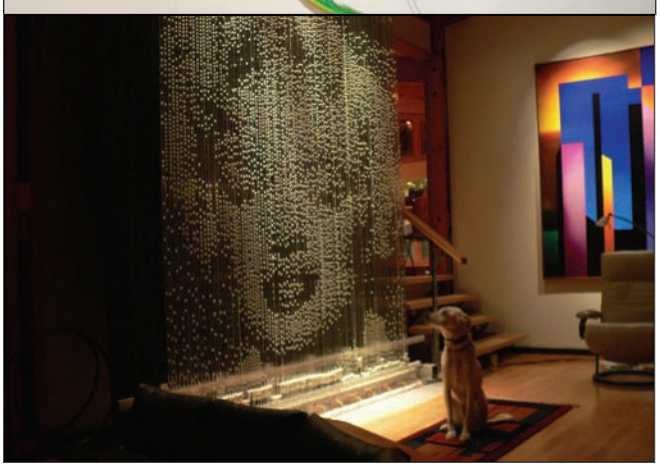
After discovering some stepper motors in a bin at an electronic junk shop, he had a revelation.

"Although I didn't know how to run the stepper motors, I understood immediately that they break motion into controllable pieces—motion pixels. And then the light bulb went on. Might it be possible to use algorithmic control of motion pixels to create beautiful movement?"

He's been pursuing the question ever since.

Shapiro, an M.D. by vocation, practiced several years as an internist in California and Minnesota before retiring to pursue his interest in motion control. He was able to purchase the necessary components at local "tech-junk" shops in the Minneapolis/St. Paul area, material that had flowed out of monthly auctions at automation-based companies like 3M and Honeywell.

The early focus of his work was on what Shapiro called "studio machines," do-it-yourself CNC machines that he designed as static sculptures. These custom machines would later become performance CNC machines, combining electronics, mechanics and programming to create motion control art. (A popular example of this art form is the Fountains of Bellagio in Las Vegas created by WET Design.)



One of Shapiro's earliest performance projects was "Sisyphus," a two-axis, polar coordinate NC device which moves a magnet beneath a field of sand. A steel ball pulled by the invisible magnet rolls through the field, creating highly intricate dune patterns. "Sisyphus III" was permanently installed at Technorama, the Swiss Science Center outside of Zurich in 2003.

While Shapiro has a deep affinity for all his creations, his favorite installation, entitled "Ribbon Dancers," debuted in 2006 at the Science Center of Iowa in Des Moines. While the project is still a two-axis NC device, the geometry is now spherical and there is no limit to travel in either axis. The result is two colorful ribbons that continuously "dance" near the ceiling of the science center.

"This is the first of my projects that truly required closing the loop (for safety reasons), and moving from stepper to servo-based systems has been somewhat of a religious experience for me," Shapiro says.

Shapiro's work in motion control has also been a significant teaching tool for students interested in science and mathematics. His very first project was an Easter egg coloring machine called "Eggbot." Shapiro teaches a course entitled, "From Bits to Bytes… to Bots," at the Science Museum of Minnesota that instructs children how to build their own version of the machine.

"The wonderful thing about motion control is that it provides a tremendous incentive to figuring out where you goofed. Do-it-yourself robots never work perfectly the first time," Shapiro says. "It's this Sherlock Holmes process that leads to deep learning."

Currently, Shapiro is working on the fourth installment of a series called "Pipedream." This is a large array of clear, fluid-filled vertical tubes. By controlling solenoid valves, he can introduce air in the tubes so that the resulting bubbles create images. "Pipedream IV" is scheduled for installation at Discovery World in Milwaukee in January 2009.

For more information on Bruce Shapiro's Art of Motion Control and to watch a video of his work, visit *www.taomc.com*.