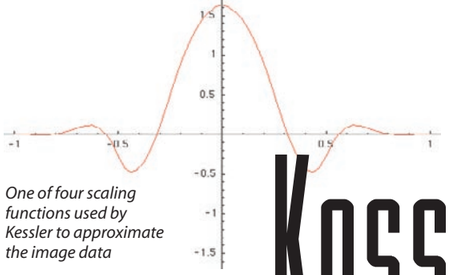

One of four scaling functions used by Kessler to approximate the image data

Kessler's Compression

BY TOMMY NEWTON

THEY SAY A PICTURE IS WORTH A THOUSAND WORDS. TO BRUCE KESSLER, A PICTURE MAY BE WORTH A THOUSAND NUMBERS.

If you look closely at the photographs, you'll probably notice slight variations as the image has been compressed. The changes weren't made with a photo-imaging software program like Photoshop. They were made with mathematic-numeric processes using fractal functions and wavelets.

Through a series of algebraic formulas and equations, Dr. Kessler, an associate professor of mathematics, can filter and compress the raw data of the image file — the series of numbers used to create the actual image we see.

Dr. Bruce Kessler original image with file size 256 Kb

Reconstructed image from a file 1/32 the size of the original using Kessler's approach

Reconstructed image from a file 1/64 the file of the original using Kessler's approach

"I'm researching ways to apply fractal functions to image compression. Fractals are the kind of strange curves where if you take a piece of them and then zoom in on a little section of it, you'll see portions of the curve again. They're kind of self-repeating," Dr. Kessler explained.

"The idea of image compression is that you take the original raw data of the image, which is just whole numbers ranging from zero to 255, and somehow turn that into another set of numbers that can be stored more efficiently or transmitted faster over the phone lines."

Dr. Kessler said one way to visualize his use of fractal functions is to think of Lego blocks. Legos come in three sizes, small for older children, medium for younger children, and big for toddlers.

"Using the small Legos, you can build things with a lot of detail, but as you use larger Legos, you lose the ability to build with as much detail," he said. "What I do with images is like building it out of the small Legos, and then rebuilding it out of the medium Legos and keeping track of the error. Then I rebuild it out of the big Legos and keep track of the error at that step.

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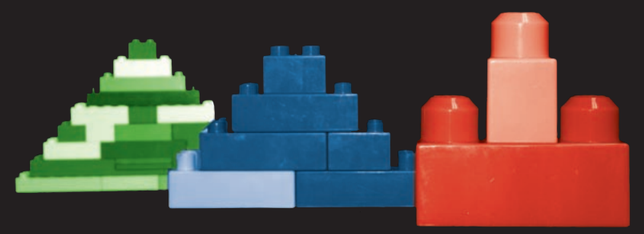


"Using small Legos, you can build things with a lot of detail, but as you use larger Legos, you lose the ability to build with as much detail. What I do with images is like building it out of the small Legos, and then rebuilding it out of the medium Legos and keeping track of the error. Then I rebuild it out of the big Legos and keep track of the error at that step."

If the error is fairly small, then I can store the image more efficiently. My goal is that the loss of detail is not too noticeable. The better the set of functions that I use to 'build' the image, the less noticeable the loss of detail is."

The growth in digital technology has driven Dr. Kessler's research. He and Doug Hardin, his Ph.D. adviser at Vanderbilt University, have been working on wavelet theories and fractal functions for several years.

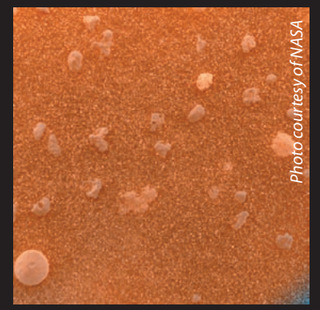
Dr. Kessler, who earned his bachelor's degree at Western, was attracted to the cutting-edge image compression research because it has numerous applications for business, industry, and science.

The FBI is using similar technology to compress fingerprint data, and images transmitted from the Mars rovers could be stored more efficiently and received more quickly.

"I'm doing fairly well. I'm not ready to have any patents yet. And nobody has paid me a million dollars for these ideas," he joked. "I'll settle for a good number of publications and notoriety among my peers."

One application that he's working on involves edge detection or the enhancement of edges in images. For example, in surveillance video the technology could be used to enhance distinguishing traits, such as a tattoo, to assist law enforcement agencies.

"It would be nice to do something innovative," he said.



Original Mars Rover photo, size 256 Kb

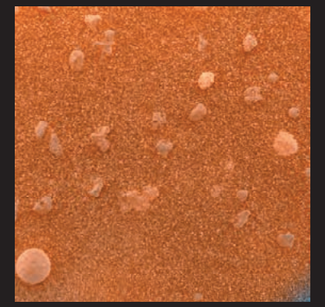
Photo courtesy of NASA

Dr. Kessler has been on sabbatical during the entire 2003-04 academic year thanks to a grant from the Kentucky Science and Engineering Foundation.

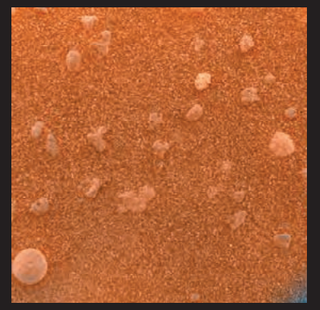
He also has received a research enhancement grant from the National Science Foundation through Kentucky EPSCoR (Experimental Program to Stimulate Competitive Research) that will allow two undergraduate students to assist in the project and present results at several conferences.

"If I can just advance what's known and make some good contributions to the field, I'll be happy," Kessler said.

"The research does have some nice applications. I'd feel a lot better if I were saving the world someway or another, but this is who I am and this is what I do. There is the possibility of doing some good things."



Reconstructed image from a file 1/32 the size of the original



Reconstructed image from a file 1/64 the size of the original