Electromagnetic Properties of Pictorial Circuits

Jason Fiering

Leonardo, Volume 34, Number 1, February 2001, pp. 17-18 (Article)

Published by The MIT Press

ARTISTS' STATEMENTS

ELECTROMAGNETIC PROPERTIES OF PICTORIAL CIRCUITS

Jason Fiering, Department of Electrical and Computer Engineering, Box 7911, Raleigh, NC 27695-7911, U.S.A.

Received 6 March 2000. Accepted for publication by Roger F. Malina.

Each of us knows the experience of moving around the antenna of a portable radio, trying to tune in a distant signal. We intuitively understand that radio signals respond to positions in space and that even the location of our bodies or the touch of our hand can change the reception of the signal. The identical principle is at work on a small scale, in the circuits inside the radio, where waves emanating from the tiny wires interact with neighboring wires and allow the receiver to tune into a station. In these mutual interactions between wires, their relative positions and shapes are critical to their function.

Mutual interactions are equally critical when we look at images; we identify and appreciate an image, at least in part, because of the relative positions and shapes of its marks. My present investigations combine these two types of space-sensitive objects, images and microcircuits. The same technology that is used to produce computer chips makes it possible to print images made of microscopic conductors. I have used this technology to form pictorial circuits and then placed these images in an electronic tuning system to observe how they react to signals.

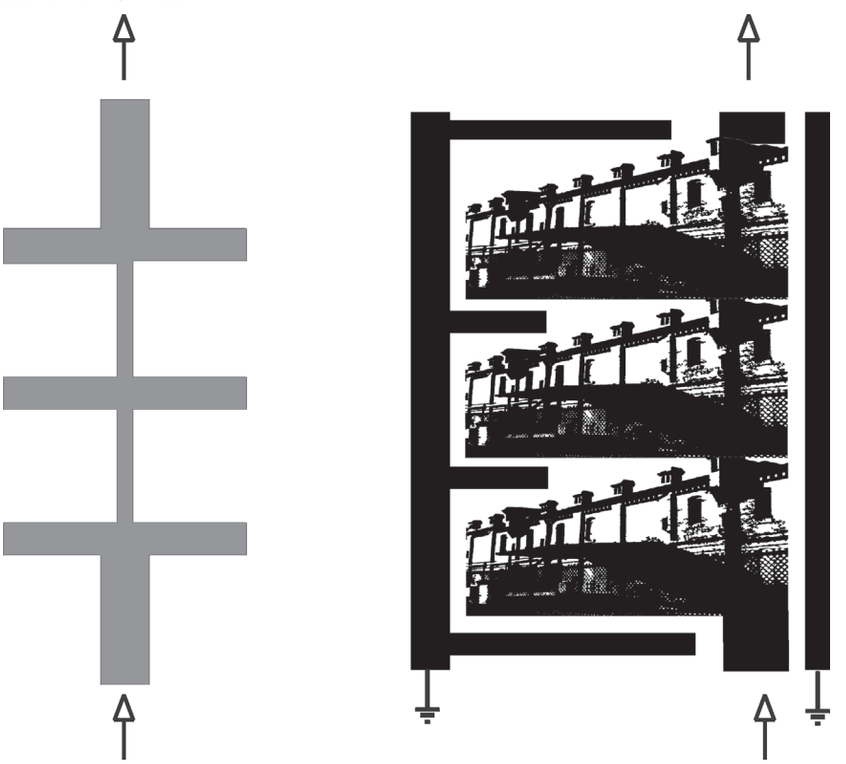
My work makes use of technologies from microchip manufacturing and wireless communications to suggest a new system for interpreting images. In this system, the images are real electronic components. An electromagnetic signal then "reads" the specific geometry of the images. Furthermore, the circuits show complex behavior in response to microwave frequency signals, suggesting possible uses in dynamic installations where they may transmit and receive signals.

Measurements show that the shape of the conducting elements becomes functionally significant. A straight line behaves differently than a curved one, and a spur off of a strip can produce yet another behavior. These circuits behave the way they do because the wavelengths of the electronic signals are close in size to the major forms in the images. Just as a stretched string vibrates at a frequency corresponding to its length, so do the planar images here resonate at frequencies corresponding to their size and shape.

Engineers in the field of microwave circuits are familiar with the ways in which the form of a circuit affects its function. They have developed a number of archetypal designs for circuit components. The behavior of these standard figures can be mathematically analyzed or simulated using computers [1]. I have taken these archetypal designs as starting points in the design of my circuits. However, I have introduced digitized photographs and architectural drawings into the circuit fabrication process. The pictorial images take the place of the CAD (computer-aided design) drawings that typically are used to design a circuit. (Fig. 1).

While the functionality of certain pictorial circuits presents many artistic possibilities, the concept in general interests me as well. Any planar circuit, no matter what its design, responds in its particular way to electronic signals. This frequency response is an inherent, quantitative attribute of the image.

Fig. 1. Jason Fiering, conventional design for a "bandstop" planar microwave filter (left), and my corresponding design for a pictorial microcircuit (right). (© Jason Fiering) The arrows indicate the electric connection points. A bandstop filter suppresses signals within a narrow frequency range while transmitting all others. I fabricated a circuit from the design shown at right, 3.4 cm in length. It shows crude bandstop behavior, suppressing signals around 2.5 GHz.



I fabricate the physical circuits by etching thin films of gold on glass plates, typically no more than a few centimeters in size. I use a photographic process to transfer the images into the circuits from digital film output or directly from negatives. These methods are widely used in the electronics industry.

I am currently developing a site specific installation employing such pictorial microcircuits. Entitled *Traces and Spaces,* it appeared during summer 2000 in the Graz 2000 exhibition [2] in Austria.

References

1. See for example David M. Pozar, *Microwave Engineering* (New York: John Wiley & Sons, 1998).

2. For more information see <http://www.comm.gr2000az.at>.