

# Second-opinion software

Professor at SCSU, with Mayo Clinic's help, develops neural net that helps diagnose breast tumors

By Amy Becker  
TIMES STAFF WRITER

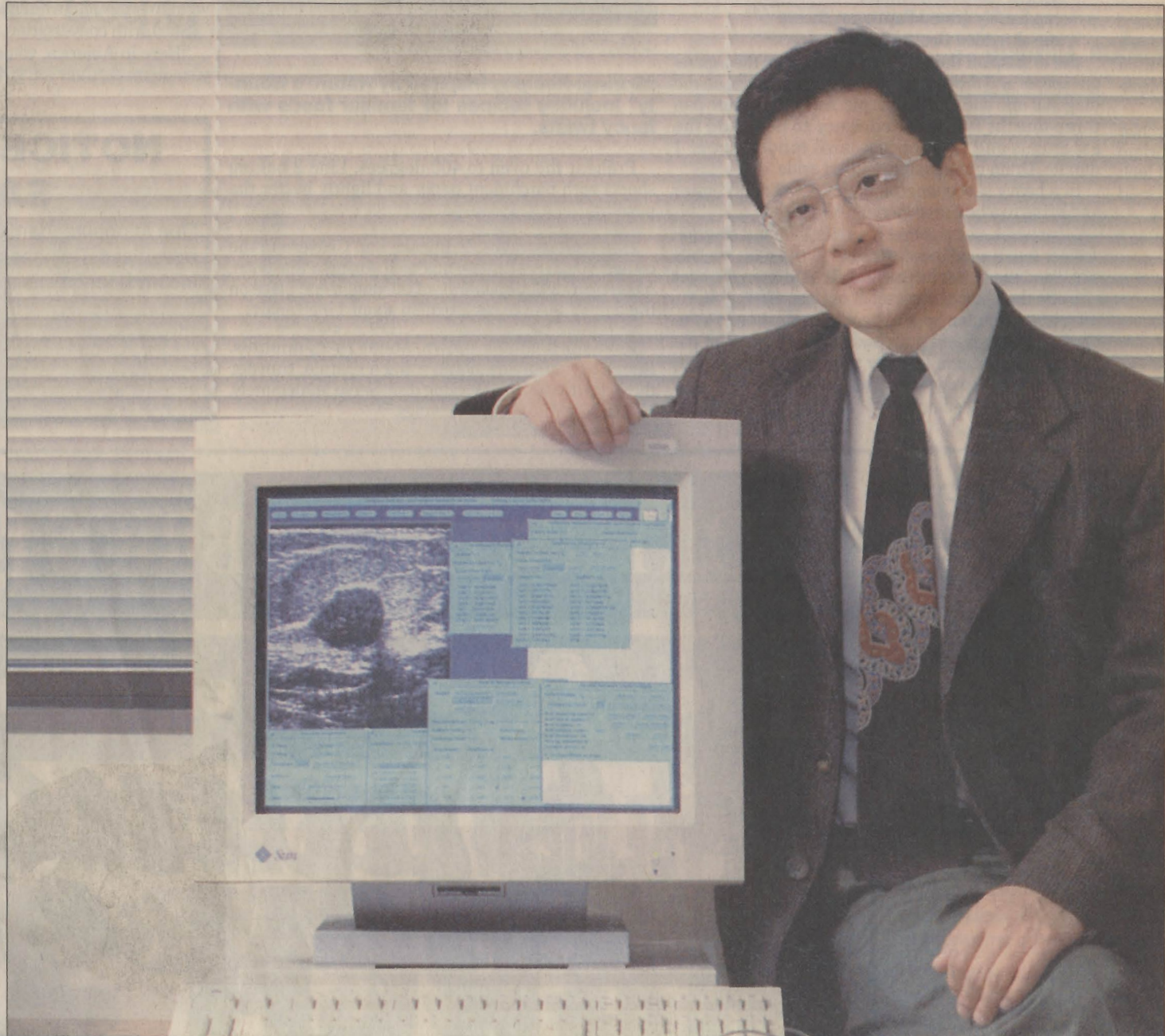
A St. Cloud State University professor and his research partners have developed software they say could save some women from unnecessary biopsies to determine whether they have breast cancer.

Yi Zheng, an electrical engineering professor at St. Cloud State, has been working with two doctors from the Mayo Clinic to study this smart software. The program essentially has been trained to differentiate between malignant and benign breast tumors on ultrasound images.

The three men revised their research paper in January. Their research will be published in the next two months in the International Symposium on Medical Imaging's 1997 conference journal. It is also being peer-reviewed. And Mayo Clinic staff are considering working with companies to market the program. The project was funded by the Mayo Foundation.

Called an artificial neural net, the software is designed to mimic the human brain, explained Dr. Jim Greenleaf, a professor of biophysics in the physiology and biophysics department at the Mayo Medical School in Rochester. Greenleaf and Zheng worked with Dr. John Gisvold in the Mayo Clinic's diagnostic radiology department on this three-year research project.

Translated into real-life terms, this software could mean fewer women have to go through the frightening, time-consuming process of having a biopsy performed. It is intended to diagnose tumors so fewer women would have to have biopsies to show their tumors are benign. It could save money on costly biopsies and trauma for patients.



## Training the computer's 'brain'

Although the three layers of "neurons" in the program are far more simplistic than the human brain, it works well, Greenleaf said. It succeeds because it has brain-like flexibility not found in many computer programs.

"The thing about this is that it is trainable," Greenleaf said.

"It's very similar to our brains," Zheng explained. "(In humans) part of the neurons are used to remember music, Parts of our brain will remember mathematics." In the case of this computer program, it remembers ways to analyze the characteristics of tumors.

"We train radiologists to look at all kinds of different ultrasound images and tell them this is benign and this is malignant. We can do the same thing to the neural network (of the computer) and it will extract the pattern for the features for malignant and benign," Zheng said.

"Later if we give an unknown image to the neural network, it will utilize its past experience to make a judgment. It's similar, in some sense, to the way we train radiologists," he said.

The concept of a neural net in medicine isn't new. The push toward artificial intelligence has prompted trends in medical diagnosis. It has been used to help diagnose patients who complain of chest pain in trauma centers, and its application in breast cancer has been studied before. There was a previous Mayo Clinic study, and another by a university. This study, however, is the first to use so many patients — 102 women — and the first to have consistent data through the use of one kind of ultrasound machine.

"Ultrasound exams are a very important tool for breast cancer diagnosis," Zheng said. The technology is particularly effective in soft-tissue imaging and doesn't have side effects when

TIMES PHOTO BY PAUL MIDDLESTAEDT

**St. Cloud State University electrical engineering professor Yi Zheng has helped to develop a computer program that may prevent women from having unnecessary breast biopsies when being tested for breast cancer. Zheng, in**

## Health

used properly.

In the group of women tracked for this study, roughly 10 percent of positive ultrasounds required an excisional biopsy, which has its drawbacks, Zheng said.

"It is expensive and it causes a lot of emotional distress for women," he said. Ideally, there would be a way to diagnose a tumor without going into the breast.

## Offering an extra set of eyes

The researchers are optimistic the neural net software can act as a second set of eyes for radiologists.

"Human eyes are very good, but they're not so good they can reliably recognize a subtle change in pattern. But the computer reliably can perform that task," Zheng said. "Because the computer can see some details that you can't see."

Such a program could be particularly helpful for radiologists who don't specialize in breast tumors, Greenleaf said.

"Neural nets have been shown to beat the average person, whether it's running a winery or a power grid. They can't beat the super experts yet, but they can beat the average Joe,"

he said.

And it has proven itself to be accurate.

"We found it (the program) was very robust," Greenleaf said. "In no case did it tell us to not biopsy a positive."

In the lingo of the report: Results indicate 40 of the 68 negative biopsies from patients who were scanned with ultrasound could have been eliminated without any false-negatives, giving a high specificity (59 percent), with 100 percent sensitivity. This implies that 59 percent of the negative biopsies (about 40 percent of all biopsies) could be eliminated with guidance from this system.

That means using this artificial neural net on ultrasound images could prevent unnecessary biopsies, he said.

Depending on what happens if it is sold commercially, the program could run on a personal computer. This means if a doctor has a patient with a palpable lump on her breast, the doctor could scan the image into the program for a fairly expert second opinion.

"It would give its opinion," Greenleaf said. "If the radiologist agreed with that opinion, they'd go with that."

However, there are factors that require a human approach. A history of breast cancer in a woman's family would mean she's more likely to need a biopsy.

**conjunction with two doctors from the Mayo Clinic, designed the neural net program to distinguish between malignant and benign tumors on ultrasound.**

## Cutting down the fear factor

A technology that could safely reduce the number of unnecessary biopsies could be a boon to women, a local radiologist said.

There are several ways to take a biopsy, said Dr. Tereasa Simonson, chief of radiology for Regional Diagnostic Radiology at St. Cloud Hospital. Needle biopsies, for example, require local anesthesia and usually aren't very painful.

The emotional trauma is a taller hurdle.

"The main thing the patient faces is the fear of cancer, which is an overwhelming fear," Simonson said.

Helping people allay such fears is the main reason Zheng has chosen to apply his engineering skills to the world of medicine.

Although this project took about three years to complete, Zheng has been involved with the Mayo for about six years. He spends one day a week on research there, with support from his department at St. Cloud State.

Despite the difficulties inherent in medical research, Zheng said he prefers be involved in health care. His wife is a physician, which may also boost his interest in and understanding of the field. Zheng said it comes down to the possibility that his research can help people.

"I feel happy to improve the quality of life, to contribute to society. Involvement in health care is a direct contribution," he said.