

Less is more in cancer imaging

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A team led by fifth-year Rice graduate student Guoping Chang uses an amplitude gating technique that gives physicians a clearer picture of how tumors are responding to treatment Credit: Jeff Fitlow/Rice University

When one diagnoses a cancer patient, it's important to gather as much information about that person as possible. But who would have thought an accurate diagnosis would depend on throwing some of that information away?

That's key to the technique employed by researchers at Rice University and the University of Texas M.D. Anderson [Cancer](#) Center as they bolster the efficiency of scanners that find and track lung and thoracic tumors.

In a paper published last month in *The Journal of Nuclear Medicine*, a team led by fifth-year Rice graduate student Guoping Chang described an amplitude gating technique that gives physicians a clearer picture of how tumors are responding to treatment.

Chang's technique works in conjunction with PET/CT scanners, commonly used devices that combine two technologies into a single unit.

CT (computed tomography) scanners capture a three-dimensional image of the inside of the body. PET (positron emission tomography) scanners look for a radioactive signature. Before a [PET scan](#), a patient is injected with slightly radioactive molecules tagged to track and adhere to particular [cancer cells](#). As the molecules gather at those cells and decay, they give off a signal that the PET scanner can read.

Together, the scanners give physicians a good idea of a tumor's location and whether it's malignant or benign. Subsequent scans can show how it's responding to treatment.

But there's a problem. While CT scans take relatively quick snapshots, PET scanners need as long as three minutes to capture an image from a single section of the body. Because patients have to breathe, the images don't always correlate well.

"Patients might have lesions located in organs that move due to respiratory motion," said Chang's technical adviser, Osama Mawlawi, an associate professor in the Department of Imaging Physics at M.D. Anderson and an adjunct lecturer in electrical and computer engineering at Rice. "When patients breathe, these lesions will be blurred."

Since physicians can't ask patients to stop breathing for three minutes, Chang found a way to turn a patient's respiratory motion - the amplitude - into a waveform that serves as a kind of time code.

In the new method, patients are fitted with a flexible band around the chest that records their breathing cycles during the CT scan -- the three-dimensional X-ray taken as the patient slides through the ring-shaped device.

During the subsequent, much longer PET scan, the program creates a "gate," which allows data for specific points in the breathing cycle to pass through and throws away the rest. The program automatically correlates that data to the CT images.

A patient may take 40 breaths during those three minutes. Combining 40 images from a specific point in the breathing cycle - say, mid-breath - makes for a much sharper image because the tumor will be in pretty much the same spot.

Even better, Mawlawi said, the radiological signal captured by the "gated" PET scan is more coherent. "One of the important aspects of PET imaging is that it can tell us how malignant a lesion is," he said. "The scan gives us a specific number which is correlated with the measured signal intensity; the more accurate this number is, the better the physician's assessment is of a lesion's malignancy and response to treatment."

When someone undergoing therapy is scanned again, he said, "the change in signal intensity - not just the size of the lesion - tells us whether the patient is responding or not. This is equally important to the quality of the image."

In tests on 13 volunteer patients at M.D. Anderson, information gathered using the technique on 21 tumors was significantly better with Chang's gated technique than without, the paper shows. Patients were not required to modify their breathing in any way, Chang said; this enabled them to be as comfortable as possible during the scan.

Chang, who earned his bachelor's degree in space physics at Beijing University in his native China, expects to defend his dissertation based on his imaging work in March. He became interested in the project shortly after joining Rice's Department of Electrical and Computer Engineering, where Professor John Clark is his academic adviser.

"Being able to image with good resolution means you might be able to catch a small tumor very early," Clark said. "It's a good piece of work."

"It can save people's lives," Chang said. "That's what I want."

More information: The paper is available online at tinyurl.com/yfno2j5.

Provided by Rice University

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