Math prof working on new ways to see through the human body

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Thanks to medical imaging techniques such as X-ray CT, ultrasound imaging and MRI, doctors have long been able to see to varying degrees what's going on inside a patient's body, and now a Texas A&M University mathematician is trying to find new and better ways to do so.

The professor, Peter Kuchment, a leading researcher in mathematical techniques for medical imaging, says the research may enhance the process for detecting cancer and many other diseases.

When talking about medical imaging, most people know that physics and computer sciences are involved, but few may be aware that mathematics is indispensable. Indeed, many imaging methods are based on mathematical analysis.

A scanner produces large amounts of data, but no picture. Complicated mathematical techniques are needed to analyze these data and finally produce pictures or 3D images that aid doctors in diagnostics.

For example, an X-ray beam's strength changes less when it goes through a layer of fat than when it goes through a bone. Mathematicians can use the change to figure out what is inside the patient's body, Kuchment says.

"Various medical imaging methods work in this way," the Texas A&M professor explains. "But besides X-rays, we can also use ultrasound, light, electrical currents, microwaves, etc. Instead of one beam or wave,

we use a large number of them."

Kuchment has received a grant from the National Science Foundation to work out the mathematical tools for new and more powerful medical imaging methods.

"Safety, cost, contrast and resolution are some of the criteria to select good imaging methods," Kuchment adds. "But none of the currently available methods is perfect and they all have limitations."

Kuchment sees promise in what he calls "hybrid medical imaging methods," and photoacoustic imaging, a combination of electromagnetic and ultrasound waves, is one of them.

"Microwave or a laser beam can give you perfect contrast so you can easily tell the difference between a tumor and healthy tissue, but you cannot resolve small details," he explains. "Ultrasound, on the other hand, can show small things, but it cannot tell the differences well."

Photoacoustic imaging combines electromagnetic and ultrasound waves, so doctors will be able to see small details as well as differences between healthy and cancerous tissues, he adds.

These hybrid imaging methods require complicated mathematical tools, and Kuchment is working on developing them.

Provided by Texas A&M University