Thinking OUTSIDE THE BOX

When exceptional researchers see the need for better techniques, they go beyond [their usual areas of expertise] to find answers. Sometimes those answers are found by combining unrelated and unusual bits of technology. In the case of Dr. Guang Jia, associate professor of physics, and Joseph "Joe" Steiner, a Ph.D. candidate who works with Jia, they pulled together radiation technologies, processes, and equipment from a variety of areas in medical physics to arrive at a better diagnostic tool for early detection of prostate cancer.

Dr. Guang Jia, left, and Ph.D candidate Joseph Steiner demonstrate the diagnostic apparatus that they developed.

Both Jia and Steiner recognized the deficiencies in standard prostate cancer diagnostic tools: False positives with PSA tests are in the range of eighty percent; digital rectal exams cannot provide definitive results; though CT scans yield high resolution images, they cannot differentiate soft tissue; and though MRI images can differentiate soft tissue, they have low sensitivity and low resolution and are noisy and slow. Since no one device or technique is ideal for diagnosing prostate cancer, Jia had the idea to combine several devices and techniques to create a new, more sensitive method.

Jia was aware that using MRI imaging with an endorectal coil improves resolution, and he and Steiner wondered if using an endorectal detector with the CT platform would provide even better resolution. They were also familiar with digital breast tomosynthesis, which uses low-dose x-ray projections over a limited range to produce pseudo three-dimensional images. The final piece of their puzzle was to find an additional sensor small enough to fit under the usually walnut-sized prostate to use with the endorectal probe; that small sensor was a dental x-ray plate, the same type used in many dentists' offices for oral x-rays. Finally, using iodine as a contrasting agent provides for better contrast.

Using these parts of existing technologies together enhances the benefits of each and ameliorates the down sides. With the device proposed by Jia and Steiner, resolution is ten times higher than using CT imaging alone. While the device is still in the prototype phase, tests using a phantom have yielded amazing results, potentially for both diagnosis and post-treatment imaging of brachytherapy seeds. The device could also be used to detect recurrent tumors that may be suspected when the patient has rising PSA results several years after the prostate has been removed. Using a kumquat to represent the prostate and a Styrofoam plug embedded with brachytherapy seeds, Jia and Steiner imaged their test phantoms using standard CT equipment and using their proposed technique. The contrast in resolution is stark. Structures that are only shadows or not visible at all appear clearly in the experimental images; the brachytherapy seeds, which are barely detectable in the standard images are brilliantly illuminated in the experimental ones.

This new detection method has the potential to advance the diagnostic protocols for prostate cancer and prevent needless additional testing and possibly unnecessary and drastic treatment. Biopsies, which present a significant risk to patients, would be prevented. Surgeries and unnecessary radiation therapy would be avoided. And perhaps equally important, patients would be saved from the anxiety of false positives – not knowing whether they actually have cancer or not and, even if cancer is detected, not knowing where the tumor lies, how aggressively it is growing (most prostate cancer is slow-growing), or which treatment option is best for an individual patient.

Combining these four technologies – the endorectal probe system from MRI, the CT platform, digital tomosynthesis, and the dental x-ray sensor – to create a completely new process is one of the remarkable aspects of research in a university environment. Jia attributes educating his to his ability to bring

Dr. Charles M. Smith, right, visits with recipients of his gift to the medical physics program, from left, Dr. Wayne Newhauser who holds the Dr. Charles M. Smith Professorship in Medical Physics; Andrew Halloran (2011 BACH SCI, 2015 MAST SCI); and Lydia Wilson Jagetic, a current graduate student in the program.

these technologies together to solve problems. They bring fresh ideas and new perspectives into the classroom, and Jia accepts the challenge to keep abreast of the technology in his field so that he can provide them with the best instruction possible. "Teaching has helped me think of various modalities," he explained. "Our students are the best! Take Joe [Steiner] for example. I give him the basic idea, and he can complete it by ninety percent without anything more from me."

Steiner graduated with a degree in physics from SUNY-Buffalo and subsequently worked in a position that required knowledge of mechanical engineering. This position gave him the opportunity to solve problems creatively and to design new equipment. The job also helped him understand that he needed something more. He discovered that, while physics seemed too theoretical, engineering was a little too applied for his taste, so he looked for graduate degree programs that would give him a little of both theory and application. "Medical physics is a happy medium," he commented. "It gives me the opportunity to work with theory to develop applications, and that works for me." Steiner's experience with machining to create tools from new designs fits very well with his research with Jia.

Jia received his Ph.D. from Ohio State University and is an ABR-certified diagnostic medical physicist. Jia has several years of experience in working with prostate cancer imaging as well as with joint cartilage imaging. His research at LSU and Mary Bird Perkins with improving diagnostic techniques for prostate cancer is yielding results with the development of a new device and technique. The research combines concepts and technology from at least four very different areas to address the issue of false positives with prostate-specific antigen (PSA) tests and digital rectal exams (DRE). His previous experience working with urologists and radiation oncologists led him to the understanding that diagnosticians needed a more sensitive device for detecting cancer in the prostate.

Jia also cites the cooperation among units at LSU that have aided his research and understanding of how other fields impact his own. For example, Fakhri al-Bagdadi, associate professor in the LSU School of Veterinary Medicine, has provided animal prostates to help the researchers have a better understanding of the anatomical structures they will be imaging, and Alumni Professor of Biological Sciences Dominique Homberger has given Jia insight regarding 3-D imaging of human anatomical structures. Jia and Steiner both work not only on the main LSU campus and at MBPCC but also at Pennington Biomedical Research Center, where they collaborate on additional research.

Jia is also sold on the partnership that LSU enjoys with Mary Bird Perkins Cancer Center and on the medical physics program itself. "Where I came from, the academic ranking is higher than that of LSU, but they don't have a medical physics program," he said. "Also, Mary Bird Perkins has a residency program that provides our own students with opportunity. Those things were very important in my decision to come to LSU."

Making A Difference:

GIVING BACK TO SAVE LIVES

DR. CHARLES M. SMITH

(1951 BACH H&SS, 1955 MD-NO) practiced family medicine for thirty-five years in Sulphur, La. "I liked all aspects of medicine and chose not to specialize in a particular area. When I started, I practiced everything from pediatrics to geriatrics – delivering babies, making house calls, even treating chemical dependency.

"After I retired, I had a tumor that could have cost me my life. The radiation, chemotherapy, and cancer treatment saved my life. Supporting the medical physics program at LSU is a way of giving back. Because of the wonderful relationship between the College of Science and Mary Bird Perkins Cancer Center, the medical physics program has really bloomed into the creation of a state-of-the-art training facility, and with their new physical plant, the community, the region, and the state will benefit. They're educating and training medical physicists, but the scope of this collaboration is much broader than I initially thought and has far exceeded my expectations. We're on the cusp of curing a lot of tumors.

"Whether they contribute to the medical physics program or some other worthwhile effort, I hope other alumni will choose to give back to the University. We need more money in support of research. I would like to see alumni take an interest in some area at the University to support, no matter what it is."