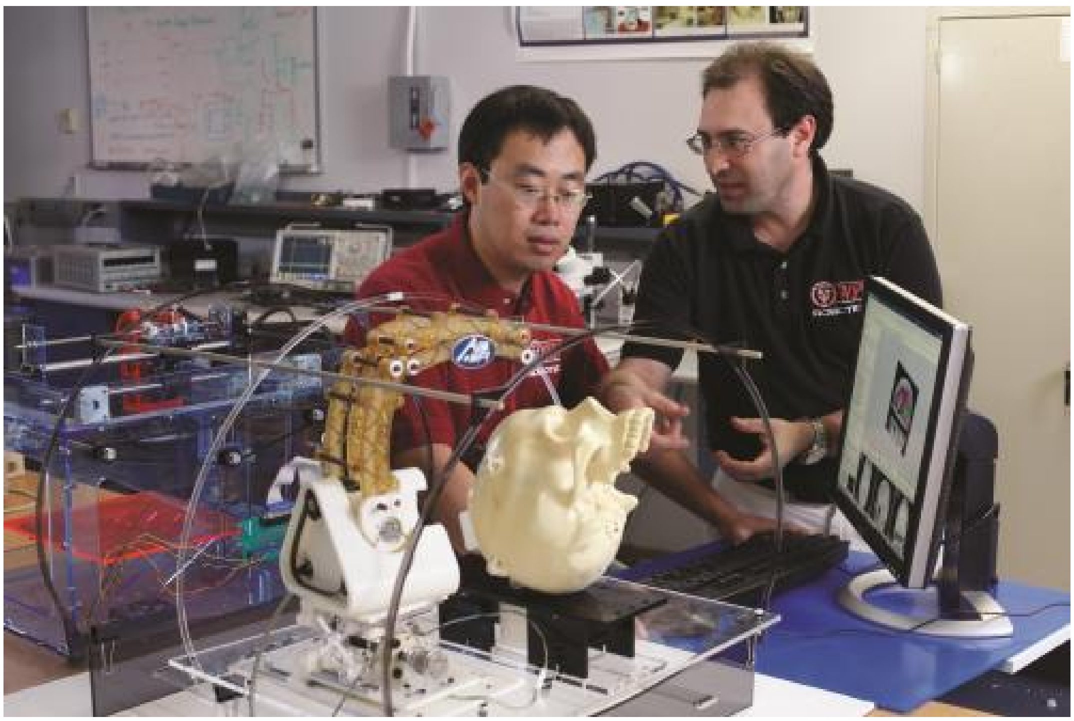
Using a robot to improve brain cancer treatment is aim of new award

August 29 2013

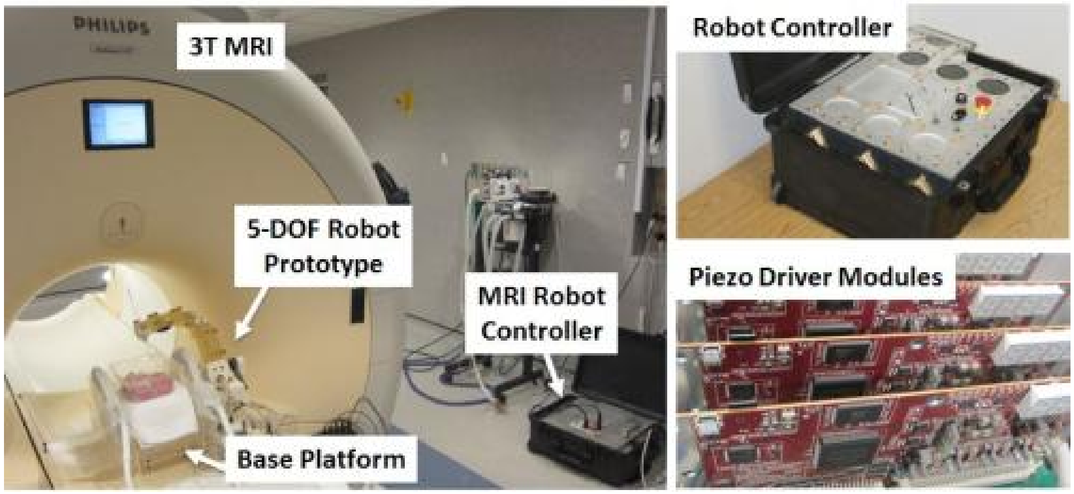


This image shows Gregory Fischer, right, assistant professor of mechanical engineering and robotics engineering at Worcester Polytechnic Institute (WPI) and director of WPI's Automation and Interventional Medicine (AIM) Laboratory, and Ph.D. candidate Hao Su with a robot designed to implant electrodes for deep-brain stimulation while inside an MRI scanner. Credit: Worcester Polytechnic Institute

With a five-year, $3 million R01 award from the National Institutes of Health (NIH), through the National Cancer Institute (NCI), a team of researchers led by Gregory Fischer, PhD, assistant professor of mechanical engineering and robotics engineering at Worcester Polytechnic Institute (WPI) and director of WPI's Automation and Interventional Medicine (AIM) Laboratory, will test a new, minimally invasive approach to treating brain tumors that promises to accurately destroy malignant tissue while leaving surrounding tissue unaffected. This approach would be a significant improvement over current treatments.

"This significant, highly competitive award from the National Institutes of Health is not only recognition for the pioneering contributions to MRI-guided robotic surgery being made by Professor Fischer and his team, but it has the potential to pave the way for more effective therapies for cancers of the brain and other organs," said WPI Provost Eric Overström, PhD. "This award is also a powerful illustration of the major advances in medicine that can be realized through collaborations between engineers and clinicians."

The system will use a robot designed to work within the bore of an MRI (magnetic resonance imaging) scanner to precisely guide a probe through a dime-sized opening in the cranium to the tumor with the aid of real-time MRI images. The probe will destroy the tumor by heating it with interstitial high-intensity focused ultrasound (iHIFU). Developed by industry collaborator Acoustics MedSystems Inc., the device can emit ultrasound energy in a highly directional manner so only malignant tissue is heated, even with irregularly shaped deep-brain tumors. When guided by live MRI images, using a novel robotic manipulator developed by Fischer's lab and specially designed MRI coils developed by Reinhold Ludwig, PhD, professor of electrical and computer engineering at WPI, the probe will be able to accurately target the tumor.



This illustration shows components of the MRI-guided robotics system being developed at Worcester Polytechnic Institute (WPI) for surgical treatment of brain tumors. In the photo at left are the MRI-compatible robot and platform and a modular robot control unit. At left is a close-up of the control unit and boards within the controller that drive piezoelectric motors in the robot. Credit: AIM Lab, Worcester Polytechnic Institute

"For surgeries that require precise knowledge of the location of structures and tumors in the body, real-time MRI imagery is invaluable," Fischer said. "Once a hole is made in the skull, for example, the brain may swell and shift, and even images acquired just prior to the surgery will no longer be accurate. Live images enable real-time control and a high degree of accuracy."

Currently, patients diagnosed with brain tumors typically face one of two courses of treatment, both of which have important limitations. Stereotactic radiation surgery, in which a radiation beam is focused on the tumor, is noninvasive and can increase survival, but it may take multiple treatments to relieve symptoms and it is difficult to confirm that the tumor has been destroyed. Open-brain surgery provides quick relief of symptoms and tissue samples for lab testing, but it is highly invasive and can lead to serious complications.

Julie Pilitsis, MD, PhD, associate professor of surgery in the division of neurosurgery at Albany Medical College, will serve as the lead clinical advisor for the research. A neurosurgeon specializing in deep-brain stimulation, Dr. Pilitsis was formerly director of functional neurosurgery at the University of Massachusetts Medical School. Co-investigators on the current project are Matthew Gounis, PhD, associate professor and co-director of the Advanced MR Imaging Center at UMass Medical School, and Everette Burdette, PhD, president and CEO of Acoustic MedSystems.

Acoustic MedSystems will develop the MRI-compatible ablation device and software to help guide and control it. The device will have tiny sensors that will enable doctors to precisely track its position in real-time MRI images and an array of ultrasound emitters that will permit the zone of penetration of ultrasound to be adjusted to match the shape of the tumor as it appears in the live images. "The combination of guidance by real-time imagery and a conformable ablation zone will result in a significant step forward in the accuracy and success of ablation therapy," Fischer said. "While our focus now is on brain tumors, we believe this technology will have applications in treating cancers in other organs, as well."

The team at UMass Medical School will bring their expertise in MRI imagery to the research and will also coordinate and conduct clinical tests of the robotic ablation system. Fischer's team will develop a new robotic device specifically designed to manipulate and deliver the ablation tool to the proper location in the brain under live MRI guidance. The ablative therapy will then be performed with live MR thermal imaging (MRI scanners are able to detect temperature changes in tissues). The ultrasound energy produced by the tool will heat surrounding tissue sufficiently to destroy it; MR thermal imaging will be used to monitor which tissues are being heated and enable physicians to interactively adjust the output of the ultrasound tool to assure that the proper thermal dose is delivered.

"MRI is an excellent imaging modality for many conditions," Fischer said, "but to date there has been limited success in harnessing this modality for the guidance of interventional procedures. With this award from the NIH, we believe we will be able to develop a new approach and new technology that will effectively harness the power of MRI to improve the treatment of brain cancer."

Provided by Worcester Polytechnic Institute

Citation: Using a robot to improve brain cancer treatment is aim of new award (2013, August 29) retrieved 25 April 2024 from
https://medicalxpress.com/news/2013-08-robot-brain-cancer-treatment-aim.html