Bankhead-Coley Cancer Research Program

Meeks, Sanford

Department of Radiation Physics

M.D. Anderson Cancer Center, Orlando

2006 Program
Shared Instrument Grant
(1-year project)

Project Title: Calypso 4D Localization System for Real-Time Tumor Tracking

Project Summary: Knowledge of the location of a tumor is critical during external-beam radiation therapy to optimize therapy and minimize complications. This requirement applies especially to emerging radiation-therapy techniques that require high-precision therapy. Multiple factors affect the location of a radiation target, including daily internal variations caused by changes that occur between treatment days (interfraction variations) and changes that occur while the patient is on the table (intrafractional changes). Numerous investigators have demonstrated that targets such as the prostate, focal liver tumors, and lung tumors move with respect to traditional positioning methods that use the skin or skeleton as references. This motion can be up to 2 cm and can compromise the ability to deliver a curative dose of radiation. Systems to localize and track the internal anatomy using implanted markers have demonstrated effectiveness. These systems require the use of additional regional irradiation of the patient to permit visualization. Pretreatment localization using ultrasound or CT imaging has also been demonstrated, although current systems are unsuited for continuous patient monitoring during treatment. Systems that monitor external references have also been described, but it is not clear that the external surface motion always correlates directly with the motion of the internal target. The Calypso® 4D Localization System is an innovative target localization platform based on detection of wireless electromagnetic markers, called Beacon® transponders. The Beacon transponders, which are smaller than a grain of rice, are implanted in or near the treatment site. When used with the Calypso 4D Localization System, Beacon transponders send signals indicating the target's position relative to its desired position. After the patient is positioned appropriately, the target position can then be monitored at a rate of 10 times/second during the entire treatment procedure. Any misalignment of the treatment target can be detected by Calypso Medical's proprietary algorithm that identifies sub-millimeter shifts of the target from its prescribed location anytime throughout the treatment. M. D. Anderson Cancer Center Orlando was one of five sites to participate in clinical trials testing a prototype Calypso system for use in prostate cancer patients. Now that the system is FDA-cleared for use in prostate cancer patients, M. D. Anderson Orlando researchers will use the Calypso system for translational research on a) interfaces between the Calypso system and treatment delivery devices, b) development and pre-clinical testing of lung-tumor targeting using the Calypso system, c) real-time dosimetry based on patient motion tracks from Calypso monitoring, and d) clinical trials using the Calypso system for the treatment of lung tumors, prostate cancer, breast cancer, and spinal tumors. Additionally, researchers from the Optical Diagnostics and Applications Laboratory at the University of Central Florida will use the system for validation of their virtual reality models that predict tumor motion.