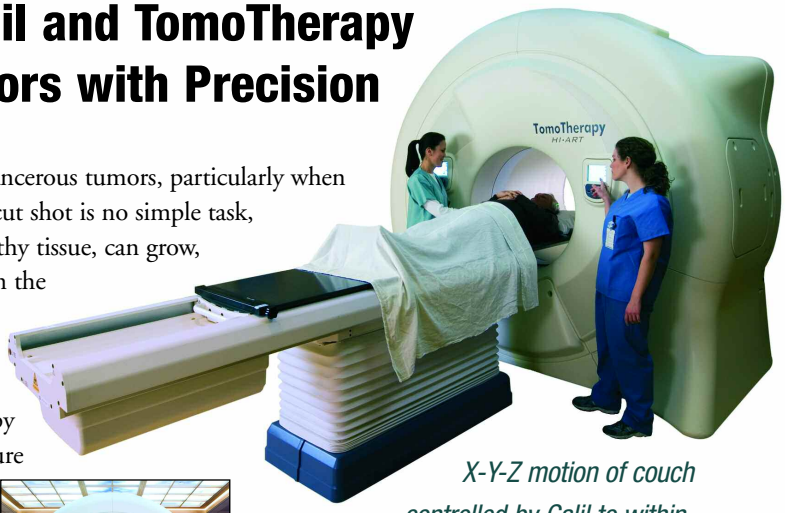
TomoTherapy, Inc.

Galil and TomoTherapy Target Cancerous Tumors with Precision



X-Y-Z motion of couch controlled by Galil to within +/- 1mm accuracy.

Focused radiation is an effective means for treating cancerous tumors, particularly when there is a clear-cut shot at the target. Getting a clear-cut shot is no simple task, especially since the target is often surrounded by healthy tissue, can grow, shrink or shift over time, and is affected by changes in the patient's anatomy.

To address this challenge for clinicians, TomoTherapy Incorporated of Madison, WI, developed its Hi·Art® treatment system, a radiation therapy device that effectively utilizes 3D CT imaging to ensure accurate treatments for patients on a daily basis.

Graham Reitz, Research Engineer, says "Most cancer centers and solution providers now know the need for image guidance. Our co-founders, Rock Mackie and Paul Reckwerdt, understood this need first. They got together 17 years ago at the University of Wisconsin and decided to mount the linear accelerator of the Hi·Art® treatment system on a ring gantry. This allowed for helical fan-beam delivery of IMRT, with integrated megavoltage CT imaging. The advance lets clinicians better focus radiation beams, and treat the most complex cases."

Essentially, the patient lays on a table or couch that slides into the rotating gantry for continuous 360° delivery of helical IMRT that uses tens of thousands of narrow beamlets, all targeting the tumor and individually-optimized to contribute to the total tumor dose. Handling the x-y-z motion of the couch is Galil Motion Control's integrated DMC-2153 5-axis controller. It places the table to within +/- 1 mm accuracy, and TomoTherapy is moving toward sub-millimeter accuracy in future models.

"We considered several motion controllers for the Hi·Art® system and Galil's controller met our requirements for its Ethernet-based control of stepper and servo motors, ability to multitask, SSI feedback capability and robust programming language," added Reitz. "It also had to be small enough to fit in our very small, allowed space."

Galil's PID Compensation feature controls the Z-axis for handling the "Up/Down" motion of the couch. An integrated motor and stepper driver work in concert with the DMC-2153 to control the Y-axis for moving the couch in and out of the bore, and the X-axis for right/left lateral movements. The DMC-2153 controller also accepts two forms of feedback, incremental and SSI absolute, to "double check" and maintain the couch position should there be any disruption due to power loss, and to ensure precise synchronization of the x-y axis.

Reitz adds, "Along with integrated CT guidance, the two key differentiators of our systems over conventional systems are the ring gantry design for helical delivery, and our binary multi-leaf collimator for beam shaping and modulation." He explains that since the width of the helical fan-beam IMRT projected to the axis is 40 cm, and that maximum couch length is 160 cm, very large volumes can be treated in a single, simple set-up. In fact, it is possible to treat anywhere within a cylindrical volume 40 cm in diameter by 160 cm long. Even larger diameter volumes can be treated with a reduced number of beams.

Typically, tens of thousands of beamlets are included in a precisely-optimized Hi·Art® system treatment fraction. A single beamlet corresponds to the radiation emitted through an open leaf of the Hi·Art® treatment system's patented Multi-Leaf Collimator (MLC) with the gantry at any given angle, during any given rotation. The need for a large number of beam angles to achieve a highly-conformal dose distribution is much like the need for a large number of image projection angles in CT imaging.

To accommodate TomoTherapy's needs, Reitz says Galil customized the controller so it could easily accept all of the SSI devices for feedback. "We used lots of the I/O provided for various tasks, like machine shutdown, clutch status, and emergency stops. It also sends signals to its embedded computer to perform motion calculations while our system's Linux computer calculates, coordinates and talks directly to the Galil controller to provide redundancy and increased safety. ■

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