Numerical Optimization

New “inverse planning” system improves brachytherapy treatment for prostate and other cancers.

By John Toon

A California medical software company has launched the first “inverse planning” system for helping cancer treatment specialists optimize the placement of radioactive seeds used in brachytherapy. Optimization improves the treatment by helping meet physician-set constraints for consistent radiation doses to tumor cells — while minimizing effects on nearby structures.

Used for treating prostate cancer and other forms of the disease, the new system is based on complex numerical optimization algorithms licensed from the Georgia Institute of Technology. Beyond improving the overall treatment, the new system dramatically reduces the time required for planning the seed placement.

The Panther™ Brachy InversePlan system, announced by Prowess Inc. at the annual meeting of the American Society for Therapeutic Radiology and Oncology in November 2006, improves local tumor control by more consistently focusing radiation while reducing the number of radioactive seeds and needles used. Because the treatment planning can now be done in less than a minute — compared to hours with older systems — planning can be done just before seed implantation. That eliminates an extra clinical visit and ensures that the plan is based on the dimensions of the tumor and organ at the time of implantation.

“From the clinical side, this is a significant advance in being able to treat prostate cancer with fewer side effects, while providing better local tumor control,” says Eva Lee, a mathematician and associate professor in Georgia Tech’s Stewart School of Industrial and Systems Engineering. “From the clinician’s point of view, this will allow physicians to prescribe how they want the radiation to be applied, and the system will produce an optimized plan to do that. The system will produce a better outcome, reduce the amount of time required to design the plan and allow patients to recover more quickly.”

The optimization algorithms developed by Lee and colleague Marco Zaider at the Sloan-Kettering Cancer Center in New York account for numerous factors, including the dose provided by each radioactive seed, shape of the organ being treated, location of tumor cells within the organ, location of critical structures for which radiation dose should be limited, sensitivity of tissues to radiation and expected shrinkage of the organ after treatment. The goals are to provide consistent tumor-killing radiation doses to the tumor cells while limiting potentially damaging doses to nearby critical structures, such as the urethra, bladder and rectum.

Earlier computer-aided techniques for determining the best locations to place the seeds required many hours of planning and could not optimize for doses specified by physicians. Because so much time was required to plan the treatment, patients had to make two clinic visits — one to obtain information for planning the treatment and a second to actually implant the seeds.

Since the size and shape of the prostate can change over time, the time between planning and implantation allowed the creation of potential inaccuracies that could reduce the tumor control and cause side effects.

“This system can be used in real time,” says Lee. “The patient can come in, the imaging is done, and we can then do the planning and implantation right away. There is no delay between the imaging, planning and implantation of the seeds.”

Read more at: gtresearchnews.gatech.edu/newsrelease/brachytherapy.htm