Improving radiation therapies for cancer mathematically

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In a paper published in December in the *SIAM Journal on Scientific Computing*, authors Li-Tien Cheng, Bin Dong, Chunhua Men, Xun Jia, and Steve Jiang propose a method to optimize radiation therapy treatments in cancer patients.

Radiation therapy is one of the primary methods used for cancer treatment, along with chemotherapy and surgery. While doses of radiation are delivered to eliminate cancerous tissue, care is taken to keep radiation within acceptable levels so as not to affect neighboring tissues and organs. The most common type of therapy delivers high-energy radiation via a medical linear accelerator mounted on a rotating apparatus to adjust the direction, and a collimator to shape the beam of radiation. In the recently developed volumetric modulated arc therapy (VMAT), beams continuously deliver doses as the delivery device rotates around the patient. Enhancement of radiotherapy treatment is challenged by complexities of shape optimization, due to the mechanics of the equipment involved as well as the apertures of devices delivering the beams of radiation.

In this paper, the authors develop a variational model and associated numerical techniques for optimization of VMAT treatment plans. The method uses CT scans of patients—with important tissues and organs identified by image segmentation algorithms—to create an improved and customized treatment plan by constructing parameters for an optimal dose distribution in VMAT treatment. Mathematical methods such as binary level-set method for shape optimization are used. Tests have

shown improved dose distributions in both model and clinical cases.

More information: Binary Level-Set Shape Optimization Model and Algorithm for Volumetric Modulated Arc Therapy in Radiotherapy Treatment, *SIAM Journal on Scientific Computing*, 35(6), B1321–B1340

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