A Novel High-Efficiency Algorithm for Optimizing Volumetric Modulated Arc Therapy (VMAT) Radiotherapy Treatment Planning

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BACKGROUND

Volumetric modulated arc therapy (VMAT) is a new technique for radiation therapy treatment that provides superior conformal radiation treatment after just one or two arcs of gantry rotation. Compared to currently used intensity modulated radiation therapy (IMRT) techniques, VMAT reduces treatment time and the number of required monitor units. If well-designed, VMAT delivers a more conformal dose to targets and reduces dosage to organs at risk (OARs). However, the currently used optimization algorithms (such as heuristic simulated annealing) for VMAT planning are based on locating a good approximation to the global minimum across a large search space. Unfortunately, this computationally intensive approach typically requires anywhere from thirty to hundreds of minutes of processing time in order to optimize a single treatment plan, thus limiting its wide-spread use in clinical settings.

TECHNOLOGY DESCRIPTION

UC San Diego researchers have developed an advanced aperture-based algorithm that significantly reduces the processing time for VMAT treatment plan optimization, permitting widespread clinical use of VMAT treatment techniques. This invention uses a column generation method that iteratively solves a sub-problem and a master problem efficiently. The sub-problem provides the most promising aperture to add to a given pool of allowable apertures while the master problem optimizes the intensities of selected apertures.

ADVANTAGES

- Much faster optimization (only 5-10 minutes on CPU and 25-30 seconds on GPU) compared to the hours required for existing algorithms.
- Reduces radiation dosage to the organs at risk (OARs) by computing a more conformed treatment volume for the target (compared to IMRT treatment plans).

STATE OF DEVELOPMENT

The planning efficiency and treatment plan quality of this novel VMAT optimization technology have been evaluated using ten clinical prostate or head-and-neck cases.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	9,067,064	06/30/2015	2010-287

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OTHER INFORMATION

CATEGORIZED AS

- **Medical**
  - Diagnostics
  - Disease: Cancer
  - Imaging
  - Research Tools
  - Software

RELATED CASES

2010-287-0, 2009-313-1, 2009-313-2, 2010-047-1, 2010-220-1

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