

VOLUMETRIC MODULATED ARC THERAPY (VMAT): ADVANCED DELIVERY TECHNIQUES FOR STATIC AND MOVING TARGETS

Swetha Oddiraju

Dr. Dharanipathy Rangaraj, Dissertation Supervisor
Dr. Lech Papiez, Dissertation Co-Supervisor
Dr. Sudarshan Loyalka, Dissertation Co-Supervisor

ABSTRACT

Volumetric Modulated Arc Therapy (VMAT) is a rotational radiation therapy which has been used to treat various cancer sites. The continuous delivery of a specific treatment plan for arc therapy can be achieved with multiple solutions for speed of gantry rotation, beam dose rate variation in time and with various speeds of trajectories of MLC leaves. This non uniqueness of arc therapy delivery creates a situation that, given treatment plan can be delivered with arc with variable degrees of efficiency. In this work, we evaluated advanced delivery techniques to improve delivery time and patient safety.

VMAT has gained a lot of interest in the present days because of less treatment time and more conformal dose distribution with single and multiple arcs as compared to intensity modulated radiation therapy (IMRT). In this work we mainly focus on the fundamentals of intensity modulated arc therapy and importantly the single arc version of it. We provide special emphasis on understanding the delivery aspects of the therapy.

The interdependence between several delivery parameters (gantry angular speed, beam dose rate and MLC leaf velocity) in the delivery of VMAT treatment plan for both static and the moving targets has been studied. We described the challenges involved in the VMAT delivery for moving targets, motion model and relation between the delivery parameters. We combined multiple arcs into a single arc to improve delivery efficiency. We also studied the effect of fourth delivery parameter along with gantry speed, dose rate and leaf speed which is the gantry acceleration and included it as a constraint during the delivery. The advanced quality assurance technique for VMAT delivery has been explored. The results have suggested that implementing these advanced delivery techniques has improved the treatment time further.