

**Purpose:**

Rotational IMRT delivery techniques, such as volumetric modulated arc therapy (VMAT), are alternatives to standard IMRT delivery, claiming faster delivery and equally good dose distributions. In reality there is a cost to faster delivery times. The purpose of this investigation is to understand the tradeoff between plan quality and treatment time in rotational delivery by use of optimization models.

**Method and Materials:**

We study a simplified VMAT model for a 2D phantom and construct an exact mixed integer optimization model for it. The model includes treatment time as a constraint, and otherwise does not specify how the delivery is to be done, allowing for either VMAT or IMRT solutions. The model is too large to solve, but we trap the optimal solution between tight upper and lower bounds with additional models. The lower bound solutions are used to warm start the upper bound solutions. We construct Pareto surfaces for the joint tradeoffs of treatment time, tumor maximum dose, and organ at risk mean dose.

**Results:**

Upper bounds are within 10% of lower bound solutions. This allows us to conclusively demonstrate that 1) the treatment time constraint becomes more important when high intensity modulation is required to achieve optimal dose distributions, and 2) finding a good feasible VMAT plan is benefitted (by ~5% in objective value) by warmstarting using the fluence modulation required at each angular location.

**Conclusion:**

For problems where the optimal dose distribution has non-convex iso-dose lines (to avoid nearby critical structures), the high modulation necessary to achieve such plans translates into longer treatment times. In these cases, when allowed treatment time is small, the optimal solutions show fluence being delivered at every angle – VMAT. If treatment time is allowed to be larger, IMRT plans are found to be optimal.