AbstractID: 11393 Title: A new software for Beam Orientation Optimization in Radiation Therapy using Genetic Algorithm

Purpose:
To investigate the effectiveness of the genetic algorithm (GA) for parallel computation and the optimization of beam orientations and beam weights in radiation therapy.

Method and Materials:
A unified platform employing existing open-source software was developed to perform radiation dose calculations, and beam orientation and beam weight optimization on a cluster of computers. This software was tested using several prostate cases. For each case, the set of dose distributions corresponding to each of 72 beams with equally spaced gantry angles were calculated using the VMC++ Monte Carlo algorithm. The GA was then used to optimize the beam angles based on the optimized beam weights/fluence map. The GA's crossover and mutation fractions were varied over several runs.

Results:
The performance of GA in optimizing the beam orientations strongly depended on the crossover and mutation fractions, with an 80% crossover and 20% mutation rate providing the best results. The scores of plans tended to cluster together in later generations. After several generations, in a 3D conformal planning, the best plan provided a 10% improvement compared to a standard four-field clinical plan.

Conclusion:
We have developed a platform for performing dose calculation and beam orientation and beam weight optimization. Evaluations were performed using prostate plans, but may be extended to other cases. The performance of the GA in optimizing the beam orientations depends on the crossover/mutation fraction. For the optimal 80% crossover rate, the clustering of scores for later generations indicates that many beam configurations are good candidates for treatment plans, and they each provide an improvement over a standard plan.

Conflict of Interest (only if applicable):