AbstractID: 13486 Title: Multi-objective Optimization of Beam Orientation and Apertures in Intensity Modulated Radiation Therapy (IMRT)

**Purpose:** The intensity modulated radiation therapy requires to determinate the beam orientation and its apertures (the leave positions of the multi-leaf collimator (MLC)). Inverse planning optimization is a multi-objective optimization problem whose solution is known as Pareto solution set. According to the multi-objective character of inverse planning in IMRT, the multi-objective optimization of beam orientation and its apertures based on Pareto solution set was studied. **Method and Materials:** The clinical requirements for a treatment plan were transformed into a multi-objective optimization problem with multiple constraints, in which the parameters are beam orientation and its apertures. And then the fast and elitist multi-objective Non-dominated Sorting Genetic Algorithm (NSGA-II) was introduced to optimize the problem. For each region of interest – target volume or organ at risk, this study used a "physical" objective function in which the dose delivered to each region in the patient's body was compared directly with a dose distribution prescribed by the physician, or a dose–volume (DV) constraint which typically require that no more than/no less than a specified fraction of volume of a given region receives a dose of higher/Lower than a certain specified level. The aim of NSGA-II based optimization algorithm was to provide a representative set of non-dominated solutions for problems where many conflicting objectives and many constraints need to be considered simultaneously instead of a single solution. **Results:** A clinical example was tested with this method. The results showed that a set of non-dominated solutions that were obtained distributed uniformly, and the corresponding dose distribution of each solution not only approached to the expected dose distribution but also met the dose-volume constraints. **Conclusions:** It was indicated that the clinical requirements were better satisfied by the method and planner could select the optimal treatment plan from the non-dominated solution set.

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