AbstractID: 14134 Title: Multiobjective Evolutionary Algorithm for IMRT Optimization: Development and Clinical Comparisons

Purpose: To evaluate the clinical effectiveness of a multiobjective evolutionary algorithm (MOEA) for IMRT plan generation.

Methods: A MOEA was developed that generates a set of IMRT plans that approximates the clinical Pareto front in a time comparable to current commercial inverse planning systems. The stochastic nature of the algorithm permits the use of any objective function regardless of convexity. Selected plans generated by the MOEA were compared with those generated clinically using a commercial planning system (Pinnacle 8.0, Philips Electronics, N.V.). Cases of head & neck cancer and prostate cancer were planned for IMRT on both systems. MOEA plans were evaluated by comparing their performance in meeting and exceeding objectives used in generating plans using conventional methods. Characteristics of the MOEA-generated solutions were compared using a range of commonly used objective functions.

Results: Results are classified into three groups: (1) establishing the ability of the MOEA to approximate the clinical Pareto front and optimizing speed, (2) evaluating objective functions, and(3) comparing MOEA plans with current clinical IMRT methods. The effect of modifications and different objective functions on the algorithm were judged by assessing the fraction of plans generated with one algorithm that Pareto dominated those of another. Results of Aim (3) showed that plans selected from the MOEA performed better than the commercial algorithm.

Conclusion: IMRT planning is inherently multiobjective and treatment planning decisions should be made using multiobjective systems. We describe an evolutionary algorithm that provides a set of plans that consistently contain multiple plans superior to those achieved using a conventional optimization algorithm and meets clinical requirements for speed and performance. Using mean dose objective for OARs and range objective for targets demonstrated better performance than using EUD.

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