AbstractID: 14507 Title: New Directions and Clinical Applications of Multicriteria Optimization

We report on the first clinical comparisons (10 patients: 5 brain, 5 pancreas) of IMRT planning with a Pareto surface based multi-criteria optimization (MCO) system versus a traditional IMRT inverse planning system. For the MCO system, we use the MCO-IMRT planning module provided by RaySearch Laboratories, and for the traditional planning system we use XiO from CMS. For each patient (5 brain cases, 5 pancreatic cases), the patient is planned and treated with XiO plan as is normally done in our clinic. The planning process was logged however to record treatment planner timing data. The planners were not given any special instructions regarding beam angle selection or optimization formulation, in an attempt to accurately capture the process as done day-to-day in our clinic. In parallel, the patients were planned in the MCO system using a template based recipe. Specifically, all patients were planned with 7 equi-spaced beams (starting from an anterior/posterior beam) and using a pre-defined set of dosimetric optimization objective functions and constraints (we will discuss these templates as well as provide general guidelines for setting up MCO problems). Once the MCO database was computed (an MCO database is a set of Pareto optimal plans that allows the user to navigate through treatment plan possibility space and select the most desirable tradeoff), the physician navigated to the desired plan. The MCO process was also logged.

MCO planning is shown to be far faster than traditional planning, and the reason for this is that the tradeoff decisions are much simpler in the Pareto surface navigation approach. Planning time totaled approximately 15 minutes in the MCO compared with about 2-3 hours for the standard treatment planning. MCO dose distributions were almost always preferred over XiO dose distributions, and otherwise they were considered neither better nor worse. This study provides strong support of the MCO-based approach for IMRT treatment planning, both in terms of plan quality and treatment planning efficiency.

Given the above positive results, we speculate that MCO-based treatment planning will become much more popular over the coming years, and will find its way into proton planning and advanced photon techniques such as VMAT. We will review some future topics including comparing modalities (or beam configurations) with multiple Pareto surfaces, robust MCO for IMPT, and VMAT MCO.

Learning objectives:

1. Understand the workflow and formulation differences between standard IMRT treatment planning and Pareto-surface based planning.
2. Understand how MCO might be used in tomorrow's clinics, and what work needs to be done to make this a reality.