Astroid Optimization

WIth IMRT plans the variety of possible dose distributions is quite large. Typically if a physician does not like an IMRT plan they will request a plan to be re-run. This requires the planner to input new constraints and objectives and a new plan to be run from the beginning of the optimization process. This is a time consuming process. An MCO (Multi Criteria Optimization) approach allows planners and physicians to visualize the the tradeoff between obtaining the required dose to the target volumes while reducing the dose to the OAR's. MCO treatment planning is based on a set of Pareto optimized plans. Pareto surface navigation puts the interactive exploration of dosimetric objectives at the planners and physicians fingertips. For a given plan it is considered optimal if it satisfies all the constraints and none of the objectives can be improved without worsening at least one of the other objectives. In other words the MCO plan cannot be improved in any one objective without worsening another objective. Instead of just creating one plan the ASTROID TPS creates a database of plans that satisfies the treatment planning goals.

Constraints are non-negotiable, the highest priority. They are chosen to limit the range of the Pareto surface. If the *constraints* are too tight there may be no reasonable feasible plans. If the *constraints* are too loose there may too many solutions to approximate. *Objectives* are negotiable, they do not have a hard level that must be obtained. The number *objectives* chosen should be so that all the relevant trade offs will be demonstrated.

Feasibility

After the *constraints* have been entered the user may start the *Feasibility* calculation. The *Feasibility* calculation is based solely on the *constraints* entered. The *Feasibility* calculation will be run to let the user know if there is a feasible plan possible. Using a narrow range of *constraints* may improve the optimizer performance. The *Feasibility* calculation may be an iterative processes in order to get an appropriate plan. In other words the user may need to enter a *constraint*, check the feasibility, then progressively drop the *constraint* and check the *feasibility* until the plan is no longer feasible. The user should start by obtaining a feasible plan utilizing the target *constraints* then add OAR *constraints*.

The user needs to be aware of the *constraints* being set on *Fraction Group* level versus the *Plan* level. It is possible to have a *constraint* set in the *Fraction Group* level so that the whole dose to an OAR is given on one day and not on another. This could happen when there are two *Fraction Groups* and the OAR dose is not split between the two.

Running the Optimizer

The *Objectives* as stated before are negotiable. The user can put *Objectives* on Targets and OAR's. The user can choose to put *Objectives* on structures that they wish to try to guide the dose to or from. The *Objectives* will guide the MCO. *Objectives* may be added all at once. There is no need to place them in any particular order as the MCO will work at finding all solutions so that one *objective* cannot be

improved without worsening another *objective*. As the MCO is trying to find multiple solutions this can be a lengthy process. The MCO takes into consideration the size of the calculation grid, the number of objectives, the number of beams as well as the number of spots. The smaller the calculation grid the longer the MCO will take to find a solution. The larger the number of objectives, beams and spots the longer the optimization process will take

Fix Me! Discuss how to check progress (put in later when progress widget done)

Dose Normalization and Display

Fix Me! Screen shots Absolute vs relative color wash isoline etc Everything on right hand side for dose controls

Navigating the Solutions

Fix Me! screen shots & explanations of sliders meaning of each item on the slider Explain save button on sliders reset button on sliders