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. Astroid eliminates this cycle using a Multi Criteria Optimization (MCO) approach that allows planners and physicians to visualize the tradeoff of target volume coverage vs reduced dose to the OAR's in real time. MCO treatment planning is based on a set of Pareto optimized plans, where a plan is considered Pareto optimal if it satisfies all the constraints and none of the objectives can be improved without worsening at least one of the other objectives. So instead of creating just one plan, Astroid creates a set of optimal plans that satisfies the treatment plan constraints and puts an interactive exploration of dosimetric objectives at the planners and physicians fingertips via a unique, highly intuitive, Pareto surface navigation slider bar system.

Constraints play an important role in the optimization process, as they bound the solution space and ensure your navigation process is focused only on plans that meet your non-negotiable, highest priority dosimetric needs. It should be noted that if the *constraints* are too tight, there may be no feasible plans. However, if the *constraints* are too loose, too many solutions will exist and the navigation will be too broad to provide adequate resolution over the truly clinically useful plans. Therefore care should be taken to ensure appropriate constraints are set, which is facilitated using the Astroid *feasibility* check feature. So while constraints supply hard limits, *objectives* are the negotiable goals, they do not have a hard level that must be obtained, but “pushing” them harder does result in benefit to the patient. The number and type of *objectives* chosen should be such that all the relevant trade offs can be demonstrated and explored.

Feasibility and Constraints

After the *constraints* have been entered, the user may start the *Feasibility* calculation by clicking *calculate* in the *Feasibility* block. The *Feasibility* calculation is based solely on the *constraints* and it should be used to ensure there is a feasible plan possible. The *Feasibility* calculation may be an iterative processes in order to get appropriate constraints established for a particular 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. It is recommended practice to start by obtaining a feasible plan utilizing only target *constraints* then add OAR *constraints* as desired. Remember, using a narrow range of *constraints* can improve the optimizer performance and improve the resolution of the Pareto surface navigation.

The user also needs to be aware of the impact of *constraints* being set on *Fraction Group* level versus the *Plan* level. For example, it is possible to have a *constraint* set in the *Plan* level so that the whole dose to an OAR is given on one day and none on the other day. This could happen when there are two *Fraction Groups* and the OAR dose is not split between the two by using Fraction Group level constraints.

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.

Once the user has all the *Objectives* entered as well as a *Feasible* plan they can start the MCO by clicking the *calculate* option in the *Navigation* block.

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

Dose Normalization and Display

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

Navigating the Solutions

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