

## AbstractID: 1478 Title: A Response Surface Based Approach for Integrating Beam Orientation Optimization with Fluence Map Optimization in IMRT

We present a response surface (RS) based algorithm to integrate beam-orientation optimization (BOO) with fluence-map optimization (FMO) in intensity modulated radiation therapy (IMRT) treatment planning. Though our linear program based FMO model can be solved in less than one minute on a personal computer, the number of possible beam sets grows exponentially with the number of beams to be used in the plan, thus rendering BOO extremely computationally expensive even for a small number of beams. The RS algorithm approximates the FMO function by modeling it as a stochastic process with a certain mean value and an error term associated with each beam orientation set in the solution space. Using this process, the RS method estimates the entire FMO function by only evaluating the FMO problem for a few selectively chosen beam orientations, drastically reducing the amount of time to reach an optimal solution. These beam orientations are chosen as those that maximize the expected improvement with respect to the current best FMO solution. The beam orientations which give the best treatment plan are then selected. In our approach, we consider the problem of determining an optimal four-beam treatment plan where three beams are fixed to  $0^\circ$ ,  $120^\circ$  and  $240^\circ$ . The FMO problem then becomes that of finding the best fourth angle. By isolating a single angle to optimize, we can easily verify the global optimality of the solution. For the two cases tested, our RS method found the global minimum after sampling 30 points in less than five minutes.