

Tomotherapy is a dose delivery technique using helical or axial intensity modulated beams. One of the strengths of the tomotherapy concept is that it can incorporate a number of processes into a single piece of equipment. These processes include treatment optimization planning, dose reconstruction and kilovoltage/megavoltage image reconstruction. For this reason, a common computational technique that could be used for all of these processes would be very appealing.

Several iterative algorithms are used in radiology. The evolution of computers and the development of more sophisticated algorithms have made this methodology fast, robust, reliable, and easy to implement. The maximum likelihood estimator, originally developed for emission tomography, is a beneficial tool in imaging and radiotherapy. In general maximum likelihood (ML) is less sensitive to random noise and inconsistencies in the sinograms than filtered back projection. We believe that this approach can serve as a useful tool in the processes of optimization planning, dose reconstruction and kilovoltage and/or megavoltage image reconstruction. Since these processes involve computations that require comparable physics methods, are based on equivalent assumptions, and have similar mathematical solutions, ML is able to provide a common framework for all three of these computational problems with a potential decrease in the calculation time.

We will demonstrate how the maximum likelihood methods can be applied to optimization planning, dose reconstruction, and kilovoltage and/or megavoltage image reconstruction in tomotherapy. Results for planing optimization, dose reconstruction, and megavoltage image reconstruction will be presented. Future directions for this work are also suggested.