AbstractID: 2018 Title: Iterative Adjoint and Forward Monte Carlo Transport for External Beam Treatment Planning

The distribution of adjoint flux from a tissue region-of-interest (ROI) is an "importance function" that indicates the importance of each source parameter to the dose within that ROI. An iterative scheme of adjoint and forward Monte Carlo transport calculations that makes repeated use of ROI importance functions was developed to automatically determine source positions, beam directions, and beam weights for IMRT. The iterative scheme begins with an adjoint calculation for each target and sensitive structure ROI. These calculations provide an estimate of which source positions and directions are most important for treating the target ROI while avoiding sensitive structure ROIs. The ROI adjoint tallies are combined into a single distribution which is used as an initial set of beam weights for a forward calculation. The results of the forward calculation are inspected, and regions of unacceptable dose form the basis of another adjoint calculation. Subsequent forward and adjoint calculations refine the set of beams for the treatment plan. The method was tested with a C-shaped water phantom and with clinical cases. The results indicate that the scheme is able to adjust beam weights effectively and can incorporate different objectives. The method may have the potential to increase the efficiency of the treatment planning process by focusing dose computational resources on the most important elements of the source field.