AbstractID: 1482 Title: Robustness of Inverse Treatment Planning with Quadratic Objective Function

The performance of a variational regularization technique to improve robustness of inverse treatment planning is analyzed and tested. It is claimed that a method is robust if its solution is free from non-physical oscillations on any computational grid. Inverse treatment planning is an inverse radiation transport problem governed by the Fredholm integral equation of the first kind. This integral equation is ill-posed which makes the problem unstable to small perturbations in input data and algorithm. Therefore, inverse treatment planning is not robust unless a regularization technique is applied. We consider a regularization technique which can be applied for the methods which minimize a quadratic objective function of the dose distribution. To compensate for the effect of ill-posing of the Fredholm integral equation of the first kind, the quadratic objective function was modified by stabilizing functions related to those proposed by Phillips and Tikhonov. We have developed a computer code which simulates inverse treatment planning for intensity modulated radiation therapy (IMRT) to analyze and test the performance of the regularization technique. The code uses a quasi-Newton method to find a minimum of the modified objective function. We have tested the code for a typical case of a Head&Neck cancer treated with seven co-planar beams. We show that the implementation of the regularization method results in suppression of non-physical oscillations in beam intensities. The regularized dose distributions have better conformation to the planning target volume (PTV).