

AbstractID: 12568 Title: Automatic beam placement for breast radiotherapy using Support Vector Machine

Purpose: To develop an automatic beam placement algorithm using the support vector machine (SVM) method for breast radiotherapy with tangential beams.

Method and Materials: The optimization goal is to find the optimal parameters of the tangential beams to cover the planning target volume (PTV) including the clinical target volume (CTV) and the ipsilateral breast and minimize the dose to the organs at risk (OARs) consisting of the heart, ipsilateral lung, contralateral breast. Relative significance of different organs were first determined based on the following clinical concerns: (1) CTV should be fully covered, (2) heart sparing is more critical than lung sparing, (3) coverage of the ipsilateral breast tissue beyond the CTV can be compromised in exchange for significant dose reduction of heart and lung, and (4) radiation to the contralateral breast should be avoided. The SVM finds the optimal plane that best separates the PTV and OARs according to a pre-defined cost function considering the relative significances of all involved objects. Gantry angle, collimator angle and collimator opening of the tangential beams were obtained through geometry transformations of this plane. Dose-volume histograms of plans determined by this beam placement algorithm were then compared with those by radiation oncologists.

Results: Plans of 23 prone and 13 supine patients were analyzed. Our algorithm reduced the heart volume that receives >500 cGy by 38.0% (from 2.68cm^3 to 1.66cm^3) on average and the ipsilateral lung volume that receives >1000 cGy by 26.3% (from 55.22cm^3 to 40.71cm^3). Volume of CTV1 and CTV2 receiving $>95\%$ of prescription dose decreased by only 0.74% and 0.07% respectively.

Conclusion: This study demonstrated the feasibility of using a SVM-based algorithm to determine the optimal beam placement without physician's intervention. Our algorithm significantly reduced the dose of OARs at the expense of slightly degraded but still acceptable dose homogeneity and coverage.