

AbstractID: 11158 Title: Nonlinear kernels as a visual analytics tool for radiotherapy treatment outcomes

Purpose: The most commonly used NTCP and TCP models are acknowledged to be over simplified. The typical approach to determining if a model 'fits' the data is to look at residuals of predicted rates, but this is not straightforward in multi-dimensional modeling problems because data are sparse. It is therefore crucial to develop methods that investigate the goodness of fit of the models over the dataspace. The goal of this work is to investigate a supervised machine-learning tool for producing contour plots of outcome probability, as a reference against simpler models.

Method and Materials: For demonstrative purposes, we used an institutional dataset consisting of 281 patients treated for non-small cell lung cancer. Two endpoints were investigated: radiation-induced pneumonitis (n=219), and local control (n=56). Clinical and dosimetric variables were extracted using CERR and logistic regression model building was performed in the DREES software system. Kernel-based support vector machines with radial basis functions (SVM-RBF) were used to produce corresponding contour maps of risk levels.

Results: The SVM projection plots identified four possible regions based on the risk group and the confidence level: (i) a region of low risk patients with high confidence prediction level; (ii) a region of low risk patients with lower confidence prediction level; (iii) a region of high risk patients with lower confidence prediction level, and (iv) a region of high risk patients with lower confidence prediction level. The SVM-RBF produces nonlinear contours that differ significantly from the logistic regression contours, with some agreement where the data is most dense.

Conclusion: SVM models provide a powerful, automated, tool to help understand NTCP and TCP model fits. We plan to integrate SVM methods within the open-source DREES modeling system.

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