AbstractID: 8391 Title: Improving lung radiation-pneumonitis prediction by combining different models

Purpose: Combining the results of methodologically different models (decision fusion) has been shown to yield a fused result that more truthfully represents the underlying phenomenon, compared to the individual models. In this work, we study the effect of combining 4 different models (Decision_Trees, Neural_Networks, Support_Vector_Machines, Self_Organizing_Maps) to predict for radiation-induced pneumonitis. **Methods and Materials:** The four models were built from a database of 219 lung cancer patients who underwent thoracic radiotherapy at our institution. Each model was built by independently selecting a small number of features from the list of all available variables; no two models had all features in common. To gauge variance in the model predictions of pneumonitis, 100 predictions per model were generated for each patient (predictions were from model versions built using randomly chosen subsets of the remaining patients). The results were fused by simple averaging of the predictions from all four models. **Results:** The low inter-model correlations between the patient predictions from the four models indicated differences in opinion (Pearson correlation range = 0.18 – 0.59, Spearman rank-correlation range = 0.19 – 0.63). Fusion improved predictive capability over any of the component models. For example, randomly fusing 5 of the 100 predictions from each of the 4 models yielded a Receiver Operating Characteristics area of 0.79 (95% interval: 0.77 – 0.80) compared to: 0.74 (0.70 – 0.77) for Neural_Networks, 0.70 (0.68 – 0.72) for Decision_Trees, 0.75 (0.68 – 0.79) for Support_Vector_Machines, and 0.72 (0.69 – 0.75) for Self_Organizing_Maps. The following three sets of consensus features were extracted as those that most influenced all four models in predicting radiation-pneumonitis: (1) chemotherapy prior to radiotherapy; (2) EUD for exponent a = 1.2 to 3; (3) EUD for a = 0.5 to 1.2 & lung volume > 20 – 30 Gy. **Conclusions:** Decision fusion by combining the results of four methodologically different models improves radiation-pneumonitis prediction.