Canadian Association of Physicists
Association canadienne des physiciens et physiciennes

Contribution ID: **8** Type: **Oral (Non-Student) / Orale (non-étudiant(e))**

Evaluating Machine Learning Models in Predicting the Dose Distribution Index in Radiation Treatment Planning QA

Tuesday 8 June 2021 14:45 (5 minutes)

Objective: Dose distribution index (DDI) is a dose-volume parameter used in the treatment planning evaluation. DDI provides the dosimetric estimates on the target coverage, sparings of all organs-at-risk and remaining healthy tissue in the treated organ in a single parameter. In this study, the DDI value was predicted by machine learning model using different algorithms.

Methods: The DDI were calculated using its original formula by definition. On the other hand, machine training was carried out to determine the DDI using the same data of 50 prostate volumetric modulated arc therapy (VMAT) plans from the Grand River Regional Cancer Centre, Kitchener, Ontario. Machine learning algorithms such as linear regression, tree regression, support vector machine (SVM) and Gaussian process regression (GPR) were used to predict the DDI value for each prostate VMAT treatment plan. For comparing the performance of the machine learning algorithms, root mean square error (RMSE), prediction time of the machine learning and training time were determined and compared.

Results: Comparing the RMSE values among all algorithms, only the DDI predicted by the medium and coarse tree regression algorithms showed a relatively large RMSE values in the range of 0.021 −0.034. For other algorithms such as SVM and GRP, they all performed very well in predicting the DDI with smaller RMSE values ranging from 0.0038 to 0.0193. By considering other factors such as prediction speed and training time, the square exponential GPR algorithm had the smallest RMSE value of 0.0038, a relatively high prediction speed of 4,100 observation per second and a short machine training time of 0.18 second.

Conclusion: It is concluded that the family of GPR algorithms performed best in the dose distribution index prediction. It is expected that the accuracy of DDI prediction will increase with more plan data trained using such algorithm.

Authors: Dr CHOW, James (University of Toronto); Dr JIANG, Runqing (Grand River Regional Cancer Centre); Mr NG, Frederick (Ryerson University)

Presenter: Dr CHOW, James (University of Toronto)

Session Classification: TS-6-2 CAP-COMP Medical Physics (DPMB Symposium) / Physique médicale ACP-OCPM (Symposium DPMB)

Track Classification: Symposia Day (DPMB) - Impactful advances in biological and medical physics