AAPM 2022
JULY 10–14 | WASHINGTON, DC
64TH ANNUAL MEETING & EXHIBITION

Automatic Feature Extraction of Modulation Maps and Monitor Unit Profiles: A Machine Learning Approach for Virtual Specific-Plan Verification

Paulo Quintero[1,2], Yongqiang Cheng[2], David Benoit[2], Craig Moore[1], Andrew W Beavis[1,2,3]

[1]Medical Physics Department, Queen's Centre for Oncology, Hull University Teaching Hospitals NHS Trust, Cottingham, HU16 5JQ, UK;
[2]Faculty of Sciences and Engineering, University of Hull, Cottingham road, Hull, HU16 7RX, UK;
[3]Faculty of Health and Well Being, Sheffield-Hallam University, Collegiate Crescent, Sheffield, S10 2BP

UNIVERSITY OF HULL
NHS Hull University Teaching Hospitals NHS Trust

PURPOSE / OBJECTIVES

Machine Learning models predicting gamma passing rates are mainly based on dose distribution data and manually extracted features such as modulation complexity metrics. We have implemented automatic feature-extraction models based on two linac parameters linked to each individual plan: the modulation map or leaf trajectories map (LTM) (2D array) and the delivered monitor units per control points profile (MU_cp) (1D array).

MATERIAL & METHODS

- 1233 prostate plans, portal dosimetry measurements
- 3 models = Model_1:MU_cp, Model_2: LTM, Model_3: MU_cp + LTM
- 5-fold cross-validation, training-validation-testing split: 70%/20%/10%
- Evaluation metrics: The area under the ROC curve (ROC-AUC)

INPUT FEATURES

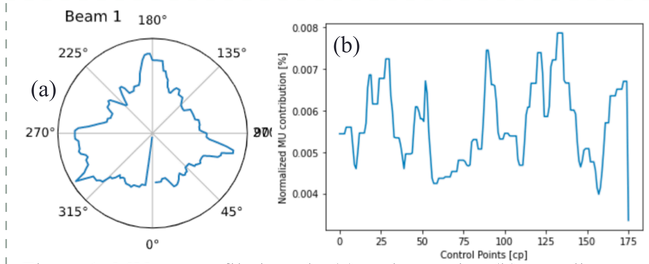

Figure 1. MU_cp profile in polar(a) and cartesian (b) coordinates

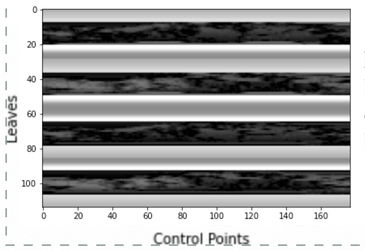

Figure 2. Modulation map or leaf trajectory map (LTM) for one Halcyon treatment (dual-layer MLC)

RESULTS

	Model_1	Model_2	Model_3 Hybrid
ROC-AUC	0.66 ± 0.03	0.81 ± 0.04	0.88 ± 0.02
Accuracy	0.57 ± 0.08	0.78 ± 0.05	0.81 ± 0.03

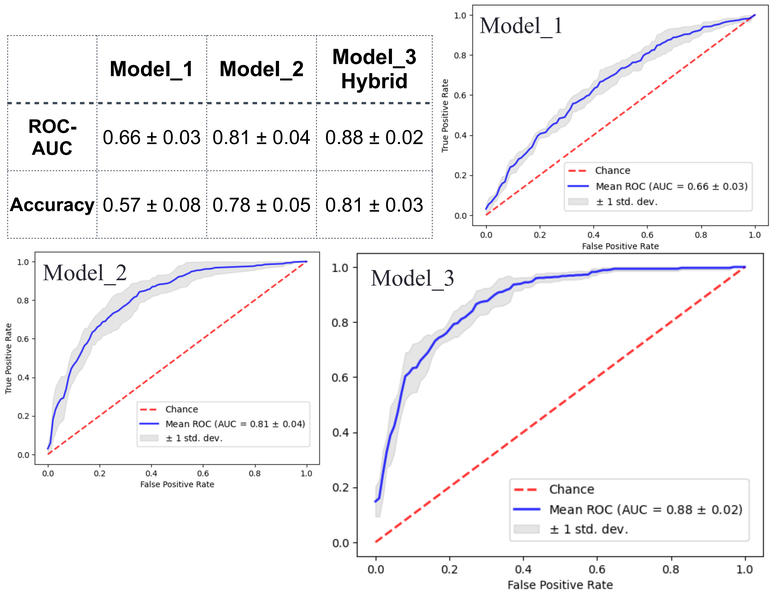

Figure 3. ROC-AUC and accuracy for the testing dataset

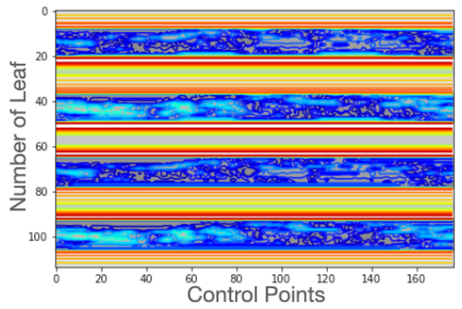

Figure 4. Activation (Saliency) map from Model_2 over the modulation map to identify physical aspects within the MLC trajectories during the treatment

MU profiles and Modulation maps are suitable features to predict dose deliverability
&
Hybrid models present higher prediction performance

pquinterome@gmail.com