Python-Based Automation Framework for Annual Machine QA Data Archiving in QATrack+

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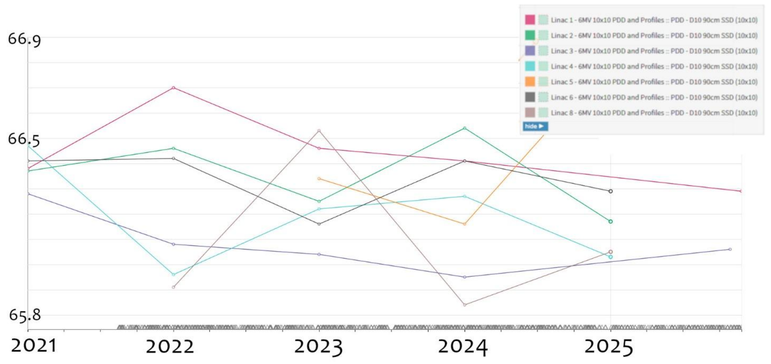
Introduction

Annual water-tank measurements help ensure beam characteristics remain consistent with commissioning baselines. However, the lack of a standardized processing workflow and decentralized data storage makes it difficult to analyze inter-LINAC and intra-LINAC temporal data trends. This project aimed to standardize data handling, centralize annual beam-scan results in QATrack+ (version v0.3.0.14, QATrack+ Project, qatrackplus.com), and implement automated data entry. The work presented here has a significant impact on the processing of LINAC annual quality assurance data. It streamlines the analysis process, thereby enabling more efficient decision-making for beam parameter adjustments. Automated entry into QATrack+ centralizes beam scan data within a single platform and significantly enhances the ability to perform both inter- and intra-LINAC data comparisons

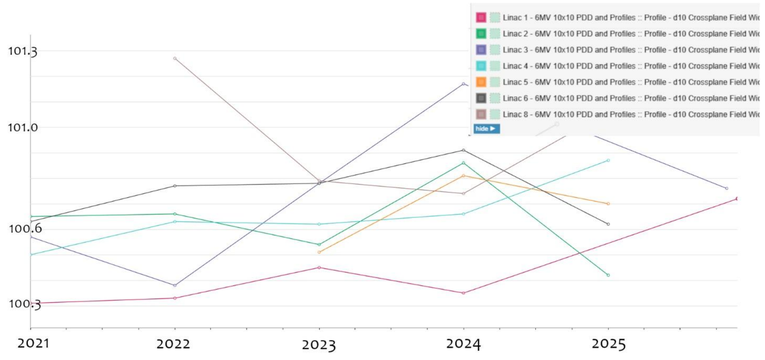
Methodology

All PDD and profile data were acquired using a 48×48×48 cm^3 IBA blue water phantom and myQA Accept software (version_8.5, IBA, Germany). To standardize the input for QATrack+ (v0.3.0.14), all datasets were preprocessed using predefined normalization, central-axis correction, and data smoothing settings, in myQA Accept and then exported as *.csv files. Numerical parameters, defining beam characteristics, were selected from the list of numerical values reported by myQA Accept. A total of 25 parameters were chosen for 6 MV and 15 MV beams, 57 for 6 FFF, and 30 for each electron energy. A Python (v3.12.5) script was written to parse the *.csv file and calculate the beam characteristic parameters independently and automatically populate the relevant QATrack+ fields. The user is only required to upload the *.csv in QATrack+ and the rest is done by the script.

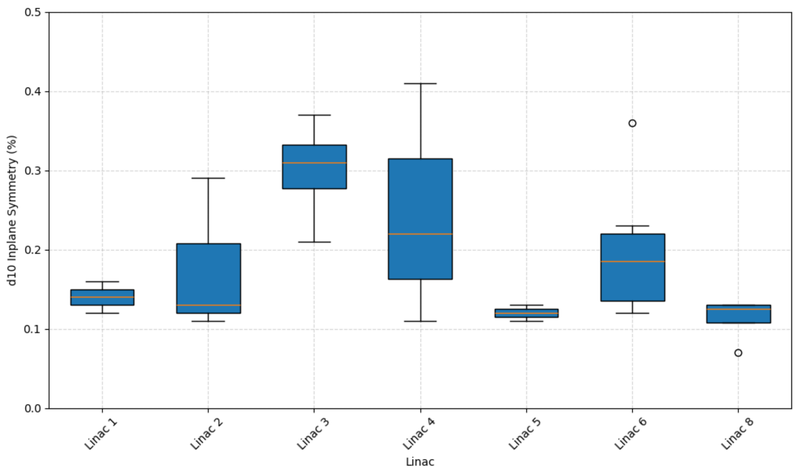
Results



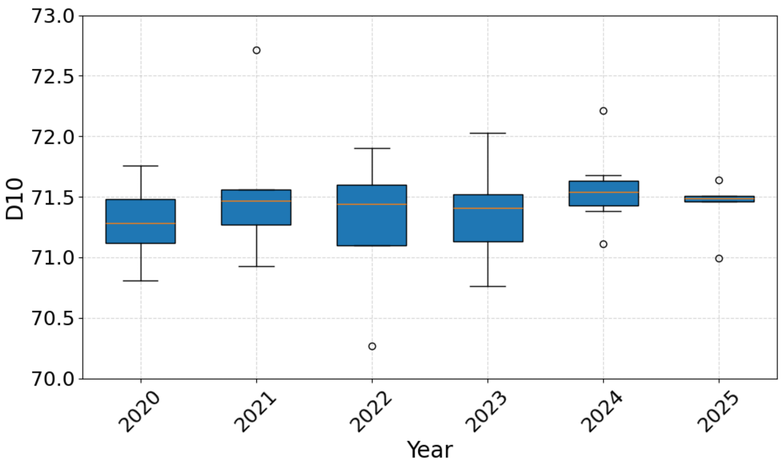
Variation of percentage depth dose value @ depth 10 cm in water phantom for 6MV beam across 8 matched machines over 5 years. Y-axis values are in %.



Variation of field width, measured from 50 % isodose line of a 10x10 cm^2 beam profile, in water phantom for 6MV beam across 8 matched machines over 5 years. Y-axis values are in mm



Box whisker plot showing the in-plane beam symmetry variation for all LINACs over a period of 5 years



D10 variation over time for a 6 MV, 40x40 cm^2 beam at 90 cm SSD

Conclusions

Using our algorithm more than 50 characteristic parameters defining PDDs and Profiles for a variety of photon and electron beam energies are saved in QATrack+ and can be displayed for analysis. We have streamlined the analysis and storage of annual QA data for matched machines in this project making an efficient use of python and QATrack+. This project can be extended further to centralize and automate data entry for the other quality control tests performed on the LINACs on regular basis.