How to improve the dose accuracy for gantry angle dependent patient specific IMRT QA using 2D ion chamber array with Octavius phantom

For the patient specific IMRT QA measurements using PTW Octavius 2D-array detector, gantry dependent cross calibration factors was determined to minimize uncertainties and maximize accuracy.

<Figure 1> Gantry angle dependency of 2D array detector (Octavius detector 729, PTW, Freiburg, Germany): dose difference (%) between planned and measured dose at various gantry angles (field size: 10cm x 10cm, energy: 6MV x-rays, MU: 100, Temperature and pressure corrected)

Because of the angle dependency, the detectors’ readings need to be corrected by using the following relationships:

\[ D_{ij} = \sum_k [(R_{ij})_k \cdot CF(\theta_k)] \]

Where, \( D_{ij} \) is the dose at i-th column and j-th row of 2D array detector, \( (R_{ij})_k \) is the reading at i-th column and j-th row irradiated from the k-th beam and \( CF(\theta_k) \) is the correction factor for gantry angle of k-th beam.

\[ CF(\theta) = CF(0) \cdot RCF(\theta) \]

Where, \( CF(0) \) can be determined by measuring cross calibration factor, set 1 Gy to the planned MU at gantry 0° (field size: 10cm x 10cm, energy: 6MV x-rays). \( RCF(\theta) \) is the gantry angle dependent relative correction factor normalized to \( CF(0) \) and be derived from the figure 1.

Example: 9-beam IMRT head and neck case. (3% 3mm, \( \gamma \)-criteria, PTW method: 71.7% PASS, proposed method: 96.2% PASS)

<Figure2a> PTW Method  <Figure2b> Proposed Method