Physics Department Thesis Defense

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A COMPARATIVE ANALYSIS OF MONTE CARLO AND COLLAPSED CONE DOSE CALCULATION ALGORITHMS FOR MONACO 3D TREATMENT PLANS

The Monaco treatment planning system offers three different dose calculation algorithms for use in calculating 3D treatment plans. These include Monte Carlo (MC), Collapsed Cone (CC) and the pencil beam algorithms. The aim of this study is an in-depth analysis of Monte Carlo and Collapsed Cone dose calculation methods to find the optimal parameters for clinical use for both algorithms. An end-to-end phantom with inhomogeneities was scanned and the DICOM images were imported into Monaco for contouring and planning. Treatment plans were then created in Monaco for both MC and CC using different permutations of variables for approximately 400 plans. These variables include CT Slice thickness, grid size, statistical uncertainty, and beam energy. Following planning the end-to-end phantom was then irradiated on an Elekta Linac and plans for each beam energy were created. Clinical beam data was then compared to the computed plans for each dose calculation method. Conclusively we found that both the CC and MC algorithms within set parameters offered relative high accuracies within 0.5% of clinical measurements. Based on study results CC calculations offer better dose distribution and faster calculation times, while MC calculation tend to offer slightly improved accuracy (~0.2% comparatively). Ultimately, this is an incremental accuracy change and does not severely outweigh the other benefits of CC calculations in the way of volume dose distributions and calculation time.