AbstractID: 9115 Title: Optimal mix of electron and photon energies using linear programming

Purpose: To find an optimal mix of electron (and photon) energies for treatment of superficial lesions.

Introduction: The PDD curves of available electron energies frequently do not match the prescription depths and desired depth doses for superficial lesions. A mixture of electron (and photon) energies however can be used to create a composite PDD curve that closely matches the clinically required one.

Methods and materials: The desired PDD is determined either manually, defining it at several depths, or semi-automatically, defining only the dose at 1 mm and the proximal and distal 90% depths. In this case, the 50% and the maximum depths will be estimated. An Excel table contains PDDs for all electron energies with 0, 0.5,..,2 cm bolus. The small field size dependence of the PDDs is neglected. The table also includes PDDs of photon beams with multiple field sizes. The user can select multiple available energies from the table.
For optimization criteria specifying PDD values to fit, upper/lower limits and exact values are all allowed. Inclusion of electron fields with boluses and photon fields is also possible. The score function is the maximum deviation between the desired PDD values and the resulting PDD at the depths to be fitted, while requesting lower, upper or equality constraints (if defined). The optimization was performed with the linear programming code of MATLAB.

Results: Tests for the correctness of the optimization and a number of optimization tests were providing good match to the desired PDD and satisfying the given constraints. Multiple examples will be presented.

Conclusion: The method is simple, easy to use, and an optimal PDD can be achieved. Since the program is written in MATLAB, it is transferable.

References: Gentry JR, Steeves R, Paliwal BA: Inverse planning of energy modulated electron beams in radiotherapy Med Dos 31. 259-268, 2006