AbstractID: 4897 Title: A novel, heterogeneity inclusive, pencil-beam based algorithm to improve lung IMRT using the Corvus planning system.

Purpose: We investigate a new finite-size pencil-beam algorithm for calculating absorbed photon dose in heterogeneous media of arbitrarily varying density for inverse planning in CORVUS treatment planning system and evaluate its performance modeling heterogeneous systems and in optimization of an IMRT lung plan.

Method and Materials: A new FSPB is developed by extending a phenomenological model (Med. Phys **26**:1893-1990, 1999) for the central-axis absorbed dose in therapeutic photon beams for heterogeneous media. The model's parameters are rescaled based on the density of the medium. A differential equation is introduced to model the interface build-up processes of CAX primary and scatter dose. Primary dose profiles are calculated using density-dependent kernel integration, interpolated in the FSPB axis direction and evaluated depending on the density at the point of interest. Scatter dose profiles are computed using scatter integration and evaluated locally.

Results: The new heterogeneity inclusive FSPB was implemented in a development version of CORVUS. Original and new FSPB dose calculations were compared with Monte Carlo calculations performed using PEREGRINE. For a heterogeneous semi-slab phantom and for an IMRT lung plan, the dose distribution generated by the new FSPB agrees well with MC results, while the original one shows substantial discrepancies. IMRT plan optimizations were carried out using both original and new FSPB, and then a final dose calculation was performed using PEREGRINE. The plan calculated using the new FSPB shows better target conformality than the one computed using the original FSPB.

Conclusion: The new FSPB possesses greatly improved accuracy as demonstrated in a variety of phantom and patient cases, both for dose calculation and IMRT optimization. FSPB best features were preserved with little extra computational overhead promising accurate and fast inverse planning and real-time dose sculpting and dose volume histogram manipulation.

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