Purpose: Monte Carlo dose calculations are considered to be the gold standard by which other techniques are compared, particularly for complex geometries with regions of electronic disequilibrium. The major disadvantage of Monte Carlo is the associated long calculation times. This necessitates limiting the number of histories and/or using interpolative techniques, potentially reducing accuracy. ProACTive is an irreducible vector space method of dose calculation with computation times significantly faster than Monte Carlo. The purpose of the work is to validate ProACTive's accuracy.
Method: ProACTive calculations were compared to measurement and/or EGS4/PRESTA Monte Carlo for both homogenous and heterogeneous geometries for 6MV and 18MV. Sufficient Monte Carlo histories were run to minimize statistical uncertainty. Depth dose and profile measurements were taken from an average of measurements obtained on 40 Varian linear accelerators commissioned in the last several years. Heterogeneous phantoms included a complex phantom consisting of water, aluminum and lung irradiated by a 2x2 cm2 18 MV x-ray beam as described by Mohan and Rogers (ICCR2000 Proceedings).
Results: ProACTive calculation times were significantly faster than Monte Carlo run with a large number of histories. For homogenous geometries, ProACTive calculations showed good agreement with measurement for a wide range of depths and beam sizes, both on and off axis. For the ICCR2000 phantom, ProACTive and Monte Carlo showed overall good agreement. Both calculation methods showed some difference compared to measurement, especially at a density boundary. It is not clear whether the differences are real or due to uncertainty in the measurements and their interpretation for this extreme geometry.
Conclusions: For the geometries tested, ProACTive shows good agreement with measurement and similar computational accuracy to Monte Carlo when the latter is run with sufficient histories to minimize statistical uncertainty. ProACTive's accuracy and computational time make it a feasible clinical solution to accurate dose calculation.