

AbstractID: 6617 Title: Development of a linac-MRI system for real-time ART

Purpose: To describe the novel design of the coupling an of MRI to a medical linac to provide real-time tracking of the tumor and healthy tissues during irradiation by the treatment beam

Method and Materials: Various embodiments are defined in our patents (Fallone, Carlone, Murray) to avoid mutual interference between the MR and the linac. Our method allows rotation of a linac with respect to the subject to allow irradiation of the subject from any angle without disturbing the magnet homogeneity. Magnetic shielding of the linac prevents disturbance from the MRI. RF signal shielding, modifications the RF-signal triggering and pulse shaping are used to minimize linac interference of MRI RF read sequences. Various Monte Carlo calculations (EGS4 NRC and Penelope) and finite-element analyses (Comsol) are performed in all design stages.

Results: The initial design for the human system involves a bi-planar MRI with 65 cm opening to allow rotation of the shoulders within the bore. A short 6 MV waveguide is coupled to one open end of the MR, and a beam-stop and a projection imaging device (eg, flatpanel) is coupled to the other end. Rotation is provide by two concentric rings, and the permanent-magnet design is preferred in the initial stage to provide stability and lack of electric wiring in the rotation process. Low fields allows very small fringe fields to minimize linac interference yet with adequate image quality of soft tissue for lungs, prostate, GBM, etc. Mutual interference issues and other issues arising externally are calculated and resolved.

Conclusion: We have shown the design to be a practical, viable and realizable within a reasonable time frame. Our other presentations detail resolutions to mutual MRI-linac interferences.