AbstractID: 8544 Title: Simulation of room distortion on measurements of RF noise due to a medical linac

Purpose: The goal of radiotherapy is to sculpt radiation dose to tumor shape. The integration of an MRI with a linac for real time image-guided radiotherapy (IGRT) would allow clinicians to reduce treatment margins beyond current technological limits. A problem with the integration of an MRI and a linac is the radio frequency (RF) noise produced by a linac. Our measurements indicate this noise exists in the MHz range with wavelengths on the order of 10s of meters. The purpose of this project is to investigate the effects an enclosed room has on the electric (E) and magnetic (H) field measurements on this type of RF source.
Method and Materials: A software programming environment (MultiStripes, version 7.5 Flomerics) has been utilized to investigate the E and H fields produced from a small dipole in free space and an enclosed room, by solving Maxwell's equations using the transmission line matrix method. The results from these simulations elucidate the effects of room structure and contents on the radiation pattern of an RF source.
Results: Our free space simulation demonstrates the theoretically expected falloff, of the E and H fields, as a function of distance from the dipole. When modeling the dipole confined in the laboratory, our results show perturbations from the free space solution. Our measurements also contain these perturbations. These results were found to depend strongly on the material properties used.
Conclusion: Measurement of RF noise for MRI-linac integration is dependant on the configuration of the laboratory. Simulation of electromagnetic wave propagation can determine the wave perturbation due to room effects. Such simulations allow determination of a "room factor" which can be applied to laboratory measurements to determine the true strength of the RF emissions. More work is needed to validate the model.