

Purpose: The integration of a medical linac with magnetic resonance imaging (MRI) has the potential to provide exquisite soft tissue contrast and real time imaging during the radiation treatment. However, during a real time treatment-imaging session, the direct irradiation of MRI's radiofrequency (RF) coil by the pulsed x-ray beam induces a current in the conductor of the RF coil due to the release of Compton electrons. This radiation induced current (RIC) can potentially degrade the SNR in acquired MRI images. The present work investigates methods of minimizing this RIC both experimentally and through Monte Carlo simulations.

Methods: Copper and aluminum metal plates emulating the conductors used in RF coils were connected to an amplifier and placed in an RF cage. The plates (i.e. "detector") were irradiated by the linac's pulsed 6 MV beam through the RF cage. The induced signal was measured by an oscilloscope and recorded using a PC. Various materials were used as buildup in an attempt to establish electronic equilibrium in the "detectors" - thus removing the undesired RIC. A Monte Carlo script was written which counts the amount of charge entering and leaving a specified "detector volume", and determines the net change in charge per primary history as a measure of RIC. The simulation geometry mimics the experimental setup.

Results: It has been clearly demonstrated by both measurements and simulations that buildup of the same material as the conductor will reestablish electronic equilibrium and remove the RIC. Also, using a polymer with a density close to that of the conductor (i.e. Teflon with aluminum) for buildup will reduce the RIC to negligible amplitude.

Conclusions: With the proper combination of coil conductor and buildup, the RIC can be reduced to negligible amplitudes. Future work will assess the importance of RIC for the SNR in MRI images.