AbstractID: 11561 Title: Non-Axisymmetric Permanent Magnet Design Optimization for a Coupled Medical Linear Accelerator and Magnetic Resonance Imager

Purpose: To develop a robust permanent magnet design optimization scheme capable of producing non-axisymmetric pole plate designs resulting in greater levels of magnetic field homogeneity achieved with rose-ring designs as currently found in industry. To permit the reduction of the overall dimensions of a magnet structure to be used in a coupled medical linear accelerator and magnetic resonance imager while maintaining acceptable levels of magnetic field homogeneity. **Method and Materials:** A steepest descent optimization program is scripted in MATLAB and integrated with finite element analysis software COMSOL Multiphysics. The pole plate surface is parameterized with a 2D grid distribution of mesh independent control points. The optimization is completed in two stages, the first yielding axisymmetric designs about the static field direction, the second permitting non-axisymmetric designs. A model of a 0.2T biplanar magnet structure with a rose-ring design is used to quantify the increase in PPM inhomogeneity over a 30cm and 40cm DSV at isocenter when the lateral dimensions of the structure are decreased. The optimization scheme is executed on the reduced structure to obtain a modified pole plate design. **Results:** FEM analysis indicates an increase in inhomogeneity of 184ppm to 4313ppm over a 30cm DSV, and 344ppm to 7649ppm over a 40cm DSV, as the lateral dimensions of the structure are reduced. The optimization results in an axisymmetric pole plate design with inhomogeneities of 200ppm and 1163ppm over a 30cm and 40cm DSV, respectively. Further optimization results in a non-axisymmetric design with inhomogeneities of 49ppm and 271ppm over a 30cm and 40cm DSV, respectively. **Conclusion:** A permanent magnet optimization scheme is demonstrated to yield novel pole plate designs with greater levels of field homogeneity than presently achieved. The method permits reducing the size of permanent magnet structures while maintaining suitable levels of field homogeneity over typical sized imaging volumes.