

AbstractID: 6656 Title: Magnetic Susceptibility Quantitation for Objects of Irregular Shapes in Inhomogeneous Fields with Magnetic Resonance Phase Imaging

Magnetic susceptibility (MS) measurement has wide-ranging applications in MRI and related medical applications. As a susceptibility object is put in a magnetic field, the field deviation at any spatial location may include several additive contributions: 1) the local magnetization induced in the object; 2) the demagnetizing field of the object, varying in space and dependent on the shape and MS of the object; 3) the intrinsic inhomogeneity of the polarizing field (sum of the main field and the demagnetizing fields from other MS objects). Conventional MRI MS measurements usually require that objects have a regular shape such as a long cylinder or a sphere, and the third contribution is negligible or can be estimated by global field fitting with polynomials or by an extra reference scan. These requirements are not met in many general cases. Here a new method is developed from first principles, good for arbitrary-shaped objects and independent on the polarizing field homogeneity.

With theoretical considerations, the polarizing field at a location inside a susceptibility object can be exactly obtained from the field values on a spherical shell/surface enclosing the object. The effect of demagnetizing field can be account for by calculating the demagnetizing factor based on the object shape. A theoretical formula is obtained for MS quantification. With MR phase imaging, MS are quantified for CuSO_4 solution phantoms with experimental results in good agreement with expected values. The potential of this new methodology for measurement of oxygenation and iron concentration *in vivo* is also discussed.