## Comparison of 2D and 3D Models of the Human Head Surrounded by a Dielectric Sheet in MRI Scans

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A sheet of high dielectric constant surrounding the head has been used in MRI scans to improve signal-tonoise ratio and lower the power transmitted by the array of coils. In a study presented at the URSI General Assembly and Scientific Symposium, Beijing, China, August 2014, we have presented a two-dimensional model in which the human head is simulated by a cylinder with appropriate uniform dielectric constant and conductivity, surrounded by a dielectric sheet of high permittivity and illuminated by an array of line sources. We proved that under appropriate excitation of the array elements, the electric field is zero and the magnetic field is locally maximum and circularly polarized on the axis of the structure.

In the present work, we perform a similar study in the three-dimensional case in which the head is modeled by a sphere surrounded by a concentric high-permittivity sheet. This model is illuminated by an array of dipoles oriented in the same axial direction and equally spaced in the equatorial plane of the spherical model. Under appropriate excitation of the elements of the array, it is shown that the electric field is zero at the center of the sphere, while the magnetic field is locally maximum and circularly polarized.

While several calculations have been performed by other authors using infinite series expansions in terms of Bessel functions (see e.g. Luo et al., *Proc. Intl. Soc. Mag. Reson. Med.*, 21, (2013)), the 2D and 3D models we studied are of interest because only one term in the infinite series expansions is nonzero on the cylinder axis and at the center of the sphere, thus allowing for an immediate and simple analysis and comparison of the 2D and 3D results, and of the effectiveness of the dielectric sheet in either case. Since the real situation is intermediate between our 2D and 3D results, we may reach reasonable conclusions on the value of the fields and on the effectiveness of the dielectric sheet near the center of the head.