The Level Set Algorithm for Microwave Imaging of Hidden Objects

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The purpose of this work is to implement the level set algorithm in the application of hidden objects behind walls using synthetic electromagnetic data. This application could serve several goals, e.g. rescuing people trapped in collapsed buildings, national security, etc. In this work, the level set technique will be used to detect the location and shape of perfect conducting objects hidden behind dielectric walls. All results here will be for the two-dimension case.

The level set is a powerful and versatile technique for shape reconstruction using electromagnetic data. Based on several published work, the level set shape reconstruction algorithm is capable of providing very good results even for low signal to noise ratio data. It also can handle topological changes in an automatic way without user interference which allows for reconstruction of multiple objects using a single initial guess.

The configuration here will consist of multiple human-shape like PEC objects located behind a dielectric wall while plane wave sources are located in the other side of the wall. In this case, several scattering mechanism are contributing to the received waves; the scattering from the objects, the scattering from the dielectric wall, the multiple scattering between the objects and the wall, etc. The dielectric constant and thickness of the wall are assumed to be known which allows the offline calculation of its effect on the scattered waves. This effect will be subtracted in each iteration of the inversion process. However, the multiple scattering between the unknown objects and the wall cannot *a priori* be predicted.

In this work, the electrical properties of the dielectric wall and the surrounding medium are assumed known. The level set algorithm will be used to locate the hidden, single or multiple, objects in addition to their shapes.

Several materials of the dielectric wall will be examined in this work. Both the TE and TM polarizations will be considered in the level set algorithm. Human-shape like PEC objects will be tested in two-dimensions, for simplicity.

Numerical results will be presented in the conference regarding the key issues of the level set algorithm such as the frequency range, efficiency, accuracy of shape reconstruction, and robustness.