3D GLOBAL AND LOCAL FIELD EM MODELING AND DISCOVERY ON RESEARCH AND SIMULATIONS OF EM CLOAKS

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Recent years, the electromagnetic metamaterials cloak and LHM materials are hot research projects. The EM cloak is anisotropic inhomogeneous dispersive materials. The exterior EM wavefield propagation through the cloak never be disturbed by the cloak and the EM wavefield can not penetrate into the cloak. Therefore, the cloak can be invisibility materials. In almost EM cloak simulations, only the plane wave is used to be incident field, the plane wave is excited by infinite plane sources. The plane sources can not be located inside of the cloak domain and can not be located inside of the cloaked concealment. These cloak simulation research papers only reported the exterior EM field propagation through cloak. They did not study the difficult cases that the local sources polarization excitation inside of the cloak and its concealment. They did not know what happen of the EM radiation excited by local sources inside of cloaked concealment. Our 3D GL EM modeling can simulate all cases that the point or local sources to excite EM wave field through the cloaks. The local and point source can be located I in any where in 3D space. We obtained excellent simulations of the EM wave propagation through the cloaks, the EM wave field are excited by the point source outside of the cloak, inside of cloak, and in side of the cloaked concealment. **We discovered that there is no Maxwell electromagnetic wavefield excited by nonzero local sources inside of a concealment.** In this paper, a Global and Local field modeling is proposed to simulate the electromagnetic wave propagation in the inhomogeneous anomalous materials, in particular, in the cloak metamaterials. The method is a significant physical scattering process. The finite inhomogeneous domain is divided into a set of small sub domains. The interaction between the global field and anomalous material polarization field in the sub domain causes a local scattering wave field. The local scattering wave field updates the global wave field by an integral equation. Once all sub domains are scattered, the wave field in the inhomogeneous anomalous materials will be obtained. We call the method as the Global and local field method, i.e GL method which is fully different from the traditional numerical methods. The GL method combines the analytical and numerical method consistently together. There is no big matrix to solve in it. The GL method does not need artificial boundary and absorption boundary condition to truncate infinite domain. The GL method is suitable for any frequency band and isotropic and anisotropic materials. Many 3D electromagnetic cloak simulations show that the GL method is effective to simulate the electromagnetic wave propagation through the anomalous materials and cloak metamaterials. The theoretical analysis of the 3D electromagnetic cloakis presented in this paper.