An Active Surface Cloak Based On The Equivalence Principle

Michael Selvanayagam* and George V. Eleftheriades
The Edward S. Rogers Department of Electrical and Computer
Engineering, University of Toronto, 40. St. George Street.
Toronto Canada

The ability to hide an object from an incident electromagnetic wave is accomplished through the use of a cloak. This concept has attracted a lot of attention with many different cloaking mechanisms proposed over the past years. These include cloaks made up of metamaterials which bend light around an object, plasmonic material and surface cloaks which cancel out an object's dipolar scattering, and guided-wave cloaks.

One commonality among all of these cloaking mechanisms is their passive nature, i.e their reliance on materials and/or surfaces to either reroute incident fields or cancel scattered fields. For electromagnetic cloaks, the concept of active cloaking has not been explored in detail. However, it should be noted that the field of acoustics has explored this idea to some extent.

Recently, we proposed the idea of an active electromagnetic cloak based on the equivalence principle (*M. Selvanayagam and G. V. Eleftheriades*, An Active Electromagnetic Cloak Based On The Equivalence Principle, *IEEE Antennas and Wireless Propagation Letters,* pp.1226-1229, 2012.). From the surface equivalence principle we know that the scattered fields generated by an object can be represented by a set of equivalent electric and magnetic currents on the boundary. Here we introduced the idea of placing electric and magnetic dipoles (Huygens sources) on the boundary of the scatterer to be cloaked. These orthogonal electric and magnetic dipoles form discrete electric and magnetic currents. The weights on these dipoles are chosen such that they generate the negative equivalent electric and magnetic currents on the boundary of the scatterer. Then through superposition the total scattered field vanishes.

In our presentation we will give an overview of this idea showing exactly how to formulate the weights on the electric and magnetic dipoles. We will also discuss how to implement this cloak using a simple antenna array. Finally, we will show some new examples and realizations of this new cloaking concept that have not been discussed before.