Solving Scattering from Thin Coating Objects by the IEDG

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Electromagnetic (EM) scattering from thin coating on conducting objects is a classic topic that arises in many practical application. The complexity of absorbing material application demands for sophisticated and flexible numerical methods. It can be argued that these requirements are even more critical when the cost of building and measuring a real coated object is great. Usually, impedance boundary condition (IBC) is used to model the behavior of the coating structure. The simplest and most popular IBC is the well-known Leontovich's IBC. This boundary condition links the tangential components of the electric field to those of the magnetic field on the outer surface of the object and avoids the solution of the functions inside the inhomogeneous domain. It provide an effective way to simplify the analytical or numerical solution procedure. At present, different IBCs are frequently used in combination with the surface integral equation (SIE) method.

SIE method is a very powerful tool for the simulation of electromagnetic radiation and scattering problems. The common approach of SIE method for the object with IBC is to simplify the IE with two equivalent surface currents (electric and magnetic currents) to the one with only one equivalent surface currents (electric or magnetic currents) by imposing the IBC. However, a well-known drawback of this approach is that it leads to ill-conditioned matrix system. And the usual formulation of the SIE is also based on continuous Galerkin method. Recently, the discontinuous Galerkin method based SIE (IEDG) is present for solving the electromagnetic scattering problem from non-penetrable objects (Z. Peng, K.H. Lim and J. F. Lee, *IEEE Trans. Antennas Propag.*, vol.61, no.7 pp.3617-3628, 2013). It allows the usual solution of SIE using discontinuous Galerkin boundary element space. Namely, both trial and testing functions will be defined in square-integral, $\mathbf{L}^2$ vector function space. That is more general and flexible.

In this paper, a surface integral equation method based on discontinuous Garlerkin is first developed for the multi-scale object coated with composite materials. It is based on a novel derivation of the weak formulation, in which the IBC is embedded. Both equivalent surface electric and magnetic currents are considered in the final formulations. Also, the testing/trial functions can be expanded in the square-integrable space, which allows for the meshnonconformal and elements with various types. Various examples are studied to validate the proposed method.