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Recent Advances in the Theory and Applications of the Surface-Volume-Surface Electric Field Integral Equation

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In the past several years [1] we have been developing a new class of single-source integral equation (SSIE) for scattering problems on non-magnetic dielectric objects. The new SSIE is formed through constraining of a single source surface integral representation of the electromagnetic fields with volume electric field integral equation (V-EFIE). Unlike previously known SSIEs which feature only field translations from the surface of the scatterer back to it's surface, the new integral equation features fields translations from the surface of the scatterer to its volume and from the volume of the scatterer to its surface. Due to such fields translations the new SSIE is called the Volume-Surface-Volume Electric Field Integral Equation (SVS-EFIE).

The SVS-EFIE offers several advantages compared to the alternative SSIEs. According to its formulation the fields in each region of a composite dielectric object can be represented by an independent fictitious surface current density defined on the boundary of that particular region only [2]. As a result, each dielectric region of the scatterer can be meshed separately according to its dielectric permittivity. Also, due to the fact that the surface currents on the common boundaries are independent, definition of the basis functions discretizing the sought surface current densities is trivial and does not require sophisticate handling at the junctions of the materials unlike the traditional surface integral equations such as PMCHWT, Muller, and other integral equations.

The SVS-EFIE also features only electric field dyadic Green's functions in each of its three integral operators. This allows for its generalization to the case of the dielectric scatterers situated in multilayered medium in mixed-potential form using classical Michalski-Zheng formulation [3]. The resultant layered medium SVS-EFIE does not feature derivatives acting on the layered media dyadic Green's function components making evaluation of the pertinent Sommerfeld Integrals substantially less demanding.

1. F. L. S. Hosseini, A. Menshov, R. Gholami, J. Mojolagbe, and V. Okhmatovski, "Novel single source integral equation for 3D scattering problems by 3D dielectric objects," *IEEE Trans. Antennas Propag.*, (early access).
2. Z. Chen, R. Gholami, J. Mojolagbe, and V. Okhmatovski, "Formulation of Surface-Volume-Surface-EFIE for solution of scattering problems on composite 3D dielectric objects," *IEEE Antennas Wireless Propag. Lett.*, (submitted).
3. S. Zheng and V. Okhmatovski, "New single-source surface integral equation for solution of scattering problems on 3D dielectric objects situated in multilayered media," *IEEE MTT-S Intl. Microwave Symp.*, Philadelphia, 2018, (accepted).