# Solving Radiation Problem with EFIE in Time Domain Using Laguerre Polynomials

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A time-domain electric field integral equation (TD-EFIE) is presented to obtain the radiation from arbitrarily shaped three-dimensional (3D) open conducting bodies.

The most popular method to solve a TD-EFIE is the marching-on in time (MOT) method using triangular patches and vector basis functions. The TD-EFIE with the MOT method suffers from its late-time instability, which usually takes the form of an exponentially increasing oscillation that alternates in sign at each time step. Instead, we solve the wave equation by expressing the transient behaviors in terms of Laguerre polynomials. By using these orthonomal basis functions for the temporal variation, the time derivatives can be handled analytically. Since these weighted Laguerre polynomials converge to zero as time progresses, the induced electric currents when expanded in a series of weighted Laguerre polynomials also converge to zero. In order to solve the wave equation, we introduce two separate testing procedures, a spatial and temporal testing. By introducing first the temporal testing procedure, the marching-on in time procedure is replaced by a recursive relation between the different orders of the weighted Laguerre polynomials. The other novelty of this approach is that through the use of the entire domain Laguerre polynomials for the expansion of the temporal variation of the current, the spatial and the temporal variables can be separated.

In this paper, an unconditionally stable solution for the TD-EFIE algorithm has been proposed for calculating radiation of 3D arbitrarily shaped open conducting structures. To model arbitrarily shaped structures, triangular patch modeling has been employed to provide more flexibility. A marching-on-in-order method is used to solve the TD-EFIE with weighted Laguerre polynomials. Numerical results are presented, which show the validity of the presented methodology.