Abstract

The charge simulation method (CSM) is a well known boundary based method; commonly used for electric field analysis in various high voltage applications. The method is widely used for open boundary problems. Appropriate arrangements of the fictitious simulation charges and contour points are indispensable to obtain accurate solutions for the electric field computations using the method. However, such arrangements usually rely on the programmer or developer personal experience resulting in the CSM programs, for a particular application, to become case specific. Several optimization techniques have been proposed to reduce such dependence. The present study is an effort towards that goal.

The purpose of the work is to present efforts towards the automatic allocation, optimally, of the simulating charges as well as their values in the charge simulation method (CSM); thus reducing the dependence on the personal judgment and experience of the user. Using the simplest type of simulating charge (point charges), Genetic Algorithms (GA) are employed as the optimization technique. An electrode system consisting of a sphere above a ground plane in three dimension (3-D) spherical coordinate system is used in the study. Procedures are devised in order to determine appropriate arrangement, the radial and angular coordinates, of the fictitious simulating charges to achieve a minimum rms error in the potential values on the sphere surface for a wide range of non-uniformity factors of the geometry.

An alternate meshless numerical technique, recently used in various engineering applications, is the method of fundamental solution (MFS). The method, which is the equivalent of the charge simulation when point charges are employed, is introduced in the present work. It is used, here, for the numerical computations of the charges, fields and forces in the geometry of a spherical particle between two parallel plates. Choosing appropriate locations of source points is crucial in the MFS as it has a great impact on the quality of the solution. A genetic algorithm

(GAs) is employed for this purpose. Comparison of the results of both analytical and numerical techniques for all parameters of significance is carried out and presented to assess the effectiveness of the proposed procedures.