

ON THE REDUCTION OF INTER-MATCHPOINT ERROR IN
POINT-MATCHED NUMERICAL SOLUTION OF INTEGRAL
EQUATIONS

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In solving computationally, electromagnetics problems formulated in terms of integral equations, the induced current is expanded in a set of basis functions and the equation itself is commonly imposed via matching the right and left sides at a selected set of matchpoints on the boundary over which the integral is carried out. The result is a set of simultaneous linear equations for the unknown coefficients in the current expansion. This set can be solved by matrix inversion for modest size problems but for large problems an iterative approach is commonly used in which the iterations, designed to reduce the residuals at the matchpoints, are continued until a suitable error level is attained. The error referred to here is the error at the matchpoints. The error between the matchpoints is typically much larger but is commonly ignored because its impact on the far-zone radiation field is small due to its rapidly oscillatory character. Nevertheless, this error can adversely impact near-field calculation and the calculation of parameters such as the input impedance at ports defined in the problem. While this error can always be reduced by increasing the number of matchpoints and perhaps also the number of basis functions, such increase can be prohibitively costly in terms of computation time and storage. Thus, an efficient and simple means of reducing this error is desirable.

This paper introduces a new iterative approach to inter-matchpoint error reduction. It is as follows. By Fourier transformation, the boundary residual can be partitioned into high and low spatial frequency portions. Once this has been done, the low frequency portion can be treated via re-application of the previously calculated inverse of the system matrix or by repeat of the iterative solution. Subsequently, the new residual is again partitioned and again the low frequency portion used to drive the system. After several such iterations, all of the remaining error resides in the high spatial frequency portion of the spectrum and can be accurately treated using a local planar approximation to the boundary. This approach has been implemented in both the Method of Moments and the Method of Auxiliary Sources and shown to be both efficient and rapidly convergent.

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