A Study of Series Acceleration Using Shank's Transform and Variations

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Application of method of moments (MoM) to waveguides and doubly periodic structures, among others, yields slowly converging double infinite series. There is a need to accelerate the converegence of such series in the analysis and design of these structures, especially if the MoM analysis has to be carried out repeatedly for optimization. Numerous papers have addressed the problem of series acceleration in the literature. While the Ewald sum based technique exhibits rapid convergence of Gaussian rate, achieved through the use of the complex error function, it is difficult to implement. It has been observed that the series evaluation time for reaching a specified accuracy is shortest for the Shanks accelerated spatial summation for the parallel plate structure (P. Takook, R. Maaskant, and P.-S. Kildal, European Conference on Antennas and Propagation, 2012).

In order to implement an acceleration technique in an existing computer program, Shank's transform and its variations are especially convenient. We investigated Wynn's epsilon algorithm (P. Wynn., SIAM Journal of Numerical Analysis, 3, 91-122, 1966), Levin's T-algorithm (D. Levin, International Journal of Computer Mathematics, Sec. B, 3, 371-388, 1973), and the theta algorithm (C. Brezinski, Mathematics of Computation, 39, 133-145, 1982). All of these techniques are ideally suited for use with existing codes where initially a sequence of finite sums is calculated and then an approximate value of the series is determined from their asymptotic behavior. We evaluated these algorithms for a number of well known infinite series with closed form results. Subsequently some of the series encountered in some moment method problems were studied. These results will be presented at the National Radio Science Meeting.

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