POLE EXTRACTION IN THE FREQUENCY DOMAIN

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An investigation has been carried out to determine the feasibility of extracting the SEM (singularity expansion method) poles of a scattering body in the frequency domain. An iterative numerical algorithm has been developed which curve fits a rational function to the frequency response ($f_1 \leq f \leq f_2$) of a scattering body with equal weighting at all frequencies. The poles and residues of the rational function are then computed.

The numerical process has been applied to the surface field at a perfectly conducting sphere for which the poles, residues, and fields were calculated to six decimal places from the Mie series. For a frequency range inclusive of the first N (≤ 5) complex conjugate pole pairs, an excellent fit can be achieved with a rational function containing a denominator polynomial of order approximately equal to 4N. Fitting the fields at another position on the sphere enables the positionally invariant SEM poles to be separated from the remaining poles of the rational function. The extracted SEM poles and residues are in good agreement with the known values. However, the accuracy of the extracted SEM poles progressively decreases as the data is rounded to fewer decimal places, with the higher order pole locations deteriorating first and most rapidly. For data accurate to one percent, only the dominant pole pair can be located with sufficient accuracy to determine the positional dependence of the residues, yet the curve fit remains excellent. Similar results are obtained when modest amounts of noise are added or when experimentally measured surface fields are employed.

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