On the Use of Wavelet Expansions in the Method of Moments

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***Abstract*— A new approach which brings into use the recently developed theory of wavelet transforms in method of moments solutions for electromagnetic wave interaction problems is presented. In this approach, the unknown field or response is expressed as a twofold summation of shifted and dilated forms of a properly chosen basis function, which is often referred to as the mother wavelet. The wavelet expansion can adaptively fit itself to the various length scales associated with the scatterer by distributing the localized functions near the discontinuities and the more spatially diffused ones over the smooth expanses of the scatterer. The approach is thus best suited for the analysis of scatterers which contain a broad spectrum of length scales ranging from a subwavelength to several wavelengths. Using a Galerkin method and subsequently applying a threshold procedure, the moment-method matrix is rendered sparsely populated. The structure of the matrix also reveals the localized scale-fitting distribution long before the matrix equation is solved. The performance of the proposed discretization scheme is illustrated by a numerical study of electromagnetic coupling through a double-slot aperture in a planar conducting screen separating two identical half-space regions.**

projections on subspaces, which for practical purposes are of finite dimension. When considering candidate moment-method discretization schemes, the ratio between the characteristic length scale of the scatterer and the wavelength plays a key role in determining the methodology of the solution. As long as the length scale is comparable to the wavelength, standard moment-method approaches are well suited. However, when the scatterer becomes large and contains a variety of length scales ranging from a subwavelength to several wavelengths, the need for a discretization scheme and basis functions tailored to the scatterer geometry naturally arises. The present work, which is an expanded version of a paper we presented at the 1991 Progress in Electromagnetics Research Symposium (PIERS) [3], addresses this need and suggests a systematic solution approach which is based on the recently developed theory of wavelet transforms [4], [5].

In the suggested approach, the unknown field or response is expressed as a twofold summation of shifted and dilated