A Multiresolution Study of Two-Dimensional Scattering by Metallic Cylinders

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Abstract— **The recent application of wavelet transforms in method of moments (MoM) solutions for scattering problems is extended to cases involving metallic cylinders whose periphery contains a variety of length-scale features ranging from smoothly varying large-scale features (characterized by a radius of curvature of several wavelengths) to rapidly varying small scale ones (characterized by a radius of curvature that is small compared with the wavelength). The basic idea is to first consider a periodic extension of the equivalent current in the arc-length variable with a period identical to the scatterer circumference, and then to expand this representation using a set of periodic wavelets derived from a conventional basis of wavelets by a periodic extension. Using a Galerkin method and subsequently applying a threshold operation, a substantial reduction in the number of elements of the moment-method matrix is attained without virtually affecting the solution accuracy. The proposed extension is illustrated by a numerical analysis of TM (transverse magnetic) and TE (transverse electric) scattering from a cylinder of elliptic cross section. A thorough study is carried out showing how the solution accuracy improves with increasing resolution level, and how this accuracy is affected by a thresholding process which renders the moment matrix sparsely populated.**

as indicated in [5], a difficulty is encountered when one is pursuing a complete and orthonormal set of basis functions that is made only of translation and dilation of a given smooth function. The difficulty lies in the inability to span a function of finite support by means of such a set, unless the domain of definition of some of the basis functions is allowed to extend beyond that finite support. In other words, the wavelet expansion for a given function of finite support requires that some of the wavelet functions reside outside that support. The equivalent current in a problem of scattering from a finite-size perfectly-conducting body is defined on the body surface which is inherently of finite size; the question of the number of wavelets and their proper location outside the scatterer surface naturally arises [5]. A way to overcome this difficulty in scattering problems involving two-dimensional (2-D) cylinders has been proposed in [7]. Denoting the arc-length variable along the periphery by s, the basic idea is to consider a periodic extension of the equivalent current in s, with a period identical to the circumference, and then to expand this