Rigorous formulation for electromagnetic plane-wave scattering from a general-shaped groove in a perfectly conducting plane: comment

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We show that the problem of scattering of an obliquely incident plane wave by a general-shaped groove engraved on a perfectly conducting plane, which was recently studied by Basha *et al.* [J. Opt. Soc. Am. A **24**, 1647 (2007)], was solved 11 years ago using the same formulation. This method was further extended to deal with a finite number of grooves and also with complex apertures including several nonlossy and lossy dielectrics, as well as real metals.

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In their recent paper [1], Basha *et al.* present the solution of the scattering problem by an arbitrarily shaped groove in a perfectly conducting plane, using the multilayer modal method, which they call "analytically based series formulation." In their paper, they aver that they present "for the first time, to the best of our knowledge, a rigorous analytically based series formulation of the scattered fields from a single general-shaped 2D groove engraved on a perfectly conducting plane for an arbitrary angle incident electromagnetic plane wave" [1], p. 1647. In fact, the solution for this problem using the same analytical formulation had already been published in 1996 [2] for both cases of incident polarization (TE and TM), while in [1] the authors present only the TE case.

The multilayer modal method was first proposed to deal with infinite periodic gratings [3], and since then there has been a large amount of work devoted to extend this formalism to deal with other, more complex, structures. The cases of a single groove and of a finite number of grooves on a ground plane were considered first [2,4]. In these two papers the authors already used the multilayer modal method—the same formalism proposed in [1]. Later on, the method was extended to deal with dielectric inhomogeneous apertures [5,6] and to a lossy aperture in a metallic screen [7]. The multilayer modal method was further extended to solve the scattering problem by arbitrarily shaped multivalued surfaces, i.e., conducting surfaces with cavities of reentrant profiles [8].

Basha *et al.* contextualize their work by claiming that "No analytical methods, to the best of our knowledge, are available to solve such general-shaped grooves in a perfectly conducting plane. Only fully numerical methods can deal with such arbitrary groove shapes" [1], p. 1648. Here we show that there has been a lot of rigorous analytical work done prior to [1], which covers not only this problem but also more generalized configurations. Not only the basic modal formulation but also the method of solving the system of equations in [1] is not new. Many techniques that can circumvent the numerical instabilities that arise in the analysis of multilayered structures have been extensively discussed (see, for example [9,10], and references therein). The authors of [1] even state that "The developed method for the general-shaped groove is extendable to multiple general-shaped grooves (finite gratings)" [1], p. 1648. In fact, many extensions dealing with general shapes have already been done several years ago [2–8].

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