Higher Order Analytical Models of Planar Mesh Grids

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A new higher order analytical formula is introduced to compute the impedance of electrically dense arrays of square patches. Wire or strip grids are frequently used to design spatial filters or resonators. Methods used to obtain the grid impedance are the variational method or mode matching.

This work is motivated by a review of some literatures related to frequency selective surfaces that revealed some limitations in existing formulas for the grid impedance. In fact, to the best of our knowledge, many existing formulas are simple, but their simplicity limits the values of the ratios of the strip width to the array period for which the formulas are applicable. Therefore, we propose a higher order formula to remove some limitations of existing formulas for the grid impedance.

Our approach is based on known analytical models for strip grids and periodic patches [Momeni Hasan Abadi, S.M.A.; Meng Li; Behdad, N., "Harmonic-Suppressed Miniaturized-Element Frequency Selective Surfaces With Higher Order Bandpass Responses," in *Antennas and Propagation, IEEE Transactions on*, vol.62, no.5, pp.2562-2571, May 2014] combined with the approximate Babinet principle for planar grids to evaluate the capacitance behavior of the periodic patches [N. Marcuvitz, *Waveguide Handbook. Lexington*, MA: Boston Technical Publishers, 1964.]. Analytical expressions for the surface impedance and reflection coefficient resulting from our analysis are thoroughly verified by full-wave simulations and our own MATLAB computations compared with available data in the open literature for particular cases.

The new formula may find its application in the design of various frequency selective surfaces and metamaterial surfaces.