COMPUTING THE SHIELDING EFFECTIVENESS OF A DOUBLY-PERIODIC CONDUCTING SCREEN OF APERTURES USING A MODE-MATCHING TECHNIQUE

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Prior efforts have investigated the use of mode-matching techniques to evaluate the transmission of electromagnetic waves through screens perforated with apertures. Typically, the focus has been on screens whose thickness is comparable to the aperture dimensions. The technique is now being extended to determine the shielding characteristics of doubly-periodic screens whose thickness is several times the size of the aperture. This paper investigates the impact of considering thicker screens with rectangular and hexagonal apertures over a broad range of frequencies. The rectangular case involves the use of standard expressions for the fields in the apertures and closed-form computations for integral expressions. The hexagonal case requires numerical techniques for evaluating the aperture fields and computing integrals. Numerical data for the rectangular case will be compared to results using the waveguide below cutoff formula. In addition, numerical results for each case will be compared to measured data for samples of aluminum honeycomb.

The screen is modeled as an array of cylindrical waveguides, where the cross-section of the waveguides is rectangular or hexagonal. The reflected field above the screen and the transmitted field below the screen are represented using Floquet waves. The fields within the screen are modeled using waveguide fields. After enforcing boundary conditions and building a system of linear equations, the system is then truncated to produce a matrix equation which is solved using standard techniques. The shielding effectiveness of the screen is determined by comparing the transmitted power to the incident power. It is clear that as the thickness of the screen increases, the transmitted power is greatly reduced at frequencies below the cutoff frequency of the dominant waveguide mode. However, increasing the thickness also attenuates the higher-order waveguide modes at a greater rate, leading to non-convergent solutions to the matrix equation. By selectively eliminating higher-order modes from consideration, meaningful solutions are found. Other results show the effect of increasing or decreasing the number of Floquet modes and changing the angle of incidence.

In comparing the mode-matching results to the waveguide below cutoff data, the two approaches are closely related when the thickness is about five times the aperture dimensions or greater. The measured data also supports the mode-matching approach at and below cutoff.

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