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Natural Complex Eigenvalues for *TE*-oscillations in 2D Arbitrary *PEC* Cavities with Longitudinal Slits: Method of Analytical Regularization

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The rigorous *Method of Analytical Regularization* (*MAR*) is applied to the solution of the wave scattering problem from an arbitrarily profiled 2D metallic cavity with a longitudinal slit, irradiated by an obliquely incident $H-$ polarized plane wave. The mathematically correct statement of the problem leads to the necessity of solving a non-trivial integral equation with hypersingular kernel. The employment of an advanced version of the *MAR* makes it possible to obtain the solution in the form of two coupled infinite systems of linear algebraic equations of the second kind. The compactness of the underlying matrix operator enables efficient numerical solution of the joint system by the truncation method. The fast convergence of the truncation method results from the ability to calculate the unknown coefficients with predetermined accuracy, depending on truncation number only.

The high effectiveness of the solution allows us to investigate the spectrum of complex $TE-$ oscillations in open cavities. By considering the homogeneous version of the truncated system of equations and finding the complex roots of its determinant, we calculated the complex eigenvalues of the $TE-$ oscillations; this used the same approach as employed [1] for sound-soft slotted cylinders of arbitrary profile (the corresponding oscillations are analogous to $TM-$ oscillations in *PEC* cylinders). Similarly to that obtained in the calculation of the unknown Fourier coefficients for the scattering problem, the desired accuracy of computations of the complex eigenvalues is achieved by proper choice of the truncation number. The computational scheme is illustrated by an example of an open duct-like structure; in addition, we present, for different slit widths, the calculation of the first 21 complex eigenvalues for a slotted circular cylinder and the first 8 complex eigenvalues for elliptic cylinders with variably placed slits. All calculations were performed with an accuracy of 5-6 significant decimal places. The first lower oscillation is treated as the Helmholtz mode; this allows us to regard the slotted *PEC* cavities as electromagnetic analogues of the acoustic (Helmholtz) resonator.

Features of the excitation of complex natural oscillations are also considered. Their emergence is traced by calculation of the resonance surface current distributions at those frequencies coinciding with, or lying close to, the real parts of the complex eigenvalues.

1. Elena D. Vinogradova, "Complex Eigenvalues of Slotted Arbitrary Cylindrical Cavities: Sound-Soft Elliptic Cavity with Variably Placed Longitudinal Slit," *Journal of the Acoustical Society of America* **144**, 1146 (2018).