Analysis of a scattering by a cylinder of a large cross section using the Hybrid Pattern Equations Method

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Scattering of waves by obstacles whose dimensions substantially exceed the wavelength of the incident radiation is one of the key problems in the theory of diffraction. In the present paper we propose a new methodology based on the Pattern Equations Method (PEM) [1,2]. The high rate of convergence of the PEM established in the above studies can be used to construct various asymptotic approaches. In particular, using PEM, the authors succeeded in obtaining approximate formulas for the integral cross section for scattering by Rayleigh objects [3]. In this paper, we develop a Hybrid Pattern Equations Method (HPEM), based on the use of a combination of PEM and the Physical Optics approximation (PO). The integral–differential equation for the "correction" to the PO solution for the scattering pattern is obtained. It is shown that this approach has a high efficiency and, at the same time, does not require significant computational costs in solving diffraction problems for cylinders, even in cases where the characteristic cross-sectional dimension is large compared to the wavelength of the incident radiation. The rate of convergence, as well as the accuracy of the results obtained, depend weakly on the geometric dimensions of the cross section of the cylinder, which makes this approach a promising method for calculating the scattering characteristics in those cases when the transverse dimension of the scatterer substantially exceeds the wavelength of the incident field.

References

[1] Kyurkchan, A. G., and N. I. Smirnova, 2016: *Mathematical Modeling in Diffraction Theory Based on A Priori Information on the Analytic Properties of the Solution*. Elsevier, Amsterdam.
[2] Demin, D. B., A. I. Kleev, and A. G. Kyurkchan, 2017: Modeling of electromagnetic scattering by thin cylinders using Pattern Equation Method. *J. Quant. Spectrosc. Radiat. Transfer* **187,** 287–292.
[3] Demin, D. B., A. I. Kleev, and A. G. Kyurkchan, 2018: Application of the Pattern Equation Method to the analysis of electromagnetic wave scattering by a thin cylinder of an arbitrary cross section. *J. Commun. Technol. Electron.* **63**, 505–511.

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