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Ockendon, J. R.; Tew, R. H.
Thin-layer solutions of the Helmholtz equation. (English) Zbl 1478.78070
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Summary: This paper gives a brief overview of some configurations in which high-frequency wave propagation modelled by Helmholtz equation gives rise to solutions that vary rapidly across thin layers. The configurations are grouped according to their mathematical structure and tractability and one of them concerns a famous open problem of mathematical physics.

MSC:

Cited in **1** Document

78M35	Asymptotic analysis in optics and electromagnetic theory
78A05	Geometric optics
78A45	Diffraction, scattering
78A40	Waves and radiation in optics and electromagnetic theory
35J05	Laplace operator, Helmholtz equation (reduced wave equation), Poisson equation
35K10	Second-order parabolic equations

Keywords:

Helmholtz equation; high-frequency asymptotics; thin layers; inflection points

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References:

[1] Babich, V. M. \& Buldyrev, V. S. (1991) Short Wavelength Diffraction Theory, Springer, Berlin.

[2] Babich, V. M. \& Kirpichnikova, N. Y. (1979) The Boundary Layer Method in Diffraction Problems, Springer-Verlag, Berlin, Heidelberg, New York. · Zbl 0411.35001

[3] Babich, V. M.& Smyshlyaev, V s for the Schrödinger equation in the case of a potential linear in time and coordinate I: Asymptotics in the shadow zone. J. Sov. Math.32, 103-111. · Zbl 0584.35019

[4] Babich, V. M. \& Smyshlyaev, V. P. (1987) The Scattering problem for the Schrödinger equation with a potential linear in time and space II: correctness, smoothness, behaviour of the solution at infinity. J. Sov. Math.38, 1562-1576. · Zbl 0621.35076

[5] Buchal, R. \& Keller, J. B. (1960) Boundary layer problems in diffraction theory. Comm. Pure Appl. Math.13, 85-144. · Zbl 0094.41803

[6] Hewett, D. P. (2015) Shadow boundary effects in hybrid numerical-asymptotic methods for high-frequency scattering. Euro. J. Appl. Math.26, 773-793. · Zbl 1383.65148

[7] Hewett, D. P. (2015) Tangent ray diffraction and the Pekeris caret function. Wave Motion57, 257-267. · Zbl 07064033

[8] Hewett, D. P., Ockendon, J. R. \& Smyshlyaev, V. P. (2019) Contour integral solution of the parabolic wave equation. Wave Motion84, 90-109. · Zbl 07215311

[9] Jones, D. S. (1986) Acoustic and Electromagnetic Waves, Oxford University Press. of the parabolic equation. J. Phys. USSR10, 13-24.

[10] Kazakov, A. Y. (2003) Special Function related to the concave-convex boundary problems of the diffraction theory. J. Phys. A Math. Gen.36, 4127-4141. · Zbl 1097.78010

[11] Kazakov, A. Ya. (2019) "Separation of variables" in the model problems of the diffraction theory. A formal scheme. J. Math. Sci243, 715-725. · Zbl 1439.35207

[12] Kravtsov, Yu. A. (1964) A modification of the geometrical optics method. Radiofizik7, 1049-1056 (in Russian).

[13] Leontovich, M. S. \& Fock, V. A. (1946) Solution of the problem of propagation of electromagnetic waves along the earth's surface by the method of the parabolic equation. J. Phys. USSR10, 13-24. · Zbl 0063.03490

[14] Ludwig, D. (1965) Wave propagation near a smooth caustic. Bull. Am. Math. Soc.73, 776-779. · Zbl 0142.37503

[15] Nussenszveig, H. M. (1965) High-frequency scattering by an impenetrable sphere. Ann. Phys.34, 23-95.

[16] Ockendon, J. R. \& Tew, R. H. (2012) Thin-layer solutions of the Helmholtz and related equations. SIAM Rev.54(1), 3-51. · Zbl 1237.31004

[17] Olver, P. J. (1991) Applications of Lie Groups to Partial Differential Equations, Springer, New York.

[18] Popov, M. M. (1979) The problem of whispering gallery waves in a neighbourhood of a simple zero of the effective curvature of the boundary. J. Sov. Math.11, 791-797. · Zbl 0401.76067

[19] Popov, M. M. (1982) Correctness of the problem of Whispering Gallery Waves in a neighbourhood of points of zero curvature of the boundary. J. Sov. Math19, 1487-1493.

[20] Popov, M. M. (1986) Whispering Gallery Waves in a neighbourhood of an Inflection Point at the Boundary. Asymptotics of the wave field as t \[\to \infty \]. J. Sov.Math.32, 215-219.

[21] Popov, M. M. \& Krasavin, V. G. (1986) Direction diagram of radiation in the problem of an inflection Point of the boundary. J. Sov. Math.32, 215-219. · Zbl 0584.35096

[22] Popov, M. M. \& Pshenchik, I. (1979) Numerical solution of the problem on whispering gallery waves in a neighborhood of a simple zero of the effective curvature of the boundary. J. Sov. Math. (now J. Math. Sci.)11, 797-804. · Zbl 0401.76069

[23] Smyshlyaev, V. P. (1991) Concentration of the solution near a limit ray in the neighbourhood of an Inflection point of the boundary. J. Sov. Math.55, 1757-1760. · Zbl 0725.35078

[24] Tew, R. H. (2019) Friedlander-Keller ray expansions and scalar wave reflection at canonically perturbed boundaries. Euro. J. Appl. Math.30, 1-22. · Zbl 1407.78015

[25] Tew, R. H., Chapman, S. J., King, J. R., Ockendon, J. R., Smith, B. J. \& Zafarullah, I. (2000) Scalar wave diffraction by tangent rays. Wave Motion32, 363-380. · Zbl 1074.76613