# Applied aspects of the high-frequency Drude—Sommerfeld model for describing field scattering on finite targets in problems of steady-state vibration theory

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*Inverse problems of diffraction theory and wave propagation are most important for real-world engineering applications. Huygens' Principle forms the basis for mathematical models of such problems. This principle, taken as a physical model of scattered field formation in the problems of electromagnetic (or acoustic) wave scattering on finite targets, assumes that the scattered field is generated by currents that the initial excitation field induces over the scattered surface or in its bulk, or, in a general case, along each parameter discontinuity boundary in a medium. This secondary field coupled with the excitation one ensures fulfilment of boundary conditions. In this case the scattered field generally propagates transversally to the surfaces listed above.*

*In practice, all direct methods of obtaining approximate numerical solutions to this type of boundary problems employ Huygens' Principle to construct mathematical models of wave phenomena. This concerns the integral equation method (surface or volumetric), methods of auxiliary currents, of non-orthogonal series, and various modifications of finite element methods. Nevertheless, this approach has its drawbacks: slow convergence in the high-frequency region, the problem of Raleigh representation of scattered field in external boundary problems, and considerable difficulties in deriving an acceptably accurate numerical solution for a model containing dielectric layers with thicknesses much smaller than the wavelength.*

*We show that the Sommerfeld method, or its generalization for the case of targets different from a circle (a sphere), makes it possible to solve the problems outlined above and ensure explicit solutions for the high-frequency case. In particular, when synthesizing radiation-absorbent aircraft coating, it can yield an equation determining its permittivity, and it can also describe a new optical effect in an illuminated area that may lead to creating a device for nondestructive control of thin synthetic film parameters.*

***Keywords***: *Huygens' principle, electromagnetic waves, diffraction, asymptotics, Sommerfeld method, Keller's equations, anti-reflection optical coating principle*

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