DOCTORAL THESIS

A.J. Hermans: High-Frequency Scattering by a Convex Smooth Object, *
Thesis Technological University Delft, 1968, 72 pages.

Author's Summary:

In this thesis a systematic treatment of the asymptotic solution of the three-dimensional Helmholtz equation $\Delta \tilde{\varphi} + k^2 \tilde{\varphi} = o$ is given for large values of the frequency k, where k is independent of the space coordinates. We investigate the diffraction of a given incoming field by a convex smooth object, however, we only consider the geometrical shadow. On the object the boundary condition $\tilde{\varphi} = o$ is required. At infinity the field should satisfy the radiation condition.

In order to construe an asymptotic solution of the Helmholtz equation we use the ray theory. Notions such as "ray" and "creeping ray" are introduced and these notions lead to a useful coordinate system.

In chapter I the diffraction of a plane wave by a sphere is treated. With the help of boundary layer expansions we derive in several regions asymptotic differential equations. For these equations we give solutions which satisfy the given boundary and radiation condition, if the considered regions reach the sphere or infinity, respectively. If this is not the case, we match solutions of neighbouring regions in order to determine all integration constants. In the neighbourhood of the axis of symmetry, which is a caustic line, we equally construe a solution.

In chapter II we analogously consider the diffraction of a spherical wave by a sphere.

In chapter III we derive, with the help of the theory of differential geometry, a "ray" coordinate system in the shadow region of a convex smooth object.

We transform the Helmholtz equation to these coordinates and find solutions in several regions. We notice that in the general case a caustic surface gives singularities. In principle we can derive a solution near this caustic surface with the same method. This is not done here. In this chapter we consider the diffraction of a plane wave and a spherical wave.

In chapter IV we investigate the diffraction of a plane wave and a spherical wave by a circular cylinder. In this case no caustics occur.

Finally some properties and expansions of Airy functions are given in the Appendix.

* Requesters may obtain copies of this thesis from the author.
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