BOUNDARY VALUE PROBLEMS IN AERODYNAMICS OF LIFTING SURFACES IN NON-UNIFORM MOTION

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1. Introduction. In the present paper we propose to discuss certain aspects of the theory of lifting surfaces in non-uniform motion. Briefly, lifting surface theory is concerned with the motion of an impenetrable, deformable surface through an incompressible or compressible non-viscous fluid. In general the impenetrable surface is intended to represent approximately an airplane wing, a tail surface, or a propeller. The adjective lifting indicates the nature of the interaction desired between the impenetrable surface and the surrounding fluid.

The mathematical nature of the problems arising in this theory is that of boundary value problems of partial differential equations. Our principal object here is formulation of these boundary value problems and presentation of some of the methods, exact or approximate, which have been used in the solution of some of these problems. As may be seen from the list at the end of this paper the amount of work done in this field is considerable and the following account is restricted to those aspects of the theory which have been of particular interest to the writer.

Lifting surface theory as developed may be designated as a perturbation theory in the following sense. Because of the assumption of no viscosity there are evidently types of motion of an impenetrable surface which proceed without disturbing the surrounding fluid at all. One now asks for such motions which proceed *nearly* without producing any disturbances and one uses the assumption of small disturbances to simplify the differential equations and boundary conditions of the theory. In general this simplification leads to a linearized theory and it is this linearized theory which will here be discussed. The main reason for the considerable literature on the subject is the fact that the range of applicability of the linearized theory has been found adequate for many problems arising in engineering, and in particular in aeronautical engineering.

Evidently one may, if one wishes, consider separately problems of uniform and non-uniform motion in lifting surface theory. Histori-