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Chapter 1

Introduction to localized interaction theory (LIT)

1 Mathematical model of localized interaction between a medium and a body surface

Assume a medium comes to a body at rest with constant velocity v_∞ and the problem is to calculate the characteristics of the medium effect on a body surface. The desired characteristics in the first place include forces and heat flux. The body at rest and moving medium are naturally considered here for definiteness. It may be done vice versa, that is to consider the body as moving in a still medium which is accomplished in Chapter 5 where it is more convenient.

Mathematical models and methods for calculation of the effect of a medium on a body depend on the kind of the medium (liquid, gas, soil, etc.) and also the properties and the state of a surface and other factors. The relevant fields of physics, mechanics and technology deal with the development of calculation methods as applied to specific classes of "medium-body" situations. As far as "classical" LIT is concerned, the problems are studied in its framework for conditions of interaction between a medium and a surface of the following form

$$c_F = \frac{1}{q_\infty} \lim_{\Delta F \rightarrow 0} \frac{\Delta F}{\Delta S} = \Omega_n(a, t) n^0 + \Omega_r(a, t) r^0, \\ t = v_\infty^2 \cdot n^0; \quad q_\infty = \frac{\rho_\infty v_\infty^2}{2}, \quad (1.1)$$

where ΔF is the force acting from the medium on a small surface element ΔS which belongs to the body surface in the given point; c_F is the local force coefficient; a is the x -coordinate head; ρ_∞ is the density; n^0 , r^0 are the vectors of inner normal and the tangent line in the point of the surface, respectively; a is the vector of "global" coordinates characterizing the interaction as a whole; Ω_n , Ω_r are the functions that