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THE TRANSITION PROCESS FROM LAMINAR TO TURBULENT FLOW

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Commonly it is assumed that the transition process from laminar to turbulent flow occurs because of an incipient instability of the basic flow field. This non-defined instability depending on subtle and obscure details of the free flow enters the boundary layer from where a variety of different instabilities can occur and growth up to the breakdown of laminar flow. The scenario following various linear stability approaches within a framework of the classical Navier-Stokes theory however failed to explain the origin and the mechanism of the transition process. The original sin lies just in the ignorance of the initial impulse triggering off an instability state. In the paper, this drawback is removed in the sense that any flow is started at some moment in time from rest, where the initial impulse/starting impact is occurred, and as long as the Reynolds number (or a similar stability parameter λ) doesn't exceed a critical value the flow/motion remains laminar/elastic regime. The wall-bounded motion, both for solids and fluids, is a rotor-translational motion creating permanently instability state parameter increases firstly in the linear/elastic range, after that is followed by transition to non-linear instabilities at a critical threshold and a statistical/hysteretic damping state. By means of the model of rotor-translational motion a universal stability parameter depending on the starting impact (V_∞^2) is defined where such as parameter is the boundary Reynolds number $R_b = e^\tau \nu^{1/\tau} / V_\infty^2$, (with e^τ - the concentrated boundary vorticity, $\nu^{1/\tau}$ - the kinematic viscosity, $\tau \le 2$ - a torsion index) for fluids and the wave number $k = \pi/2 + n\pi, (n = 1, 2, 3)$ for solids [1]. Thus, the transition process becomes a well-defined entity as the jump from linear to non-linear behaviour for continuous media strained by force potentials. Considerations relative to transitional behaviour are presented for two canonical wall-bounded motions: the rolling elastic wheel and the boundary layer on a flat plate, [2].

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