Aerodynamics | Technology Offer

Flow surface for three-dimensional boundary-layer flow

Field of application

On every body with a fluid flowing over its surface a thin boundary-layer, within which the speed of the fluid adapts due to friction to the speed of the body, forms at the body surface. The state of the boundary-layer flow determines the drag, wherein the calm, laminar form causes a significantly smaller drag than the mixing, rough, turbulent form. The turbulent form is caused by the instability of the laminar flow form. In order to diminish drag and, thus, to increase the efficiency of machines as well as their environmental compatibility, it is attempted to maintain the laminar form as long as possible on the surface of the body of e.g. a wing, tail plane or wind turbine rotor.

Drawback of currently available technologies

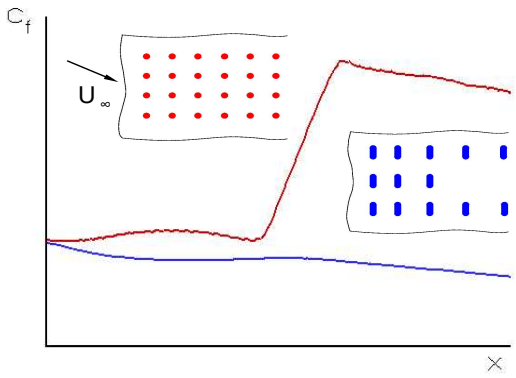
A method for stabilising the laminar flow is the suction of boundary-layer fluid at the wall surface. In case of swept aerodynamic surfaces, the boundary-layer suction is not as efficient as desired. This is due to the fact that on such aerodynamic surfaces three-dimensional flow effects occur due to a flow component (cross flow) extending in crosswise direction. This causes an instability of disturbances, leading to growing longitudinal (crossflow) vortices and an early transition into turbulent boundary-layer flow.

Secure your innovation advantage

At the Universität Stuttgart a new method was developed to significantly improve the efficiency of the suction of boundary-layer fluid to increase the stability of laminar flow.

Patent situation

An European patent application has been filed. Further patent applications are planned.



Local friction coefficient over streamwise direction for conventional technology (red) and invention (blue) for a 3-D boundary-layer flow. Inserts: sketches of flow surfaces with suction orifices.

Innovation

The invention pursues the principle of a continuous excitation of an adapted primary disturbance and its maintenance with relatively high amplitude. An important aspect of the invention is, thus, to permanently excite benign cross-periodic vortex disturbances (primary disturbances) in downstream direction by means of a specific geometric arrangement of the excitation locations. The benign primary crossflow vortices suppress naturally growing nocent primary disturbances by a non-linear physical mechanism. The benign primary disturbances preserve a laminar flow, such that unsteady secondary disturbances, which may initiate turbulence and which, otherwise, are excited in streamwise direction by nocent primary vortices, are suppressed or at least stabilised. If based on suction, the method allows for a higher stabilisation than ideal (homogeneous) suction alone, or for the same stabilisation the suction rate can be significantly lowered.

Your advantages at a glance:

- Stabilising of laminar boundary-layer flow on the surface of wings, tail planes or rotors
- Reduced drag of wings, tail planes or rotors, therefore higher efficiency of machines
- Considerable performance gain of machines at low costs

The application of the method is not limited to devices using suction for stabilising the boundary-layer flow. Small bumps or artificial roughness can also serve as excitation location reducing the complexity of the system.

Technology transfer

The Technologie-Lizenz-Büro GmbH (Germany) on behalf of the Universität Stuttgart offers interested companies the opportunity to acquire an appropriate licence for this innovative technology. Furthermore, the research group offers cooperation for further joint development.

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