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TURBULENT NEAR-WALL FLOW CONTROL BASED ON MICRO-ELECTRO-MECHANICAL-SYSTEMS

During a crisis, special attention is paid to efficiency and minimization of costs in fly realization. There are several principal ways to reduce the consumption of aviation fuel by engines. One of the most actual is reducing the turbulent friction drag of streamlined surface. These drag reduction methods development and implementation can be effectively connected with application of new progressive technologies of flow manipulating, based, in particular, on the usage of modern materials and intellectual electronic systems, having negligibly small dimensions. Active flow control is one of the leading areas of research of many scientists and engineers in fluid mechanics and transport vehicles development. The potential benefits of flow control include improved performance and maneuverability, affordability, increased range and payload, and environmental compliance. One of the newest and most progressive methods to control turbulent near-wall flow is micro-electro-mechanical systems (MEMS) application. The MEMS technology enabled to design, model, and analyze the actuators and sensors having small enough dimensions that are suitable for use within the boundary layer for realization of turbulent flow coherent vertical structures control for developing ultra modern aerodynamic control systems with better efficiency and effectiveness in comparison with the existing solutions. This type of microactuator-based active flow control is expected to greatly augment the conventional hinged type aerodynamic control systems for flight vehicles and enables to perform real-time distributed control. Hence, the ability to interactively manipulate individual high-speed streaks in the turbulent boundary layer is made possible and could be effective in decreasing the surface friction force. **The aim** of the work is to analyze the available types of MEMS, their structures and abilities to influence on the near-wall turbulent flow and, therefore, to improve the efficiency of flight. The basic results of the realized step of investigation are following: interactive MEMS may be effectively used to reduce drag by local manipulation of the quasiperiodic near-wall boundary-layer disturbances, but the most important problem is to determine the background requirements to the distribution of MEMS on the streamlined surface and to elaborate the general principles and laws of their optimal control realization. The mentioned above information can't be effectively achieved experimentally, that is the most important reason of implementation and development of mathematical and, first of all, numerical models and methods analysis of this kind of flow control technique. Weight, thermal conductivity and other inertial characteristics of MEMS are very small, therefore the basic requirement to the MEMS sensors and activators is to provide necessary and quick responses on the turbulent flow disturbances. Moreover, it is important to account the necessity of achieving the real-time interactive distributed control for an integrated system of surface microprobes, microactuators and microprocessors. This approach opens new horizons for interactive and adoptive turbulent flow control, but also poses new scientific and engineering problems, which will be the perspective subjects of further author's investigations.