Laminar flow design for three lifting surface configuration

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The purpose of research is to introduce advancements in aircraft aerodynamics including laminar flow technology. The scope is limited only for subsonic and transonic speeds.

Aerodynamic quality criteria remained almost the same from Boeing 707 (1954 year) to Boeing 747-400 (1988 year). However in spite of some stagnation in aircraft aerodynamics development it will play a great role for future airplanes. Aerodynamic features allow Piaggio P.180 Avanti II having advantages in fuel consumption and emission advantages comparing to the competitors from the same market segment. Laminar flow design and three lifting surface configuration are main reasons for such a success.

Natural and hybrid laminar flow (HLF) technologies have several implementation issues. Firstly, numerical modeling of laminar-turbulent transition, which is possible however in many cases not enough precise at the moment. Secondly, aircraft stability and control characteristics will change in highly turbulent atmosphere. Thirdly, laminar flow effectiveness can be affected by insect contamination on aircraft lifting surfaces. Nevertheless, Green Regional Aircraft project in the framework of European Clean Sky research programme shows significant advancements in the field of laminar flow design.

In order to demonstrate the effectiveness of advanced aerodynamic technologies implementation it is proposed to use three lifting surface configuration for unmanned aerial vehicle, which have more advanced movable foreplane with leading-edge vortex generators of a new type presented in paper [1]. Such combination of foreplane with vortex generators and laminar fuselage and wing can provide not only higher aerodynamic characteristics comparing to aircraft of conventional configuration, but also better flow separation resistance.

1. Udartsev E.P., Alekseenko S.I., Sattarov A.I. Improvement of UAV navigation reliability at high angles of attack, 3rd International Conference Methods and Systems of Navigation and Motion Control Proceedings, Kyiv, Ukraine, 2014, pp.40-43