Laminar-turbulent transition structure on classic and wavy wing at low Reynolds number.

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Nowadays, micro air vehicles (MAV) find new military and civil applications. Miniaturization of the electronic equipment promotes the creation of progressively smaller unmanned aircraft. At the moment, many researchers pay much attention to MAVs with an overall mass below 0.5 kg and a chord-based Reynolds number between 10^4 and 10^5. In spite of certain success, the wide application of MAVs is limited by their rather modest aerodynamic performances. Important MAV parameters, such as the critical angle of attack and lift-to-drag ratio, are mainly deteriorated by changes in the boundary-layer flow character at low Reynolds numbers. Wing surface modification is one of the major resources of separation control and aerodynamic performance improvement. The one of most aspects is to consider the effect of spanwise-periodic modifications to the wing surface on the laminar boundary-layer separation. As in our previous work was demonstrated [1], the wavy wing stall angle of attack is 1.5 times higher than classical wing one and aerodynamic performance hysteresis was not observed.

Laminar-turbulent transition on classic and wavy wing compare at presented work. The data obtained by means of hot-wire measurement was integrated with oil-film flow visualization picture. At result received that laminar-turbulent transition process on classic and wavy wing have significant difference. Separation area is displaced close to leading edge on wavy wing in comparison with classic wing, but essentially different structure of the boundary layer was observed along the groove and the hump of the wavy wing. In the groove, the laminar-turbulent transition is accompanied by separation area appearance, but on the hump, the transition occurs without flow separation and generation of a pronounced instability wave packet. More detailed investigation of wavy wing boundary layer was performed by PIV measurements procedure.

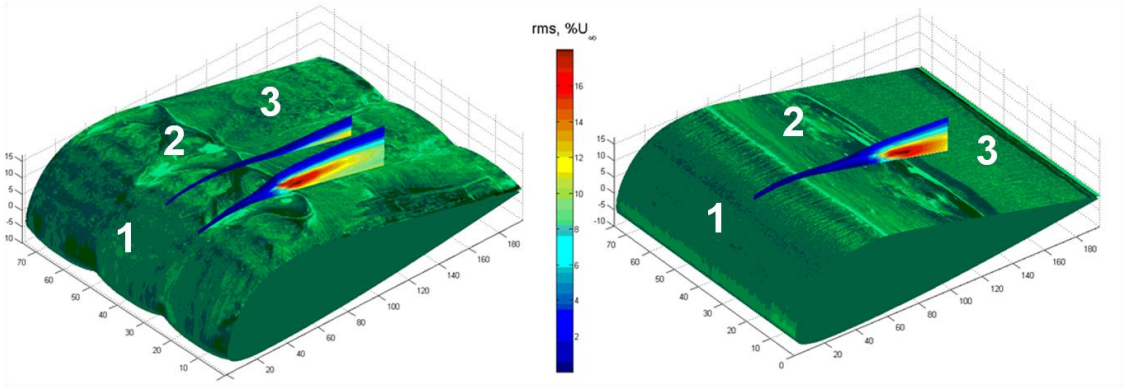

Figure 1. Oil-film visualization of laminar-turbulent transition structures and flow reattachment on flat and wavy wing surface with similar profile Z-15-25 with RMS from hot-wire measurements. Re=1.5×10^5, free stream turbulence level ε=0.04%, angle of attack α=0^o. 1– laminar flow; 2 –separation structure; 3 – reattached turbulence flow.

1 Zverkov, I. D., Zanin, B. Yu., Wing Form Effect on Flow Separation. *Thermal physics and Aeromechanics*, 10(2): 197–204, 2003.