Aerodynamic studies for moderate capacity long-range aircraft in “flying wing” layout

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“Flying wing” (FW) or blended-wing-body (BWB) configurations are considered by aviation community as a serious alternative to conventional airplanes in the 21st century. Despite of the long list of the shortcomings FW/BWB passenger configurations possess at least potentially by three serious advantages: high lift-to-drag ratio due to decreased relative wetted area, favorable load distribution along span and possible engine noise shielding.

At present there is no established point of view on optimal FW layout. For many years a conventional configuration has reached its maturity and refinement, therefore the FW configuration can compete with it on equal terms only with the same thorough consideration of different aspects. Even now, as seen from preliminary investigations, the FW is competitive. There is no doubt that thanks to intrinsic integrated nature of the FW scheme benefits provided by MDO will be higher for it than for a conventional configuration. That is why large multidisciplinary studies were initiated in USA and Europe looking for the different aspects of mutual synergism between aerodynamics, structure, propulsion system and controls. Novel ideas and concepts evolve progressively giving a new impetus to enthusiasts of FW schemes.

New concept of moderate capacity long-range FW aircraft in a single-deck layout is considered in TsAGI over the last years. Unlike the huge 800-seater configuration that could be realized only by international efforts, a small-size airplane features a lower technical risk and requires less investments for its launch.

Special aerodynamic model with flexible arrangement of tail units, wing tips and nacelles has been designed and manufactured (Fig.1).

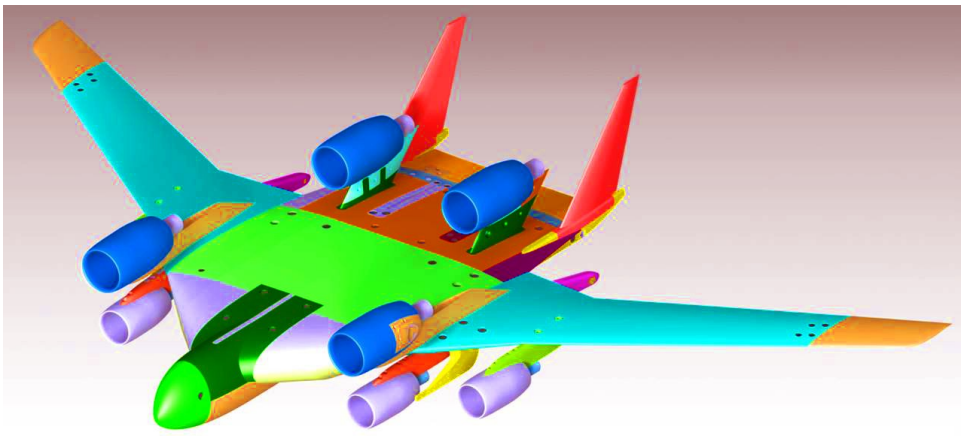

Fig.1 – Principle structure of the aerodynamic model

The span of the model of 1.8м gives a possibility to test it in several subsonic and transonic TsAGI’s wind tunnels with sufficiently large MAC Reynolds number value. The main task of the experimental program is to investigate the effect of different nacelles and tail accommodation at cruise (M=0.85) as well as at low speed regimes and to compare wind tunnel results with CFD data.

This paper presents some results of the experimental studies together with a preliminary CFD results. A description of the aerodynamic design procedure is given and some thoughts about engine-to-wing interference are presented. The paper concludes with suggestions for the most promising nacelle and tail positions and proposals for future research.