By-pass transition effects in propulsion components of high-altitude airships

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Abstract

Natural transition usually occurs at low turbulence intensities [1]. For higher turbulence intensities one needs to account for the by-pass transition mechanism. Herein we implemented in OpenFOAM the laminar kinetic energy transition model, named $k-kl-\omega$ [2]. Several modifications are proposed into the original published model that result in an improved transition tool. This new formulation is validated using the ERCOFTAC T3A test case, as well as multiple turbulence flow conditions over a flat-plate. The computed test cases are also compared with Fluent 13.0 version of the transition model. The model is used to analyze the influence of boundary layer transition on drag coefficient as applied to characteristic propulsion elements. The study was conducted over several geometries such as the NACA0012 airfoil and the 3D 6:1 prolate-spheroid. The calculated flows are representative of high altitude flight conditions, as the ones that may be encountered by MAAT Project airships [3], in particular in their propulsion elements.

Key-words *transition model, k-kl-w, laminar kinetic energy, OpenFoam, MAAT Project*

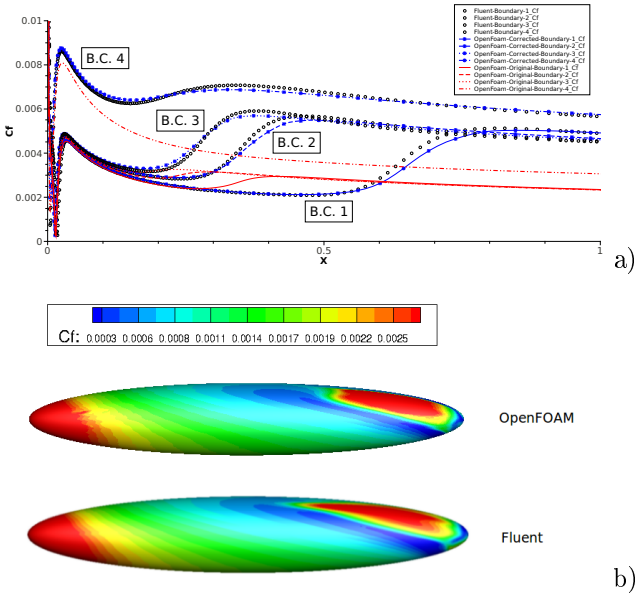

Fig. 1- Results: a) Flatplate skinfriction coefficient distribution with multiple boundary conditions; b) 6:1 Prolate Spheroid Fluent and the OpenFOAM corrected model comparison of skinfriction coefficient distribution.

References

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