Investigating the parameters of flow around the rotation body with a flap

© O.Yu. Vlasov, N.V. Semenchikov

Moscow Aviation Institute (National Research University),
Moscow, 125993, Russia

The article presents the results of the computational investigation of supersonic flow around the rotation body with and without a flap. The work aims at studying the application of the numerical method developed on the basis of Reynolds-averaged Navier—Stokes equations (RANS-method) to solving the problem of flow around the rotation body with a flap as well as at choosing the most suitable turbulence model for such computations. Due to the calculations using various turbulence models and the software package ANSYS 14.5 we have obtained the pattern of flow and the distribution of pressure over the surface of rotation body both with the flap and without it and found the coefficients of net forces and moments acting upon it. We compare the pressure distribution in the detachable area in front of the flap as well as the summarized aerodynamic characteristics with the acquainted experimental findings. The study shows that to calculate the complicated separation-induced flows formed in the neighborhood of the body with a flap, the best convergence of numerical calculations results and experimental data is achieved when using the turbulence model SST k—ω in the calculations by means of RANS-method. The divergence between the numerical and experimental aerodynamic coefficients of the normal force and pitching moment does not exceed 5%.

Keywords: *Reynolds-averaged Navier—Stokes equations, ANSYS, separation-induced flows, turbulence models*

REFERENCES

[1] Ionov S.S., Kalugin V.T., Mishina E.A., Muraviov V.L., Usmanov A.I., Shmanenkov V.N. *Aerodinamicheskoe proektirovanie shchitkovykh i struynykh organov upravleniya letatelnykh apparatov* [Aerodynamic design of flap and jet controls of the aircraft]. Moscow, Informtekhnika Publ., 1992, 192 p.

[2] Korontsvit Yu.F., Fejman M.I. *Uchenye zapiski TsAGI — TsAGI Science Journal*, 1985, vol. XVI, no. 1, pp. 27–37.

[3] Kalugin V.T. *Aerogazodinamika organov upravleniya poletom letatelnykh apparatov* [Aerogasdynamics of aircraft flight controls]. Moscow, BMSTU Publ., 2004, 688 p.

[4] Bondarev E.N., Dubasov V.T., Ryzhov Yu.A., Svirschevsky S.B., Semenchikov N.B. *Aerogidromekhanika* [Aerohydromechanics]. Moscow, Mashinostroenie Publ., 1993, 608 p.

[5] Fletcher C.A.J. *Computational Techniques for Fluid Dynamics*. Berlin, New York, Springer-Verlag, 1992, 256 p.

[6] Kalugin V.T., ed. *Aerodinamika* [Aerodynamics]. Moscow, BMSTU Publ., 2010, 687 p.

[7] Bradshaw P., Woods W.A. *An Introduction to Turbulence and its Measurement*. Pergamon, 1971, 238 p.

[8] Wilcox D.C. *Turbulence modeling for CFD*. DCW Industries Inc., 1998, 537 p.

[9] Belov I.A., Isaev S.A. *Modelirovanie turbulentnykh techeniy* [Turbulent flow modeling]. St. Petersburg, BSTU Publ., 2001, 108 p.

[10] *ANSYS Customer Portal.* Available at: http://support.ansys.com/portal/site/AnsysCustomerPortal (accessed January 6, 2017).

[11] Artonkin V.G., Leutin P.G., Petrov K.P., Stolyarov E.P. Aerodinamicheskie kharakteristiki ostrykh i prituplennykh konusov pri dozvukovykh i sverkhzvukovykh skorostyakh [Aerodynamic characteristics of sharp and blunt cones at subsonic and supersonic speeds]. *Trudy TsAGI* [Proceedings of TsAGI], no. 1413. Moscow, TsAGI Publ., 1972, 93 p.

Vlasov O.Yu., post-graduate, Department of Aerodynamics of Flying Vehicles, Moscow Aviation Institute (National Research University). Research interests: aerodynamics of rotation bodies. Author of 3 scientific publications. e-mail: olegvlasov@yandex.ru

Semenchikov N.V., Cand. Sc. (Eng.), Professor, Department of Aerodynamics of Flying Vehicles, Moscow Aviation Institute (National Research University). Research interests: aerodynamics of aircraft at high angles of attack. Author of over 130 scientific publications. e-mail: nvs2108@mail.ru