COMPUTATIONAL VISUALIZATION OF AERODYNAMIC INTERACTION OF SIMPLE OBJECTS IN SUPERSONIC FLOW

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ABSTRACT: A large quantity of calculating results on the nature of aerodynamic interaction has been obtained for simple objects of different geometry in a velocity range from 2 up to 6 Mach numbers. In this paper the results obtained and partly reported before for compact objects (sphere, cube) [1, 2] and elongated objects (cylinders with different nose parts) [3] are presented in a full-scale volume. The examined objects have a character size (sphere and cylinder diameters, cube edge) d = 13.5 mm. The lengths of cylinders with different nose parts are in a range from 2 to 5d, and the nose parts have hemispherical or conical shapes and at that the conical nose parts are of different length right up to the complete transition of an initial cylinder into a complete cone. The method of numerical solution of the complete Navier-Stokes equations averaged according to Reynolds and supplemented by the k-ε turbulence model, which is enabled in the EFD.Lab engineering fluid-dynamic software, has been selected for simulations. The rather complete picture of flow and interaction was obtained for the system of two arbitrarily located spheres separated at a centre-to-centre distance l in a transversal direction up to l = 4d and in a longitudinal direction up to l = 10d. The analogous but not so complete results were obtained for the system of two arbitrarily located cubes separated in transversal and longitudinal directions. The complete picture of the flow past a single cube was built taking into account its orientation relative to the flow direction. The elongated objects located parallel to each other were separated in a transversal direction up to l = 4d. The results obtained were presented as the dependences of aerodynamic characteristics of objects on a flow velocity and a distance between them. The joint analysis of these dependences and the results of computational visualization was carried out for all considered situations. Several results of computational visualization of the joint flow past examined objects are shown in Fig. 1. They point out the considerable influence of head shock waves moving away from the objects on the nature of their aerodynamic interaction.

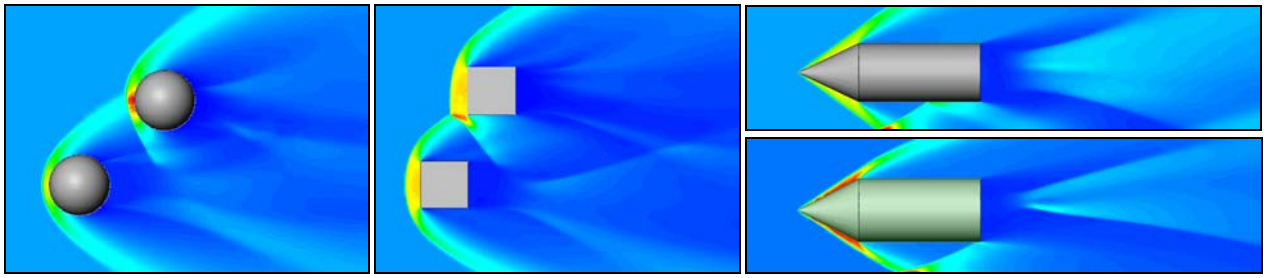

Fig. 1. Flow past two spheres (density field, M = 3, l = 2d, α = 45°), two cubes (density field, M = 4, l_x = d, l_y = 2d) and two cylinder-conic objects (pressure fields, task symmetry taking into account, l = 2d, M = 3 (top) и M = 6 (bottom)).

References

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