Static Aeroelastic Studies on a High Aspect Ratio Airplane

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Abstract: The static aeroelastic behavior of the high aspect ratio airplane is examined using computational and experimental approach. The purpose of this paper is to establish an highly efficient and accurate simulation procedure of static aeroelasticity for the complex configuration based on Navier-Stokes equations and multi-block structure meshes technology. Displacement transfer and load transfer method[1] are developed to maintain the level of accuracy in the coupling of flow and structural solvers. A three-dimensional dynamic grid technology is developed based on advanced map[2], and the original topology of a fluid mesh system could be kept and the higher mesh quality and faster computational effect for mesh update could be obtained, then it is much more efficient, as is suited for fluid/structure interaction with large deformation. In addition to numerical simulation, the videogrammetry deformation measurement (VMD) technique[3-4] is used to measure displacements and local surface angle changes on a high aspect ratio airplane wind-tunnel model. The results show that: (1) the deformation of the wing is monotone increasing corresponding to variation of Mach number and attack angle; (2) the results of numerical simulation agree well with experimental data, thus the numerical simulation method is suitable for engineering application. Figure 1 is the wing deformation of numerical simulation corresponding to variation of attack angle. Figure 2 is the deflection comparison between numerical simulation and wind tunnel test.

Key words: high aspect ratio airplane, static aeroelastic, videogrammetry deformation measurement (VMD)

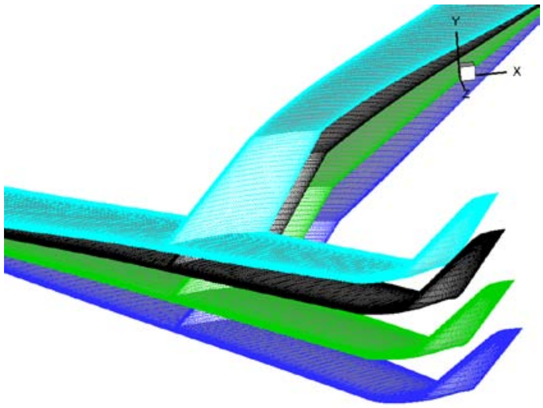

Figure 1: The wing deformation corresponding to variation of attack angle

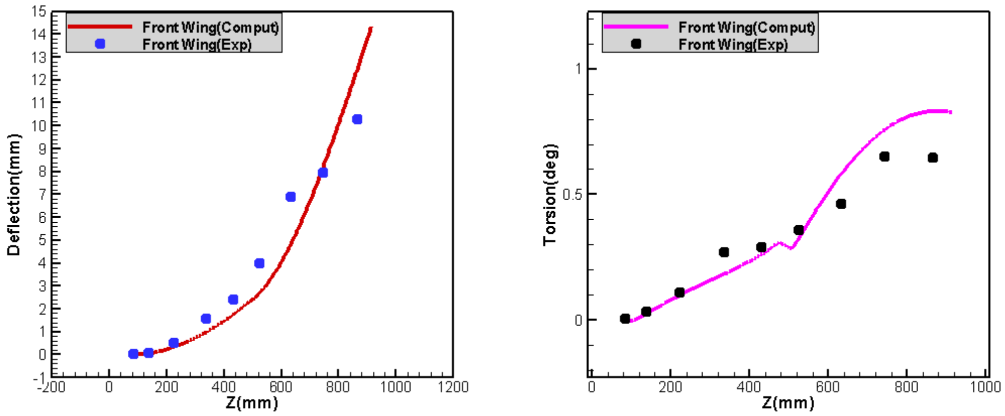

Figure 2: Deflection comparison between numerical simulation and wind tunnel test

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