Boundary Layer Mesh Generation Using Vector Fields Computed by the Boundary Element Method

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ABSTRACT

A typical mesh configuration for viscous flow simulations is to create prismatic elements in boundary layers by marching the surface triangulation on viscous walls along certain directions. The quality of resulting elements and the reliability of the meshing procedure thus highly depend on the computing strategy of marching directions. In this study, we propose to compute a field of marching directions governed by a vector-form Laplacian equation. This new approach could ensure the smooth transition of marching directions, thereby leading to more desirable element shapes. Besides, the possible intersections of boundary layer elements growing from opposite sides of a narrow region could be identified by analysing vector field. With respect to the solution of the governing equation, the boundary element method (BEM) is preferred because of its advantage in solution accuracy. Meanwhile, since the BEM needs an input of the surface triangulation only, there is no need to create a volume background mesh. Following the above idea, we develop a new hybrid prismatic meshing method, and the capability of this method is demonstrated by meshing experiments on models with complex geometries.

Key words: Mesh generation; Hybrid mesh; Boundary element method; Vector field; Laplacian equation; Viscous computation