Golf Ball Wake Patterns with and without Back-Spin

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ABSTRACT

Wake patterns for flow over a stationary and a back-spinning golf ball is presented. In order to represent a golf ball geometry on Cartesian meshes, an adaptive mesh refinement (AMR) based signed distance function (SDF) computation \cite{1} was utilized. By using an efficient and accurate SDF transformation approach \cite{2}, a rotating golf ball was efficiently represented on Cartesian meshes without any re-initialization of the SDF for a rotating golf ball. The number of grids for entire computational domain is considered as approximately 17 billions (\(17 \times 10^9\)), and 128 grids are positioned along a diameter of a golf ball. The multi-dimensional MPI parallelization was applied to compute this very large-scale problem. The computations were conducted on the Nurion supercomputer operated by the Korea Institute of Science and Technology (KISTI), and 32,764 cores were utilized. In order to visualize wake regions of a golf ball, an open-source visualization software ParaView was utilized. Visualization was also performed on the Nurion supercomputer.

Figure 1. Adaptive mesh refinement procedure (level-0 to 6) for computing signed distance function of a golf ball
Figure 2. Instantaneous vortical structure based on $\lambda_2$-definition behind a stationary golf ball at $Re = 1.1 \times 10^5$

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