THE 5TH ASIAN COMPUTATIONAL FLUID DYNAMICS
BUSAN, KOREA, OCTOBER 27 ~ 30, 2003

Active Control of Turbulent Flow over a Model Vehicle for Drag Reduction

Jeonglae Kim [1], Seonghyeon Hahn [2], Dong-kon Lee [1], Jin Choi [1], Woo-Pyung Jeon [2] and Haecheon Choi [1,2]

1. School of Mechanical and Aerospace Engineering, Seoul National University, Seoul 151-744, Korea
2. Center for Turbulence and Flow Control Research, Institute of Advanced Machinery and Design, Seoul National University, Seoul 151-744, Korea

Corresponding author ***Haecheon Choi*** *(choi@socrates.snu.ac.kr)*

Abstract

The objectives of the present study are to examine the applicability of the distributed forcing [1] to flows over bluff bodies having a fixed separation and thus to evaluate the universality of the distributed forcing. Therefore, both the large eddy simulation (LES) with a dynamic model for subgrid-scale stress components and wind-tunnel experiment are carried out for flow over a model vehicle. LES is performed at the Reynolds number of $Re=u_\infty h/\nu=4200$, whereas two different Reynolds numbers of Re=20,000 and 40,000 are considered in the experiment, where u_∞ is the free-stream velocity and h is the body height. In LES at Re=4200, a significant amount of the base-pressure recovery is obtained with the in-phase distributed forcing, while the out-of-phase one leaves the base pressure almost unchanged. Furthermore, the in-phase distributed forcing substantially suppresses vortex shedding, whereas the out-of-phase one does not seem to influence vortex shedding very much. The power spectra of the velocity fluctuations and the spatial distribution of the Reynolds shear stress also show that the in-phase distributed forcing considerably enhances the three dimensionality of the wake behind the model vehicle. Similar results are also obtained from the in-phase forcing in the experiment at higher Reynolds numbers and thus it is believed that the distributed forcing is applicable to a broad class of two-dimensional bluff bodies for drag reduction in a wide range of the Reynolds number.

Keyword: *distributed forcing, model vehicle, drag reduction, base-pressure recovery, vortex shedding*