Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

A numerical study of air layer drag reduction phenomenon on a flat plate[1] DOKYUN KIM, PARVIZ MOIN, CTR, Stanford University — The objective of the present study is to predict and understand the air layer drag reduction (ALDR) phenomenon. Recent experiments (Elbing et al. JFM 2008) have shown large net drag reductions if air is injected beyond a critical rate at the wall. The stability analysis and numerical simulations are performed to investigate mechanisms of ALDR on a flat plate using the same geometry as in the experiment. The linear stability of air-liquid interface is investigated by solving the Orr-Sommerfeld equations, and numerical simulations of two-phase flow have been performed to describe the evolution of air-water interface. The stability analysis shows that the air flow rates, Reynolds number, Weber number, and Froude number are important parameters determining the stability of the air layer. In laminar boundary layer, it is observed from the numerical simulations that the Froude number is the key to the stability of the air layer. The presentation will include a new and very efficient numerical method for two-phase flow calculations used in this study.

[1]Supported by the Office of Naval Research.

Dokyun Kim
CTR, Stanford University

Date submitted: 11 Aug 2009 Electronic form version 1.4