Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Mechanisms Of Pressure Distributions Within Laminar Separation Bubble At Different Reynolds Numbers[1] DONGHWI LEE, University of Tokyo, SOSHI KAWAI, TAKU NONOMURA, AKIRA OYAMA, KOZO FUJII, Institute of Space and Astronautical Science, JAXA — Large-eddy simulation around 5% thickness flat plate at $Re = 5,000, 6,100, 11,000$ and $20,000$ are performed and the physical mechanisms of the pressure distributions (C_p) in laminar separation bubbles are analyzed. Depending on the Reynolds number, a gradual pressure recovery and plateau pressure distribution are observed as experiments by Anyoji et al. [AIAA paper 2011-0852]. The causes of the pressure distributions are quantitatively shown by deriving the pressure gradient (momentum budget) equation from the steady momentum equation. From the results, we identify that the viscous diffusion term near the surface has a major contribution to the pressure gradients, and a different growth of the separated shear layer relying on the Reynolds numbers affects the viscous stress near the surface. The gradual pressure recovery at the lower Reynolds numbers is caused by the progressive development of separated shear layer due to the viscous stress which makes a non-negligible viscous stress. On the other hand, a thin laminar separated shear layer is created at the higher Reynolds numbers because of the relatively small viscous diffusion effects, which results in a negligible shear stress distribution. It makes $dp/dx \approx 0$ and the plateau pressure distribution is generated.

[1]Asahi Glass Scholarship

DongHwi Lee
University of Tokyo

Date submitted: 30 Jul 2014 Electronic form version 1.4