

Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Aerothermodynamics of compressible flow past a flat plate in the slip-flow regime CHI-YANG CHENG, YI DAI, GENONG LI, YITAO HU, ANSYS, Inc, MING-CHIA LAI, Wayne State University — Compressible flow past a flat plate in the slip-flow regime features a very simple geometry and flow field, but it retains the most relevant and interesting physics in high-speed rarefied gas dynamics. In the slip-flow regime, the aerothermodynamic issues, especially the recovery factors and the convection heat transfer correlation, are the focus of this presentation. We first present the detailed similarity equations, especially the transformed Maxwell's slip and jump boundary conditions, and the equations for the Chapman-Rubens parameter as well as how we incorporate the variable gas properties and the constitutive scaling model for the Knudsen layer in the similarity equations. The similarity solutions are compared with results published by E. R. van Driest [NACA Technical Note 2597, 1952]. We point out that van Driest's solutions were computed by using no-slip and no-jump boundary conditions. The recovery factor and Nusselt number of the plate are shown as functions of the Reynolds number and the Mach number. Finally, the similarity solutions are also compared with simulations of a two-dimensional computational fluid dynamics model solving the full Navier-Stokes-Fourier equations with slip and jump boundary conditions.

Chi-Yang Cheng
ANSYS, Inc

Date submitted: 01 Aug 2015

Electronic form version 1.4