Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Numerical Study of Nusselt Number in a Heated Pipe With the Use of Variable-Order Resolution KENNETH DAVIS, Department of Mechanical Engineering and Materials Science, Rice University, PAUL FISCHER, Mathematics and Computer Science Division, Argonne National Laboratory — We present results for a numerical study of turbulent heat transfer in a pipe with a constant heat flux at the wall. Nusselt numbers are computed for Reynolds numbers between 5,000 and 15,000 over a wide range of Prandtl numbers and the results are compared to the Dittus-Boelter relation. The simulations are based on the spectral element method in which the velocity and pressure are represented by tensor-product polynomials of degree N in each of E elements. Typical values of N are in the range 4 to 20 and, for this study, E is between 4000 and 12000. We examine potential savings of using elevated resolution for the temperature field only, which is particularly interesting for the case $Pr > 1$. Specifically, for water flow, one has as Peclet to Reynolds number ratio of approximately six, which implies a need for elevated resolution of the temperature field. This study explores the relative convergence rates and costs when the polynomial order for the temperature field, N_t, is increased with respect to N. We identify the optimal ratio, N_t/N, as a function of Prandtl number as grid convergence is attained.

Kenneth Davis
Dept of Mechanical Engineering and Materials Science, Rice University

Date submitted: 10 Aug 2012 Electronic form version 1.4