Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Direct simulation of heat transfer in a turbulent swept flow over a wire in a channel REETESH RANJAN, CARLOS PANTANO, University of Illinois at Urbana-Champaign, PAUL FISCHER, ANDREW SIEGEL, Argonne National Laboratory — We present results from direct numerical simulations of heat transfer (considered as a passive scalar) in a turbulent swept flow across a thin, cylindrical wire in a channel. This model mimics the flow through the wire-wrapped fuel pins typical of fast neutron reactor designs. Mean flow develops both along the wire and across the wire, leading to the formation of a turbulent cross-flow regime in the channel. This leads to improvement in heat transfer properties of the channel surface due to enhancement in mixing. The friction Reynolds number in the axial direction is approximately 305. Cross-flow friction Reynolds numbers ranging from 0 to 115 are examined. Two passive scalars at Prandtl number of 1.0 and 0.01 respectively, are simulated in this study. Constant flux boundary conditions are used along the walls of the channel and adiabatic conditions are used along the surface of the wire. The numerical method uses spectral elements in the plane perpendicular to the wire axis and Fourier decomposition in the direction of the axis of the wire. The simulations use up to 107 million collocation points and were performed at the Argonne Leadership BG/P supercomputer. The passive scalar field statistics are investigated, including mean scalar field, turbulence statistics and instantaneous surface scalar distribution.

Carlos Pantano
University of Illinois at Urbana-Champaign

Date submitted: 29 Jul 2009 Electronic form version 1.4