Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Assessing Turbulent Convective Heat Transfer Effectiveness with POD-based low order models MARKUS SCHWAENEN, ANDREW DUGGLEBY, Texas A&M — The efficiency of convective turbulent heat transfer processes is significantly affected by turbulent flow structures. These either increase drag within the flow for the gain of higher heat transfer or need to be controlled in order to maintain a given surface temperature level for cooling applications. Proper Orthogonal Decomposition (POD) has proven to be a useful tool for the analysis of structures in turbulent flows. In the approach developed, we extend the use of POD by including the fluid temperature, thus making a quantitative assessment of the interaction between flow structures and surface heat transfer possible. Specifically, we use the low order flow description provided by POD to create a framework within one can identify the most important spatial or temporal flow structures that have undesired implications on the convective energy transport at hand. We achieve this by calculating enthalpy thicknesses based on fluctuating quantities from the most energetic mode pairs. The method has been applied to pin fin heat transfer which might exist, for example, in an internal gas turbine cooling passage.

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Date submitted: 10 Aug 2009 Electronic form version 1.4