Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Coupled Convective and Radiative Heat Transfer Simulation for Urban Environments STEFAN GRACIK, Graduate Student, MOSTAPHA SADEGHIPOUR, Researcher, GEORGE PITCHUROV, Visiting Scholar, JIYING LIU, MOHAMMAD HEIDARINEJAD, Graduate Student, JELENA SREBRIC, Professor, BUILDING SCIENCE GROUP, PENN STATE TEAM — A building's surroundings affect its energy use. An analysis of building energy use needs to include the effects of its urban environment, as over half of the world's population now lives in cities. To correctly model the energy flow around buildings, an energy simulation needs to account for both convective and radiative heat transfer. This study develops a new model by coupling OpenFOAM and Radiance, open source packages for simulating computational fluid dynamics (CFD) and solar radiation, respectively. The model currently provides themo-fluid parameters including convective heat transfer coefficients, pressure coefficients, and solar heat fluxes that will be used as inputs for building energy simulations in a follow up study. The model uses Penn State campus buildings immersed in the atmospheric boundary layer flow as a case study to determine the thermo-fluid parameters around buildings. The results of this case study show that shadows can reduce the solar heat flux of a building's surface by eighty percent during a sunny afternoon. Convective heat transfer coefficients can vary by around fifty percent during a windy day.

Stefan Gracik
Graduate Student

Date submitted: 02 Aug 2013 Electronic form version 1.4