Raya Horesh

# Heat Transfer Model and Inversion for Smarter Buildings

IBM T J Watson Research Center
1101 Kitchawan Rd
Yorktown Heights
NY 10598
rhoresh@us.ibm.com
Lianjun An
Young M. Lee
Young T. Chae
Rui Zhang

In the United States, the energy consumption of commercial and residential buildings exceeds 40% and it is responsible for 45% of greenhouse gas emission. Consequently, saving related energy and costs, improving energy consumption efficiency and reducing greenhouse emissions are becoming key initiatives in many cities and municipalities. For that reason it also plays an important role in IBM smarter planet initiative.
In order to reduce energy consumption in buildings, one needs to understand and be capable of modeling the underlying heat transfer mechanisms, characteristics of building structures, operations and occupant energy consumption behaviors. Often, some of the crucial building envelope parameters are not known. In order to infer thermal parameters associated with buildings envelope, sensor data is utilized within an inversion procedure. The forward problem involves a system of ODEs capturing the governing heat transfer model. Our formulation also involves derivation of adjoints for efficient gradient computation. Through sensitivity analysis, we assess the impact of potential energy saving retrofits and their quantitative impact upon energy consumption of commercial buildings.