Abstract

Buildings worldwide account for approximately 40% of global energy consumption and the resulting greenhouse gas emissions. The building sector is directly or indirectly responsible for about 32% of global energy consumption and for 26% of global end-use carbon dioxide emissions. For example, even a 10% reduction in U.S. building energy consumption saves about the same amount of energy as is currently deployed from all renewable resources and a 50% reduction in buildings' energy usage would be equivalent to taking every passenger vehicle and small truck in the United States off the road. Therefore, achieving significant reductions in energy consumption in the building sector is a problem with huge national and global ramifications. Achieving significant reductions in energy consumption in the building sector present several challenges to science, engineering and physics. As mathematical objects, buildings are complex, multi-scale, multi-physics and highly uncertain infinite dimensional systems with a wide variety of disturbances. Recent results have shown that by considering the whole building as an integrated system and applying modern control, optimization and design techniques to optimize the whole building system, one can achieve greater efficiencies than obtained by optimizing individual building components such as lighting and HVAC. Managing the uncertainties while optimizing the efficiency of a whole building system is a “grand challenge control and design” problem. In this presentation we discuss some areas in the mathematical and computational sciences which are enabling technologies in the control, optimization and design of high performance energy efficient buildings. Simple room level examples are presented to illustrate the ideas and corresponding mathematical challenges.

BIO: John Burns is the Hatcher Professor of Mathematics at Virginia Tech and the Director for the Center for Optimal Design and Control. He has published over 150 research papers on computational methods for identification, design, optimization and control of systems governed by partial and functional equations. He has served as Vice President of SIAM, is the past Chair of the SIAM Activity Group on Systems and Controls and is a Fellow of the IEEE. He was awarded the 2010 Reid Prize for his fundamental contributions in computational methods for and applications in control, design and optimization of infinite dimensional dynamic systems.

Drinks will be served at 3:45 p.m.