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CC2.0 LDRD Seminar Series

2pm – 3pm
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Bldg 15 Rm 253

Building Systems for Net Zero Energy Buildings

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State and federal governments declared that by 2030 all new commercial buildings should be Net Zero Energy Buildings (NZEB). Depending on the climate and building type, a rule of thumb is that to achieve a cost-effective NZEB, the energy demand needs to be reduced by about 70% to 80%, while the remaining energy will be provided by using on-site or off-site renewable energy sources. It is clear that for such an aggressive energy demand reduction, building system solutions need to adapt to the local availability of sources and sinks for thermal conditioning, ventilation, lighting and electricity production, while respecting constraints for occupant health and comfort, building service levels, building system maintainability and aesthetic considerations. As a result, the building becomes an integrated system of multi-physics, multi-scale heterogeneous systems. The underlying equations are nonlinear systems of ordinary differential equations, partial differential equations and algebraic equations with continuous and discrete states. Modeling, simulation and analysis of such systems pose new challenges as systems become increasingly integrated.

This seminar will present our recent research in the development of tools that support modeling, simulation, analysis and operation of complex building systems. To provide a tool for coherent design, fast modeling, dynamic simulation of building energy and control systems, we have developed a Modelica "Buildings" library. Modelica is an equation-based modeling language for dynamic systems and it is based on separation of concerns between modeling physical systems and solving underlined differential algebra equation (DAE) systems. To facilitate the integrated simulation of programs for different domains, we are developing a standard interface for co-simulation between various DAE solvers using the functional mock-up interface. The integrated simulations of complex systems are demanding in computing power. To make them feasible for industrial applications in terms of computing time and financial cost, we are investigating high-performance low-cost computing solutions through the optimization of algorithms combined with the use of parallel computing on graphics processing units. Finally, we will discuss future research needs to apply our findings in a large scale for accelerating the implementation of NZEBs.

Carbon Cycle 2.0 LDRD Seminar Series is a weekly seminar series hosted by Berkeley Lab's Carbon Cycle 2.0 Iniative. Seminars are given by recipients of Laboratory Directed Research and Development (LDRD) awards related to climate and energy. These seminars are open to anyone interested in learning more about the wide variety of Carbon Cycle 2.0-themed research at Berkeley Lab.

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