

# **Tool coupling for the design and operation of building energy and control systems based on the Functional Mock-up Interface standard**

Thierry Stephane Nouidui, Michael Wetter  
Lawrence Berkeley National Laboratory  
One Cyclotron Road, Berkeley, CA  
TSNouidui@lbl.gov

This paper describes software tools developed at the Lawrence Berkeley National Laboratory (LBNL) that can be coupled through the Functional Mock-up Interface standard in support of the design and operation of building energy and control systems. These tools have been developed to address the gaps and limitations encountered in legacy simulation tools. These tools were originally designed for the analysis of individual domains of buildings, and have been difficult to integrate with other tools for runtime data exchange. The coupling has been realized by use of the Functional Mock-up Interface for co-simulation, which standardizes an application programming interface for simulator interoperability that has been adopted in a variety of industrial domains.

As a variety of coupling scenarios are possible, this paper provides users with guidance on what coupling may be best suited for their application. Furthermore, the paper illustrates how tools can be integrated into a building management system to support the operation of buildings. These tools may be a design model that is used for real-time performance monitoring, a fault detection and diagnostics algorithm, or a control sequence, each of which may be exported as a Functional Mock-up Unit and made available in a building management system as an input/output block. We anticipate that this capability can contribute to bridging the observed performance gap between design and operational energy use of buildings.