


Chapter 13

Towards Integrating Occupant Behavioral Modeling With Building Performance Simulation

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ABSTRACT

This chapter explores the integration of occupant behavioral modeling with building performance simulation (BPS) to enhance building energy performance. It discusses methodologies and tools such as obXML, obFMU and occupancy simulator for modeling occupant behavior, along with simulation approaches like user-defined profiles and co-simulation techniques. Limitations of BPS programs are addressed, highlighting their inability to capture multiple behaviors simultaneously and incorporate social influences on occupant behavior in shared spaces. Recent advancements in co-simulation technology offer promising avenues for enhancing predictive capabilities, utilizing major BPS programs. Integrating behavioral models into BPS programs provides stakeholders with insights into occupant interactions with building systems, identify energy-savings, evaluate design alternatives, and predict comfort levels. Continued research in this field is essential to address existing limitations and unlock innovative building design and operation strategies prioritizing energy efficiency and occupant well-being.

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INTRODUCTION

The escalating energy demands in buildings have created an urgent imperative for the implementation of effective strategies to optimize energy consumption. In response to this pressing need, occupant behavior modeling has emerged as a pivotal tool at the forefront of energy efficiency endeavors. At its essence, this modeling approach is centered on the development of methodologies aimed at accurately simulating the intricate interplay of occupants within the context of building energy modeling (BEM). While traditional BEM frameworks have provided a solid foundation, researchers are actively engaged in a journey of innovation, seeking to transcend the limitations of conventional methods (Fen et al., 2015; D'Oca and Hong, 2015). Notably, initiatives like the IEA EBC Annex 66 have played a pivotal role in driving this evolution forward, catalyzing the emergence of novel data ontologies, methodologies and simulation tools specifically tailored to model occupant behavior with precision (Yan et al., 2017). Over the past decade, significant advancements have been achieved, marking the advent of sophisticated approaches such as customized codes and co-simulation techniques. These innovations have been instrumental in enhancing the robustness of occupant behavior representation within the BEM paradigm.

The importance of integrating occupant behavioral modeling (OBM) with Building Performance Simulation cannot be overstated in the pursuit of optimizing energy efficiency and enhancing occupant comfort within built environments. By incorporating realistic representations of occupant behavior into building performance simulations, designers, engineers and policymakers gain invaluable insights into how occupants interact with various building systems and components. This integration enables the identification of opportunities for energy savings, the evaluation of design alternatives and the prediction of occupant comfort levels with greater accuracy (Pan et al., 2023). Moreover, it facilitates the development of more effective strategies for building operation and management, as it accounts for the dynamic nature of occupant behavior and its impact on energy consumption patterns (Zambrano et al., 2023). An overview of occupant behavior and its simulation interface is illustrated in Figure 1.

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