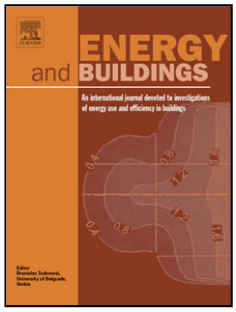

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System Identification for Building Thermal Systems under the Presence of Unmeasured Disturbances in Closed Loop Operation: Theoretical Analysis and Application

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Abstract

It is important to have practical methods for constructing and learning a good mathematical model for a building's thermal system in the presence of unmeasured disturbances and using data from closed loop operation. With this goal in mind, this paper presents a mathematical framework that explains the asymptotic behavior of an estimated model under those conditions and that can aid in learning an accurate model. Some analytic results from the literature of system identification are extended and interpreted for building systems. A new identification approach for determining an accurate thermal network (RC) model for a multi-zone building is developed based on the analytic result, and its superior performance over a conventional grey-box modeling approach is demonstrated experimentally.

Keywords: building modeling, grey-box model, system identification, thermal network, disturbances

1. INTRODUCTION

In the past three decades, there has been great interest in applying system identification methods for characterizing building thermal dynamics. Mathematical models obtained through identification processes have been widely used for many purposes. Identified models for buildings can be utilized for shifting cooling loads using the building's thermal capacities, for optimally operating heating ventilation and air conditioning (HVAC) systems using prediction of future loads and for monitoring building energy performance [1; 2; 3; 4; 5; 6; 7; 8; 9; 10].

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