IER Instituto de Energías Renovables

Guillermo Barrios del Valle <gbv@ier.unam.mx>

Invitation to review for Energy & Buildings

1 message

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Manuscript Number: ENB-D-23-00972

Physics-constrained Graph Modeling for Building Thermal Dynamics

Ziyao Yang; Amol D. Gaidhane; J'an Drgona; Vikas Chandan; Mahantesh M. Halappanavar; Frank Liu; Yu Cao

Dear Dr Barrios del Valle,

I would like to invite you to review the above referenced manuscript submitted by Phd Ziyao Yang , as I believe it falls within your expertise and interest. The abstract for this manuscript is included below.

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Associate Editor

Energy & Buildings

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Abstract:

In this paper, we propose a graph model embedded with compact physical equations for modeling the thermal dynamics of buildings. The principles of heat flow across various components in the building, such as walls and doors, fit the message-passing strategy used by Graph Neural networks (GNNs). The proposed method is to represent the multi-zone building as a graph, in which only zones are considered as nodes, and any heat flow between zones is modeled as an edge based on prior knowledge of the building structure. Furthermore, the thermal dynamics of these components are described by compact models in the graph. GNNs are further employed to train model parameters from collected data. During model training, our proposed method enforces physical constraints (e.g., zone sizes and connections) on model parameters and propagates the penalty in the loss function of GNN. Such constraints are essential to ensure model robustness and interpretability. We evaluate the effectiveness of the proposed modeling approach on a realistic dataset with multiple zones. The results demonstrate a satisfactory accuracy in the prediction of multi-zone temperature. Moreover, we illustrate that the new model can reliably learn hidden physical parameters with incomplete data.

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