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Mocanu, E.; Nguyen, H.P.; Gibescu, M.; Kling, W.L.

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Deep Learning to estimate building energy demands in the smart grid context
Elena Mocanu, Phuong H. Nguyen, Madeleine Gibescu, Wil Kling
Department of Electrical Engineering

Problem and Motivation
Occupancy information can improve building energy management systems
Large meteorological variations yield intense power fluctuations
Quantification of uncertainty introduced with the advent of new renewable energy sources

Energy prediction
Prediction method: Conditional Restricted Boltzmann Machine

People Detection and Localization
Approach: Inexpensive user tracking using Boltzmann Machine

Classification method: Extended Factored Conditional Restricted Boltzmann Machine

<table>
<thead>
<tr>
<th>Lighting consumption</th>
<th>Total energy consumption</th>
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<tbody>
<tr>
<td>Method</td>
<td>RMSE</td>
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<tr>
<td>ANN</td>
<td>2.24</td>
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<tr>
<td>HMM</td>
<td>1.23</td>
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<tr>
<td>CRBM</td>
<td>1.11</td>
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</tbody>
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Total energy function
\[ E(v, h, u, W) = -v^T W^{hv} h - v^T b v - u^T W^{hv} v - u^T W^{uh} h - h^T b h \]

Learning for CRBM using Contrastive Divergence
\[ C_{D_{KL}} = D_{KL}(p(x)\|p_{\theta}(x)) = D_{KL}(p(x)\|p_{\theta}(x)) \]

Probabilistic Inference in CRBM
\[ p(h = 1 | u, v) = \text{sigmoid}(u^T W^{uh} + v^T W^{hv} + b^h) \]

Bias updates

<table>
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<tr>
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Artificial data

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Experiment & Results


Different temporal scales prediction is widely used as input to several decision-making problems in the smart grid context.