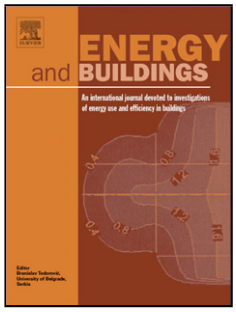

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Uncertainty quantification for Energy Savings Performance Contracting: application to an office building

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Abstract

Building energy models are widely used to estimate or predict the average energy consumption of a building. However, they only provide approximate figures with significant uncertainties. Particular uses such as energy performance guarantee require more reliable results in order to set suitable contracts. For this purpose, uncertainty quantification can be used to support modeling phase and results interpretation. The aim of this paper is to present a comprehensive methodology applied to an office building.

First, sensitivity analysis allows users to identify and prioritize the most influential inputs of their model. Non-influential inputs can then be fixed to their nominal values, without impacting the results. The remaining set of parameters makes it possible to assess quantitative measures such as Sobol' indices which give useful information on the model variance. Different methods are suitable for such calculations but generally rely on specific sample design. Meta-model reduction based on Polynomial Chaos Expansion can be used as a post-processing method and appears to be the best compromise between accuracy and computation time for our case-study. This approach also involves the use of probability density function and cumulative distribution to calculate confidence intervals and probability to exceed a threshold value. At last, the importance of using adjustment variables to take into account time-varying parameters is also discussed.

Keywords:
Sensitivity analysis, Propagation of uncertainty, Polynomial Chaos Expansion, Energy performance guarantee

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