A strategy for fit-for-purpose occupant behaviour modelling in building energy and comfort performance simulation

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Summary

Building performance simulation (BPS) software are useful tools to simulate the energy and comfort performance of buildings. Their use has become widespread in supporting the design and operation of buildings, which are becoming more and more complex and energy-efficient, without compromising indoor environmental quality (IEQ). However, a number of uncertainties related to the BPS models impair the reliability of the simulation outcome.

Occupant behaviour (OB) is recognized as a main source of discrepancy between predicted and actual building performance. For this reason, researchers attempt to offer more realistic alternatives to the simplistic assumptions regarding occupants that are commonly made in building performance simulation (BPS) models. Literature shows a proliferation of increasingly complex, data-based models that describe occupants’ presence, adaptive, and non-adaptive behaviours. However, the use of these models in practice is still very limited. Moreover, simpler models might be preferable, depending on the purpose of the investigation.

This doctoral dissertation explores how computational modelling, simulation and sensitivity analysis techniques can be used to support simulation users towards the appropriate (or fit-for-purpose) selection of OB models for their investigation. More specifically, the aim of this work is to develop a computational methodology that can be used to facilitate the model selection of various OB aspects. The methodology was iteratively developed, verified by means of virtual experiments and tested on a range of existing buildings.

The outcome of this research shows that the computational methodology presented here is able to produce fit-for-purpose models, or models that are able to satisfy the purpose of the simulation in an efficient and effective way. The models obtained with the methodology proposed here allow for more informed decision-making if compared with traditional modelling techniques. When compared to calibrated models, the fit-for-purpose models require less input parameters without compromising the desired predictive ability. For these reasons, the computational methodology is effective in supporting simulation users in the selection of OB models and shows high potential to improve the traditional building design process.
**Simulation**

**Purpose**

**Impact Indices**

**Method**

Can make decision?

**Diversity**

Patterns

Method

Can make decision?

Mann-Whitney U Test

Can make decision?

Reduce uncertainty/

Refine modeling

Can make decision?

FFP OB Model

no

no

no

yes

Can make decision?

no

Sensitivity Test 1

Sensitivity Test 2

Sensitivity Test 2

Dealing with influential OB aspects

- Can still increase complexity or reduce uncertainty?
  - yes
  - The available information does not lead to a reliable answer
  - no

**Fig. 1:** A high level overview of the fit-for-purpose occupant behaviour modelling strategy

**Fig. 2:** The strategy produces more accurate BPS results without requiring complex models for all occupant behaviour aspects