Using agent-based modelling for indoor thermal comfort assessment

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The aim of the paper is to provide better understanding of whether user comfort perception in office buildings and resulting behaviour can be simulated via an agent-based modelling technique. This could serve as the first step to calculate the energy performance of these buildings by taking into account for heterogeneous user actions and preferences.

Agent-based simulation is a widely accepted methodology in the social sciences because it is possible to study the agents' behaviour depending on the relationship with other agents and with environmental factors. Thermal comfort of building occupants is a complex issue. Persons have quite different perceptions what they rate as comfortable. This is not only dependent on properties of the indoor variables (indoor temperature, etc.) but also on building fabric characteristics (like surface temperature, heat distribution within the room) and on user related properties (clothing, etc. but also whether the user feels sick or is an old person).

There are some standardized methods for comfort sensations. The best known are the stationary model of O.Fanger (EN ISO 7730) and the adaptive comfort model of EN 15251. Fanger`s model calculates the heat balance of a person and gives the predicted mean vote for the comfort on a scale. The percentage of dissatisfied people for all thermal conditions is at least around 5% which means that there are always people whose comfort range is not matched by the prevailing thermal conditions (air temperature, humidity, surface temperatures, etc.). The adaptive model goes one step further and postulates the dependence of the comfort temperature range on the outdoor temperatures of the past days.

In a Netlogo simulation the comfort sensations of agents in a room are calculated. Agents can heat or cool the room if the room temperature exceeds their individual comfort range. The typical resulting temperature curves are presented and typical behaviour patterns are explained.