Proceedings of SEBUA-12
ICHMT International Symposium on Sustainable Energy in Buildings and Urban Areas
July 14-20, 2012, Kusadasi, Turkey

SEBUA-12-xxx

ROOM TEMPERATURE CONTROL WITH ADAPTIVE ALGORITHM

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ABSTRACT

Water-based heating systems are mainly controlled by thermostatic valves which ensure a constant room temperature and avoid unintentional cooling or heating e.g. by solar gains. The valve's setpoint is normally set to provide the users "comfort temperature". This "comfort temperature" should only be provided if the user is present. If the user is absent a lower temperature setpoint than the "comfort temperature" is reasonable with respect to energy savings. Reheating the room before the user's return is preferable.

An adaptive control system for single room heating is developed at the Institute for Energy Efficient Buildings and Indoor Climate at the E.ON Energy Research Center of RWTH Aachen University. This system adapts to the user's behavior without initial setup and needs only "too warm" or "too cold" as user feedback to ensure highest usability.

The adaptation algorithm was tested in a simulation modeled in Modelica. Two different hydraulic systems were compared. The first hydraulic system was a system with typical thermostatic valves acting as normal P-controller, the second system included thermostatic valves with PI-controller characteristics. This was done to analyze the impact of an improved controller with regards to the user's thermal comfort and energy savings.

The user behavior was modeled by a fixed scheme for presence and absence, the user's comfort was measured by use of the Predicted Mean Vote (PMV). The Predicted Percentage of Dissatisfied (PPD) was used to decide which feedback the user gives to the adaptive system. Based on this feedback the system creates temperature profiles for every day taking periods of absence into account. The user's comfort and the energy demand were compared to a reference case.

Referring to the reference case, we were able to keep the thermal sensation the same with exception of one room while reducing the energy demand by approximately 12-14 %, with the PI-controlled hydraulic network yielding slightly better results.