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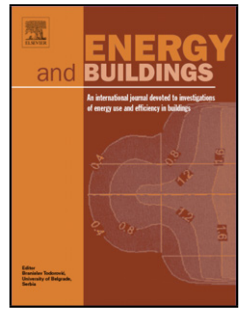

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Thermal Comfort Prediction using Normalized Skin Temperature in a Uniform Built Environment

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Abstract

Thermal comfort prediction can be instrumental in bridging the gap between energy efficiency and occupants' comfort by utilizing the predicted thermal state (Discomfort/Comfort) of occupant as a control criterion for the cooling systems in buildings. Skin temperature, through its heat-transfer properties, plays a significant role in the thermoregulation principle that governs thermal comfort. This paper presents a method termed as Predicted Thermal State (PTS) model, which uses the peripheral skin temperature and its gradient features from a single body location to evaluate the thermal state. The model introduces a novel normalization process to resolve both inter and intra individual differences by incorporating body surface area and clothing insulation, respectively. Human subject experiments were conducted, during which each subject's skin temperatures and respective thermal sensation surveys were recorded while environmental conditions varied from cold/cool-to-neutral levels (18°C-27°C). This study revealed that the combined information of skin temperature and its gradient carry significant potential to establish the thermal state. Four model input cases were compared using Support Vector Machine (SVM) and Extreme Learning Machine (ELM) based classifiers. While non-normalized skin temperature alone could accurately estimate only about 65% of thermal states, the PTS

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