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A simulation model for visitors' thermal comfort at urban public squares using non-probabilistic binary-linear classifier through soft-computing methodologies

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ABSTRACT

Sustaining outdoor life in cities is decreasing because of the recent rapid urbanisation without considering climate-responsive urban design concepts. Such inadvertent climatic modifications at the indoor level have imposed considerable demand on the urban energy resources. It is important to provide comfortable ambient climate at open urban squares. Researchers need to predict the comfortable conditions at such outdoor squares. The main objective of this study is predict the visitors' outdoor comfort indices by using a developed computational model termed as SVM-WAVELET (*Support Vector Machines* combined with *Discrete Wavelet Transform algorithm*). For data collection, the field study was conducted in downtown Isfahan, Iran (51°41′ E, 32°37′ N) with hot and arid summers. Based on different environmental elements, four separate locations were monitored across two public squares. Meteorological data were measured simultaneously by surveying the visitors' thermal sensations. According to the subjects' thermal feeling and their characteristics, their level of comfort was estimated. Further, the adapted computational model was used to estimate the visitors' thermal sensations in terms of thermal comfort indices. The SVM-WAVELET results indicate that R^2 value for input parameters, including Thermal Sensation, PMW (The predicted mean vote), PET (physiologically equivalent temperature), SET (standard effective temperature) and T_{mrt} were estimated at 0.482, 0.943, 0.988, 0.969 and 0.840, respectively.

1. Introduction

Microclimate can be defined as the variation of climate within a small region in a scale of few kilometres [1]. In addition to global warming, microclimate is affected by multiple local factors, namely topography, soil, ground surface and urban geometry, as well as anthropogenic heat [2–4]. In moderate climates, it is possible to ameliorate the microclimatic conditions using modest modification strategies, such as blocking wind, providing shade, or radiation attenuating devices [5]. Form and geometry of urban structures change the microclimatic conditions of a city, which creates and differentiates climate of a given region from other surrounding localities [6–8]. Although outdoor thermal comfort lies on the indoor thermal sensations, the indoor energy need depends on the prevailing microclimatic conditions (i.e., humidity and temperature).

Several personal and environmental parameters consciously and unconsciously affect thermal situation. Moreover, thermal comfort range and conditions varies between and within different climatic zones. Previous studies on thermal comfort were limited

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