CONSIDERING INDIVIDUAL PHYSIOLOGICAL DIFFERENCES IN A HUMAN THERMAL MODEL

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Over the last few years, UCB has developed a comprehensive model of human thermoregulation and comfort. This model is based on the Stolwijk model of human thermal regulation but includes several significant improvements including the ability to model an unlimited number of body segments (compared to six in the original) and a counter-current heat exchange blood flow model. Radiation heat transfer is calculated by the view factor method using a three-dimensional model of the body. It is thus possible to do a detailed assessment of complex radiative environments including the effects of solar radiation. The model is capable of predicting physiological response to transient, non-uniform thermal environments, and closely reproduces the results of many experiments in the literature.

Physiological differences between individuals can significantly affect human thermal response to the environment yet models of human thermal regulation have generally not taken this into account. Most thermal models use a single set of physiological data to represent an average person. We have developed a model that we call “body builder” that translates descriptive data about an individual (height, weight, body fat, gender, skin color and body type) into a set of physiological parameters that can be used by thermal models. Through literature review, we have selected what we feel are the best descriptive equations to calculate physiological parameters such as body fat, body density, basal metabolic heat production, blood flow rates, body segment length, and solar absorption. We have incorporated this “body builder” model into our thermoregulatory model and can use it to predict variations in thermal response between individuals. This paper presents the “body builder” model as well as preliminary comparisons between thermal simulation results and experimental data found in the literature.

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