The Distribution of Air Gap Thickness and the Contact Area During Alpine Skiing

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Abstract

The heat and mass transfer in the functional sport and protective garments is not only affected by the fabric properties but also by air gap distribution between the body and the garment and its change. Until now several studies have been conducted to analyse the impact of clothing fit, moisture content and body posture on the distribution of the air within garment. However, used methods are limited to only a stationary position of the manikin, whereas the air gap changes dynamically with body movement during sport activities due to bending joints. The present study addressed the quantitative and comprehensive evaluation of the 3D garment simulation tool and simulation of air gap distribution change during various activities.

In the first step the 3D garment simulation software was quantitatively validated by comparing these parameters obtained from this tool with the ones obtained from accurate 3D scanning method to assess its capability and accuracy [1]. Next, for the first time, air gap distribution was calculated for garments on walking male avatar wearing t-shirt and sweatpants. The adapted post-processing method could discriminate the differences in the observed parameters over the body regions and among the phases of the movement. Finally, a male human body avatar wearing a coverall in tight and loose fits was simulated during alpine skiing and the developed processing methodology was applied to determine dynamic change of the air gap thickness due to this complex movement.

The presented study showed that the cyclic change of body movement was reflected in the change of the air gap thickness and contact area mainly in the concave body regions and was highly dependent on garment fit (Fig. 1). The findings of this study can be used in theoretical models to understand how the body movement interacting with different garment fit can affect the heat and mass transfer process through the garment. Moreover, the outcome of this study could serve garment designers to improve the wearing comfort and protective performance of sport garments.

Fig 1. 3D colour maps of alpine skiing frames from front of the body wearing tight and loose coverall, where contact area is showed in green and air gap thickness in yellow-to-red scale.

Keywords: air gap, clothing contact area, 3D body scanning, 3D body simulation

References:

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