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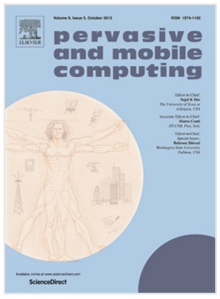

Measuring muscle activities during gym exercises with textile pressure mapping sensors

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Bo Zhou, Mathias Sundholm, Jingyuan Cheng, Heber Cruz, Paul Lukowicz

German Research Center for Artificial Intelligence (DFKI)
and University of Kaiserslautern
Trippstadter Straße 122 , 67663, Kaiserslautern, Germany
{*bo.zhou, mathias.sundholm, jingyuan.cheng, heber.cruz_zurian, paul.lukowicz*}*@dfki.de*

Abstract

We present a wearable textile sensor system for monitoring muscle activity, leveraging surface pressure changes between the skin and compression garment. Our first prototype is based on an 8×16 element fabric resistive pressure mapping matrix with $1cm$ spacial resolution and $50fps$ refresh rate. We evaluate the prototype by monitoring leg muscles during realistic leg workouts in a gym out of the lab. The sensor covers the lower part of quadriceps of the user. The shape and movement of the two major muscles (vastus lateralis and medialis) are visible from the data visualizing during various exercises. With features extracted from spacial and temporal domains out of the pressure force mapping information, with 4 different leg exercises plus non-workout activities (relaxing, adjusting machines and walking), we have reached 81.7% average recognition accuracy on a fine-grain sliding window basis, 93.3% on an event basis, and 85.6% spotting F1-score. We further investigate the relationships between people's perception of the exercise quality/difficulty and the variation and consistency of the force pattern. A second prototype is also developed with tether-free to explore various placements including upper-arm, chest and lower back; a brief comparison with arm-worn EMG shows our approach is comparable on the signal quality level.

Keywords: pressure force mapping, wearable garment, sport science, muscle activity, gym fitness tracking