Alignment of Dynamic Plantar Pressure Image Sequences

Francisco P. M. Oliveira, João Manuel R. S. Tavares

Faculdade de Engenharia da Universidade do Porto (FEUP) / Instituto de Engenharia Mecânica e Gestão Industrial (INEGI), Rua Dr. Roberto Frias, 4200-465 Porto, Portugal, email: {francisco.oliveira, tavares}@fe.up.pt

In this work, a computational methodology to align the plantar pressure in an image sequence with the plantar pressure in a second image sequence was developed. Simultaneously to the spatial alignment, the temporal shift and scale of the first sequence are transformed with the aim of synchronizing the two input sequences. In terms of spatial alignment, the methodology can use rigid, similarity, affine or projective transformations. For the temporal alignment can be adopted linear or curved transformations. The suitable geometric and temporal transformations are found by minimizing the mean squared error (MSE) of the plantar pressure in the two sequences. The best alignment is achieved in two steps: first, a coarse alignment is obtained, which is then improved by using a multidimensional optimization algorithm.

Two kinds of tests were performed to assess the accuracy: 1) a set of known geometric and temporal transformations was applied to the test images, and the residual errors (RE) were computed from the spatial and temporal positions of the pixels. 2) a set of real plantar pressure image sequences were aligned, and the accuracy evaluated by visual inspection and from the MSE values. The methodology revealed high accuracy (maximum spatial RE < 0.04 mm) and robustness in both tests.

A straightforward application of the developed methodology is the automatic building of a mean image sequence model of a subject, which represents more accurately the subject's footstep than a single sequence trial, as 3-5 walking trials are needed to enhance the reliability of the pressure measurement.

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