RECENT METHODS FOR PLANTAR PRESSURE IMAGE REGISTRATION

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Introduction

Image registration is the process of aligned two or more images in a common coordinate system, in a way that similar structures become optimally overlapped. The registration of plantar pressure images has increased in the last years, as various time consuming tasks can be accurately and rapidly reached if the original images are efficiently registered.

The aim of the present abstract is to introduce the image registration methods that we have been developed to register plantar pressure images.

Methods

We have been developed and applied different computational methods to register plantar pressure images. In [Oliveira, 2009], we proposed a methodology based on the matching of the external contours of the feet represented in the images. Afterwards, in [Oliveira, 2010], we applied registration methods based on the Fourier transform properties to search for the optimal registration solution. Later, a two-step computational registration method was proposed in [Oliveira, 2011c]: it starts with an initial pre-registration that is then optimized using an iterative multidimensional optimization algorithm, which searches for the geometric transformation that optimizes the similarity of the pressure distribution. Recently, in [Oliveira, 2011a] a new method has been presented to allow the automatic spatio-temporal registration of plantar pressure sequences representing complete footstep, i.e., 2D + Time.

Results

The registration methods have been applied and evaluated on the registration of plantar pressure images acquired by three different devices [Oliveira, 2011d]: Footscan® (5.08×7.62 mm² each sensor, RSscan International, Belgium), Emed® (2 sensors per cm², Novel GmbH, Germany) and a light reflection system (approximately 1.8×1.8 mm² per pixel). We have considered the residual error to assess the registration accuracy: the position of each foot pixel after the registration is compared with the expected position, Table 1.

For the spatio-temporal registration of plantar pressure sequences from the Emed® device with a frequency acquisition rate of 25 Hz, the maximum spatial residual error has been inferior to 0.04 mm and the maximum temporal residual error approximately equal to 5 ms.

Discussion

Using the methods based on Fourier transform and iterative optimization, the registration accuracy of 2D plantar pressure images has always been very good, with the mean residual error several times inferior to the spatial dimension of each sensor. Good results have been also achieved on the registration of plantar pressure image sequences, with the spatial maximum residual error approximately seventeen times inferior to the spatial dimension of each sensor, and the temporal maximum residual error eight times lower than the time period of each image frame. These plantar pressure registration methods have been integrated into software solutions for statistical analysis, data visualization, atlas building and plantar indices computation [Oliveira, 2011b; Pataky, 2011a; Pataky, 2011b].

References