Automatic Evaluation of Sports Motion: A Generic Computation of Spatial and Temporal Errors

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Automatic Evaluation of Sports Motion: A Generic Computation of Spatial and Temporal Errors

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Abstract

In this paper, we propose an innovative automatic evaluation process for any sport motions. Based on a 2-level Dynamic Time Warping, the process allows the evaluation of both spatial and temporal errors of a novice motion based on an experts' motion database and without any prior knowledge on the sport. This new methodology is evaluated with regards to coaches' assessment on two different kinds of motions: tennis serves and karate *tsuki*.

Keywords: Dynamic Time Warping, Evaluation, Multidimensional features, Synchrony, Motion Capture

1. Introduction

Motion sensors are part of our lives in devices such as smartphones or gamepads. They give information about the motion of the device and thus indirectly of the user body part that holds it. Moreover in recent years, the emergence of new low-cost motion capture systems such as Microsoft Kinect or Noitom Perception Neuron allows access to full-body motion. All these devices are thus radically changing the interaction users have with computers or consoles. It will even lead to a new generation of sports training tools based on the motions of the subject. However, the system must be able to evaluate its performance, to identify its errors and then to propose a way to correct them. This evaluation is a challenging task due to the large types of sports and the variability in morphology and style of the subjects.

In this paper, we propose a new generic motion evaluation method that automatically identifies the spatial and temporal errors performed by the subject, whatever the sport. It is only based on a database of motions performed by experts that includes the different correct ways to perform the motion.

To our knowledge, sport gestures were never studied this way, namely (i) **without any prior knowledge** on the motion to be executed, except some instances made by experts, (ii) by estimating their qualities limb by limb, (iii) by detecting their errors to be corrected. Some approaches exist where an expert specifies what is a good gesture (for a karate kata, the kicking wrist must have a linear trajectory for example). Then, the system has to determine if a new gesture checks or not these rules and possibly evaluates the distance from these rules. The approach proposed in this paper strongly differs from the previous ones in the sense that it is only based on a set of expert gestures. The system learns from this set what is important and has to be checked,