Recognition of Periodic Motions Using One-Dimensional Contour Based Features

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Abstract: *In this article, a new method for detecting periodic motions in image sequences based on one-dimensional features is presented. The method starts by the detection of moving object in the consecutive frames. Then the contours of the moving target are extracted and one-dimensional features are constituted. The features are based on the calculated distance from target contour to its bounding box sides in four directions. By applying the autocorrelation to the calculated distances, four one-dimensional curves are obtained and the periodicity of the target motion is evaluated. The proposed algorithm was tested with a database of 100 videos and experimental results showed the efficiency of the proposed algorithm.*

Keywords: Autocorrelation, human motion, periodic and non-periodic motion.

1. Introduction

All of us in our daily life face with acts that can be divided into two categories: periodic and non-periodic. The importance of recognition periodic motions is related to the periodicity of most human motions such as walking, running, different types of sports and etc. Human motion analysis is a major part in different applications such as visual surveillance systems, virtual reality, advanced user interface and biometrics [1]. The main problem in the area of human motion analysis is the high flexibility of structure and non-rigid motion of the body that causes the complicated processes in motion analysis. Recently some algorithms are utilized to detect periodic motion and its features to overcome the problems of traditional human motion analysis algorithms. These algorithms are successfully used in the areas like motion classification, tracking and human identification [2-5].

In Allmen and Dyer's work [6], periodic motion is defined as repeating curvature values along a path of motion. Method is stated to detect periodic motion using spatiotemporal (ST) surfaces and ST-curves. The projected motion of an object generates ST-surface. ST-curves are detected on the ST-surfaces, providing an accurate description of the ST-surfaces. Curvature scale-space of the ST-curves is then used to detect intervals of repeating curvature values. The work of Cutler and Davis [7], deals with the recognition and analysis of periodic motions. In their method, first moving objects are segmented, then for recognition object's period, the segmented objects in each frame are aligned using object centers and all objects are resized to have the same sizes. The similarity measure and autocorrelation of the objects are used to estimate the periodicity of the motion. To recognize the periodicity of an object motion, one-dimensional power spectrum is estimated and periodicity is presented by the location and amplitude of peaks in the power spectrum. Briassouli and Ahuja [8] provided a method based on time-frequency analysis of the video sequence. Several periodic trajectories are extracted and their periods are estimated simultaneously. Periodic behaviors of moving objects which are using spatial information are extracted.

Cheng et al. [9] introduced a periodic motion feature descriptor for the classification of different kind of sports consisting periodic motion. The method utilizes motion vectors in the horizontal and vertical direction as the basis to extract periodicity features. Then power density spectrum characteristic curves using the modified covariance are obtained. Finally by identifying the local maximums of power spectrum, a series of frequency characteristics are obtained for the analysis of human motion and the recognition of four types of sports that has periodic motion. Tong et al. [10] extract local motion in the consecutive frames and determine the object area using the motion segmentation algorithm. Then the method calculates the mean squared of motion vectors in each frame and obtains motion curve. The local maximums of autocorrelation of motion curve are then used to extract periodicity features by fitting proper Gaussian functions.

Some of the mentioned methods utilize motion vectors or features from motion vectors for the recognition of