BACHELOR THESIS PROPOSAL

Comparing and Optimizing Geometric Distance Measures for Human-Motion Tracking

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April 22, 2024

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1 Topic

The advent of virtual reality (VR) motion capture technology has led to an increased interest in automated feedback systems for human motion. In this context, Felix Hülsmann et al. developed a pipeline that provides real-time feedback for sports coaching in VR. Their work builds upon existing coaching systems, which either provide a crude assessment of the performed motion or feedback generation by combining the two to generate and verbal as well as augmented visual feedback.
A crucial part of this pipeline is the utilization of Dynamic Time Warping (DTW) in order to align input vectors (i.e., skeleton data from a motion capture system) with the requisite temporal frame as defined by the support vector machine (SVM), which is employed for the purpose of classification. It should be noted that input vectors must be of a fixed size in order for the SVM to function optimally.
This thesis will examine the comparison and optimization of several DTW variants and other algorithms for the alignment of time series, including the Frechet distance based on the aforementioned pipeline. Additionally, several distance functions will be explored and evaluated with regard to their accuracy in classifying the movement data. To assess the efficacy of these variations, we will compare our implementations with those presented in Hülsmann's paper, as well as the reference implementations utilized by Hülsmann to assess the performance of his pipeline. Furthermore, we will analyze the algorithms with regard to time and space complexity.

2 Concept [wip]

- Frechét-distance
- ANN-Frechét distance
- DTW
- kNN-DTW
- Sliding-Window DTW
- Global invariance DTW

- BILCO
- several distance-functions
- "A limitation of our pipeline is that temporal properties of the movements are not covered directly. However, for motor actions where the user's timing has an influence on whether certain errors occur, temporal information could be included via adding velocity as well as information on the warping function extracted from DTW"
- "Concerning the augmented feedback, we even do not always need classification in order to provide feedback. In cases where just the attention of the trainee needs to be guided to the crucial parts of the movement with respect to a certain error pattern, we only need the first part of the pipeline, the temporal warping. Then, we could highlight the important joints based on Eq. (2). One aspect of future work is to further investigate when to provide which amount of augmented feedback."

3 Timeline

4 Structure

5 Literature