Region Matching by Optimal Fuzzy Dissimilarity

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This paper presents a method to extract the moment invariant features, introduces a notation of fuzzy dissimilarity to simplify matching computation and proposes an optimal matching pair theorem which can greatly decrease the computing complexity of searching for optimal matching path.

To extract region features independent on translation, rotation and scaling of object, a new coordinate system is established. The origin of the new coordinate system can be set at the mass center of the object. The new axis x' and y' are based on the main inertia axes. The size of the object can be identified by its minimal constraint rectangle called feature rectangle which has minimal area and contains the object based on the new coordinate system. Based on the new coordinate system of the object, the features of regions can be obtained using similar method above. The new axis x_i'' and y_i'' are based on the main inertia axes of the region. Thus the new coordinates of all points of ith region can be obtained. The size of the ith region can be identified by the minimal constraint rectangle or feature rectangle based on the new coordinate system of ith region.

Region matching is supposed to find a set of matching pairs of regions of two objects according to some matching criteria. The fuzzy dissimilarity of the ith vector of source object relative to jth vector of target object can be defined as the normalized Euclidean distance between ith vector of source object and jth vector of target object. A matching map shows all possible matching pairs of regions of two objects. The optimal matching path is the one which reach the minimal sum of fuzzy dissimilarity in all valid matching paths.

To those regions of two objects, which are static relative to the object mass center and distinctive from their features, we find that it is no necessary for them to participate in such a time consuming searching. They can be matched directly according to the following Optimal Matching Pair Theorem: If the matching error of a matching pair (i^*, j^*) is the unique minimum in its row and volume of matching map, then the match pair (i^*, j^*) is in the global optimal matching path. The theorem is general to all matching applications which use matching dissimilarity of two regions. Applying this theorem, one can dramatically save the matching time without losing matching accuracy.

Based on the region extraction and optimal matching algorithm presented, four experiments have been conducted to evaluate its performance.

In some special applications as two regions are similar and interchange their position in two key frames, the region features presented in this paper may be not enough to distinguish regions from each other and mismatches may be caused. More region features such as the position of adjacent region should be extracted and participant in matching.