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3D object indexing and recognition

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Abstract

In this paper, we address the problem of 3D object recognition from a single 2D image using models database. We propose a method based on geometric quasi-invariant features of the 2D images. We index the 2D images in a model base using a modified quad-tree technique that enhance the research process. The final vote that matches the 2D object image to the 3D object of the database is solved by a vector approximation file which overcomes the difficulties of high dimensionality by following not the data partitioning approach of conventional index methods, but rather as filter based approach.

Keywords: Model base; Geometric quasi-invariant; Content based indexing and retrieval

1. Introduction

An easy way to recognize an object in an image is to find the more reassembling object in database models. This problem can be considered as an indexing problem which consists in calculating an index key from a set of image features and comparing these keys to find similar images. The keys comparison gives a global similarity between images and the rate of matching images. Several image features can compose image index. We are interested in geometric ones.

It exists a large number of contributions to the indexing problem [1–4] with geometric features. Segments are particularly interesting features because of their robustness to noise and their connectedness constraint that reduces the possibility of false matches, since it is based on a topological reality in the image. They also have the properties to vary slightly with a small change in the viewpoint, and to be invariant under similarity transform of the image [13–22].

Since these features are used to match objects, we needed to use geometric invariant features. We considered therefore as 2D image features the intersecting segments and transformed them to couples of quasi-invariants features (ρ, θ) [11]. The set of (ρ, θ) couples find in the image are to be the object indexes.

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Our aim is to develop a complete recognition system based on matching geometric quasi-invariant indexes [8]. This induces that recognition and indexing is restricted to 2D–2D matching and recognition. Instead of directly interpreting 3D object information, we stored several 2D features (quasi-invariant) of a 3D object, and perform the object retrieval in the 2D indexes representation space [7]. Once the object has been identified, it is easy to backtrack the 3D information. To enhance the search process, the quad-tree algorithm [5] is adopted to code these indexes instead of the hashing table.

When a request image is to be compared to the images of the image base, this is done by comparing the request object indexes to those in the geometric model base. The method we propose begins by extracting the request image geometric features, and build the object indexes (quasi-invariants). We then search in the geometric model base the nearest indexes. A final vote step will identify the best matching object from the geometric model base (Fig. 1). This last step is performed by a vector approximation file [6] which overcomes the difficulties of high dimensionality by following not the data partitioning approaches of conventional index methods, but rather act as a filter based approach.

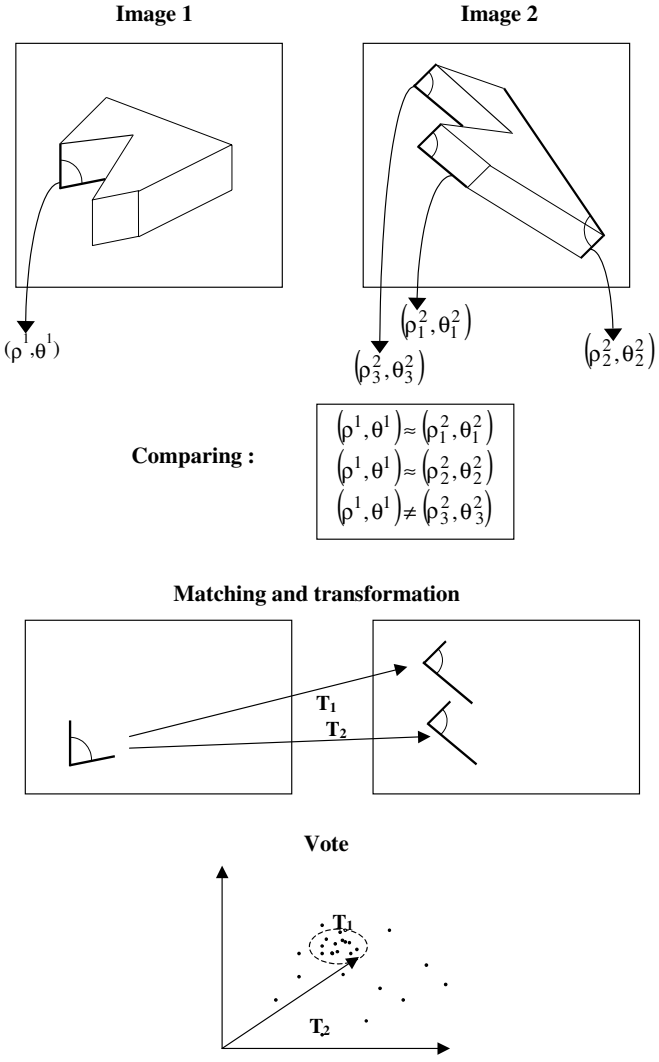

Fig. 1. Matching process.