Correspondence matching of non-coplanar circles from a single image

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Abstract

In this work we have proposed a method to determine 2D-3D correspondence between non-coplanar circles from a single image. Our method uses image conics to compute circle plane orientation in camera coordinate system, thus bringing the problem from 2D to 3D domain. This information is used to generate projective invariant descriptors which can be used directly for correspondence matching, given that the 3D information about circles are known. Additionally, the evaluation also covers study stability of the projective invariants and the factors affecting their computation. One of the intended applications is for tracking industrial objects with circles on it.

In our approach we use conic properties of circles to compute projective invariant descriptors. These descriptors are matched with known 3D information to establish correspondences. We also demonstrate stability of the invariants used to generate descriptors, In our approach we compute 3D plane orientation of each circle from its image contour, and compute projective invariants between each pair of circles. We propose a new descriptor

1 Introduction

Correspondence matching is one of the key problems in computer vision. Applications related to pose estimation or object detection require accurate knowledge of model features and their corresponding image features. This is a challenging problem especially for monocular systems. Machine learning based methods [6] provide promising results, but are limited to a specific group of objects and require prior learning of the object. Many authors have proposed using natural features like points, lines and conics for solving correspondence problem. The core idea is to compute projective invariants from such features to obtain robust matching with model feature points.[Quan] One approach is using two or more images from different perspective to find same image features and then obtain correspondence using triangulation technique. The problem is more complex with a single image as depth feature is lost. In this paper we will focus on solving this particular problem of matching from a single image.

Single image correspondence matching problem is easier to achieve when a group of coplanar model features ar also in use due to their reliability and performance.

Explain the problem in detail, the motivation for the work and the proposed application in mind.Explain the problem in mind (finding correspondence between non planar conics). The proposed solution, independent of the application. Comment on why circles and the paper we build up to. The assumptions made in our work.

2 Related Work

Many applications in vision or augmented reality using points and lines for single image correspondence. Work done by zissermann and safreed on computing 3D position. Single circle based coded solution proposed by TRIP. We work on problem of un-coded circles which can very much be natural features of a particular model.

We are fixed on fiducial based systems or sparce points and therefore other solutions of markerless are not idea because selection of feature points in not in users hand.

Write about the uniquness of the work and proposed analysis of the invariants.

3 Method

Page 3: The available information, the concept of descriptor and back ground of the reprojection

3.1 Descriptor design

The invariant analysis and selection of the invariants <d,theta>, <d,th1,th12,th21,th22>

3.2 Step 1: Initial Matching

- Algorithm

3.3 Step 2: Triplet Matching

- Matching steps on voting

3.4 Step 3: Hypothesis generation

Process the voting matrix to generate hypothesis

Hypothesis of correspondence as output. Selection of the matching pairs. (3 are enough to predict solutions) since we know the calibration.

4 Evaluation

Page 5: Model 1 : 12mm Model 2 : 8mm-5mm Ground truth : GOM data for 3D and 2D correspondences.

4.1 Matching comparison

1. Exp 1 : Models on their own 2. Exp 2 : Models in presence of each other.

4.2 Time

Time taken for high resolution images and low resolution images. Tracking applications specific performance comments.

5 Conclusion

Page 7 : The conclusion and the comments

6 Future Applications

References

[1] A. Alpher. Frobnication. *Journal of Foo*, 12(1):234–778, 2002.

[2] A. Alpher and J. P. N. Fotheringham-Smythe. Frobnication revisited. *Journal of Foo*, 13 (1):234–778, 2003.

[3] A. Alpher, J. P. N. Fotheringham-Smythe, and G. Gamow. Can a machine frobnicate? *Journal of Foo*, 14(1):234–778, 2004.

[4] Authors. The frobnicatable foo filter, 2006. ECCV06 submission ID 324. Supplied as additional material `eccv06.pdf`.

[5] Authors. Frobnication tutorial, 2006. Supplied as additional material `tr.pdf`.

[6] R. I. Hartley and A. Zisserman. *Multiple View Geometry in Computer Vision*. Cambridge University Press, ISBN: 0521623049, 2000.

[7] N. David Mermin. What's wrong with these equations? *Physics Today*, October 1989. http://www.cvpr.org/doc/mermin.pdf.