An Empirical Study of Some Feature Matching Strategies

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Abstract

This paper proposes an empirical evaluation of different matching strategies that have been proposed in the literature to solve the problem of feature point correspondence between images. They will be evaluated in terms of their ability to reduce the number of false matches in given match sets, while preserving the good matches. The validation process determines the number of good matches and the proportion of good matches in a given match set, and this for the different parameter values of a matching constraint.

1 Introduction

Recently, great advances were made in establishing correspondence between views generated by uncalibrated systems of cameras. Most matching schemes share a common structure [11, 15, 16]. They apply correlation between automatically detected feature points to obtain a set of candidate matches. Then, a robust estimation method is used to find the epipolar or trifocal geometry of the camera system. This estimated geometry can then be used to reject some incompatible candidate matches, and to guide the search for more matching points.

The efficiency and accuracy of this scheme depends greatly on the quality of the candidate match set initially obtained. Indeed, robust estimators require candidate match input sets with many correct matches to find an accurate solution, and with few mismatches to perform efficiently. Thus, candidate match sets should be filtered before camera system geometry estimation. This is generally done by introducing basic constraints that aim to eliminate mismatches. These additional constraints are basic in the sense that, at the stage where they are applied, the epipolar or trifocal geometry of the camera system geometry is not yet known. Thus, neither image rectification or guided matching are possible at this point.

In this paper, we propose to empirically compare and validate the effectiveness of different matching strategies. They will be evaluated in terms of their ability to reduce the number of false matches in given match sets, while preserving the good ones. The match sets obtained by these matching strategies are intended to serve as input to robust estimators of the epipolar geometry which can thereafter be used in further improving the sets. It is important to note that the constraints and strategies studied here would not be sufficient, by themselves, to find match sets of sufficient quality. Instead, they should be used within more elaborate matching schemes. The objective of the present study is therefore to validate the constraints used inside matching algorithms, not to study these algorithms as a whole. These algorithms have been surveyed and empirically compared in several other works [3, 5, 9, 12].

Many authors use iterative processes in the steps preceding robust estimation. Relaxation is such an iterative process [16]. In this case, an energy function, corresponding to some aggregate value of a constraint applied to the pairs in a candidate set, is iteratively minimized. Testing the same constraint outside of such an iterative scheme represents a good measure of its effectiveness. This is why we have chosen to limit the scope of this study to the direct application of constraints.

The next section describes our scheme for evaluating matching methods. Then, section 3 studies the role of feature point detection in matching. Section 4 looks at the way in which correlation is applied. Section 5 is concerned with matching constraints that require corresponding features to have similar properties. Section 6 looks at matching constraints that require matches to have similar disparities as their neighbors. Finally, section 7 justifies the use of some matching constraints when the goal is fundamental matrix estimation.

2 Validating Point Correspondences

The feature point matching problem consists in finding pairs, among many candidate feature points, that correspond to the same scene element. To evaluate and compare matching strategies, we will use image pairs on which all possible good matches were identified, among fixed sets of detected