2012 International Conference on Indoor Positioning and Indoor Navigation, 13-15th November 2012

Image Matching Techniques for Vision-based Indoor Navigation Systems: Performance Analysis

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ABSTRACT

Image matching techniques have been used in a variety of applications, such as 3D modeling, image stitching, motion tracking, object recognition and vision based localization. Over the past few years, many different methods have been developed, which can be generally classified into two groups: area-based matching (e.g. cross-correlation, least-squares matching) and feature-based matching (e.g. SIFT). No single algorithm, however, has been universally regarded as optimal for all applications.

A matching procedure actually consists of three steps: firstly, an interest operator (or feature detector) identifies image locations presenting rich visual information; secondly, a vector describing local textures (descriptor) is generated for each image location identified previously; and finally, matching is performed to associate each descriptor with its correspondence in the image to be matched with. While a good number of interest operators, feature descriptors and matchers have been proposed in the literature, for a certain type of applications a suitable combination of some or all these three parts is necessary. However, very little work has been done on the evaluation of interest operators, descriptors and matchers in the context of vision-based indoor navigation systems, which works an effective alternative for satellite based navigation systems.

In this paper, we explore the performance of image matching techniques according to the specific needs of vision-based positioning systems for indoor navigation applications. An ideal system of the kind will be able to detect a large number of features that are well-distributed from query images and then, match them reliably across images in the database. Moreover, matching accuracy is the most important criterion for the evaluation of such applications, for it can further affects the positioning accuracy. Therefore, a detailed comparison study is carried out to evaluate the matching accuracy and reliability between the SIFT and least-squares matching methods. And their impacts on final positioning accuracy are analyzed. Furthermore, some drawbacks of current image matching methods used in the system are compensated by adopting improved matching techniques such as ASIFT for viewpoint invariance. This work is one of the critical steps to find suitable

interest operators, descriptors and matchers for image matching techniques used in vision-based navigation systems in order to improve the overall performance in terms of accuracy and reliability.

KEYWORDS: indoor positioning; vision; image matching