答辩后归档材料：

博士/硕士论文题目：基于局部不变特征的图像匹配研究及导航中的应用

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毕业论文的摘要

（中文摘要）

近十几年来，随着数字图像获取设备日益成为生活便利品，计算机存储介质成本不断降低，互联网络技术迅速发展，同时随着人们对视觉媒体日益关注，互联网上数字图像的数量和种类正在以前所未有的速度增长。互联网正变成一个无比巨大的图像数据库，图像数量数以亿计。如何有效地对图像进行分析和处理成为一个具有挑战性的课题，图像匹配正是其中一个重要组成部分。本文的研究试图从局部不变特征的角度使图像匹配方法能够在仿射变换或者光学变换的图像间鲁棒地匹配。为此，本论文的一项重要研究内容在于如何提高局部不变特征的描述能力上；同时本论文还探索图像匹配技术在导航上的应用，该应用对匹配算法的实时性和鲁棒性提出了更高的要求。本文做出的主要贡献如下：

第一，提出一种新的局部不变描述子(PRCS)。局部不变特征(如 SIFT)能够对图像的仿射变换和光学变换具有不敏感性。提取局部不变特征一般包括两个部分：寻找兴趣点和描述兴趣区域；前者被称为检测子，后者被称为描述子。而 Mikolajczyk 和 Schmid 通过实验证明：检测子对局部不变特征的性能影响差异不大，而描述子对其性能的影响更加明显。所以本文重点研究局部不变描述子，并提出了

一种融合亮度和颜色信息的局部不变描述子(PRCS)。该描述子的性能相对于常用的一些局部不变描述子有明显的提高。

第二，改进了基于局部不变特征的图像匹配方法。基于局部不变特征的图像匹配方法一般分为初始匹配和消除错配两步。其中初始匹配就是通过特征间的一一匹配来确定初始匹配点对集合，然后使用 RANSAC 方法从初始匹配集合中拟合基础矩阵；最后通过判断初始点对是否符合基础矩阵描述的（同一场景的）两幅图像外极线几何约束来消除错配。本文正是从这两方面改进了该匹配方法，首先通过一个自适应的分块(根据图像特征的“密度”)来加快初始匹配的速度，并在一定程度上减少了错配；然后，提出了权重 RANSAC 方法加速基础矩阵的拟合。在对比实验中，我们的匹配方法在速度上比一些经典的方法提高了将近一倍。

第三，设计和实现了一种基于本文提出的图像匹配方法的导航仿真系统。该系统尝试去克服飞行过程中拍摄的图像存在的各种变化(如光照、尺度等)的影响，并通过一系列方法提高导航速度；该系统(在仿真条件下)能够准确和实时地在较复杂的环境下导航。

关键词：图像匹配，局部不变特征，兴趣点，SIFT，PRCS，RANSAC，基础矩阵，外极线约束，图像导航.

（英文摘要）

In the past ten years, with increasing conveniences of capture devices, decreasing prices of storage devices, advances of web technologies and increasing interest in visual media from users, the number of images on the Internet is growing explosively. Internet has become an unprecedented large image library with billions of images. It is a challenging problem how to analyze and process so many images. Especially for image matching, it is very difficult to match diverse real images. The thesis aims to present a new matching approach based on local invariant features to make it more robust to photometric and affine variance. Thus, a significant focus of the thesis is to investigate the way to improve the descriptive power of local invariant descriptors. Three main contributions of the thesis are summarized as follows:

1) Propose an effective and efficient local invariant descriptor (PRCS). Local invariant feature can be robust to photometric and affine variance in an image. There are two steps in extracting local invariant features: locating interest point (keypoint) by a detector and describing the local patch around the keypoint through a descriptor. The evaluation experiments performed by Mikolajczyk and Schmid showed that the ranking of accuracy for different algorithms is relatively insensitive to the methods employed to locate interest points in images, but depends much on the representation used to model image patches around interest points. Thus, we pay more attention to descriptor design and propose an effective local invariant descriptor combining color and luminance information, which

outperforms some common descriptors such as SIFT.

2) Improve the image matching method based on local invariant descriptors. Image matching methods based on local invariant descriptors commonly consist of two steps: initial matching and the elimination of outliers (false matches). The initial matching collects matched keypoint pairs by computing the similarity between two features. Then, the RANSAC method is generally used to search for a fundamental matrix which approximately optimally describes the epipolar constraints between two views of the same rigid scene so that inconsistent matches can be removed. It is just these two aspects that improve the classic matching method. On one hand, we speed up the initial matching procedure by dividing the two matching images adaptively according to the density of the image features. On the other hand, we propose a weighted RANSAC method to improve the convergence speed of solving the optimized fundamental matrix. In some related comparison experiments, the speed of our method nearly doubles that of the classic method.

3) Design and implement a navigation simulation system based on the proposed image matching approach. In the system, we try to overcome the influence of various kinds of variances (e.g, photometric, scaling and etc.) in images captured from the flying aircraft, and some tricks are employed to improve the navigation speed. The designed simulation system can smoothly and real-time implement navigation in some complex environments.

Keywords: Image matching, local invariant features, keypoint, SIFT, PRCS, RANSAC, fundamental matrix, epipolar constraint, image navigation.