Chapter 32
Image-Based 3D Reconstruction on Distributed Hash Network

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ABSTRACT

In order to optimize the workflow of iterative 3D reconstruction and support the goal of massive image data processing, high performance and high scalability, this article proposes an image distributed computing framework FIODH. It is a distributed computing framework based on distributed hash algorithm, which accomplishes the task of storing, calculating and merging the image data in multiple nodes. A SIFT algorithm is used to extract feature points from the original images which are distributed on the hash nodes. During the process of image clustering computation, the agent nodes are responsible for task management and intermediate result calculation. The clustering results in hierarchical trees which can be converted into computational tasks and assigned to the appropriate nodes. The experimental analysis shows that the algorithm has achieved satisfactory results in efficiency and error adjustment. In a large amount of experiment data, the advantage of the algorithm is more obvious.

INTRODUCTION

Background

The estimation of camera pose and the generation from the sparse points, the basis for dense matching and texture mapping, are very important in 3D reconstruction. There are two main methods, one is the overall reconstruction, and the other is iterative reconstruction. The overall reconstruction processes all the images together and avoids the problem of local optimization, however its calculation is very large and once a new picture is added, all the images need to be reprocessed.

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While iterative reconstruction uses the relationship between multiple images and perform incremental computation. When a new image is added, only this new one is required to be calculated. The disadvantage of iterative reconstruction is the cumulative error caused by the calculation of the image based on the specified sequence. In addition, much of time is consumed in the process of image matching. So when reconstructing from large-scale images, it often causes slow operation and even failure of reconstruction.

Therefore, the availability and capacity of the image storage system have become the two important issues in the calculation. The real availability and good performance of the automatic elastic telescopic storage system can not only solve the problems in storage system, like machine failure, hard disk damage and user data overflow, but also reduce the risk of workload, and ensure system be more durable and stable.

So, in this paper, we focus on how to introduce the high-performance storage and calculation in the iterative reconstruction.

Related Works

Iterative reconstruction has attracted many scholars because of its obvious advantages, and they have focused their efforts on the research and improvement of algorithms. Snavely et al. (Snavely, Seitz &Szeliski, 2008) uses image position covariance to estimate a initial relationship among images, as the bundle start point. Crandall et al. (2011) uses MRF to acquire constraints between images parameters and uses LM algorithm to optimize the computation result. Sattler et al. (Sattler, Leibe & Kobbelt, 2012) uses active correspondence search and visibility filtering to improve registration performance.in this way, He can filter out the best 2 dimensional and 3 dimensional matching positions with the shortest search time. The method adopted by Fiore P. (Fiore, 2001) is dimension reduction. He decomposes the feature points and maintains the features of the main direction so that the computational scale can be reduced. Simon et al. (Simon, Snavely & Seitz, 2007) selects a representative set of samples from an existing collection of images that visually represent the original scene. Each set of samples can be computed and corresponding label records can be obtained. Snavely et al. (Snavely, Seitz & Szeliski, 2006) uses the idea of image modeling to develop an interactive framework that automatically calculates the pose of an image by means of interactive information. With model and photo correspondences, he provides image-based applications that allow for free switching between images, depending on location and perspective. Zhang et al. (Zhang, Liu & Dong, 2016) believe that the main problem affecting SFM is the occlusion of objects and the interference of noise and data. To solve this problem, he built a method of tracking the feature points of different images and found the feature association between images. Wan F. et al. (Wan & Jin, 2018) builds a condensed hierarchy tree during the period of dense match to avoid invalid match and computation to improve the iteration speed.

To speed up the computation for huge numbers of images, there are also some distributed framework put forward and many related research work has been carried out. Sandholm et al. (Sandholm & Lai, 2009) argue that task sharing is the most effective way to improve computing efficiency. In its cluster framework, the management and use of shared data are emphasized. Therefore, a variety of scheduling algorithms are proposed to coordinate the utilization of resources. In his cluster framework, the management and use of shared data are emphasized. Therefore, a variety of scheduling algorithms are proposed to coordinate the utilization of resources. The work of Tierney (Tierney, Lee & Chen, 1994) provides a distributed data storage system. In order to minimize the performance constraints that arise from the problem of the machine platform itself, he optimizes as much of the underlying service as possible to

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