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ELASTIC PARALLEL COMPUTING PLATFORM BASED LUNAR ROVER STEREO VISION SYSTEM DESIGN

Abstract

In China's lunar exploration program, lunar rover stereo vision system is used for navigation and exploration. Stereo image pairs which are collected by binocular stereo vision cameras are transmitted to ground station to reconstruct lunar 3D terrain environment. More than one hundred image pairs are collected at one site and terrain data increases rapidly as the rover explores more unknown area such that sequential system cannot generate visual environment in time dual to large data scale. To break through time bottleneck, we build elastic parallel computing platform using Hadoop, a distributed computing software platform running on a small cluster of machines which consists of 10 computing nodes with one of them is the master and the others are slaves. Two key modules of stereo vision system, stereo-matching module and terrain triangulation module, are applied on the cluster. The platform processes image pairs and generates disperse 3D point clouds parallel, then joints different point clouds stored in each computing nodes. Additionally, a new implementation of parallel Delaunay triangulation algorithm runs on the elastic computing platform which can adjusts its parallel degree to get the largest speed-up radio. The lunar rover stereo vision system has been tested in lunar terrain simulation ground and the experiment result shows elastic compute platform can obviously accelerate 3D lunar terrain generation speed compared with traditional sequential system. We analyze the performance of the system in the process of terrain triangulation using simulation data sets range from 500 terrain characteristic points to 50 million points. The platform always gets the most speed-up radio because it can elastic decide the number of computing nodes according to the scale of data set. This paper describes the design and structure of elastic compute platform based lunar rover stereo vision system in detail and illustrates the complexity and efficiency parallel algorithm.