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A Kind of Lidar Application Grid Based on eScience's View

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Abstract

eScience means sharing documents, information and knowledge in research team and makes convenience to cooperate working. Furthermore, eScience becomes a social research platform open to anyone who is interested in specifically subject and can easily participate in it. The goal of this paper is to put up a web based distributed forest lidar processing service for forest researchers. Through a dedicated web portal users can have easy and fast access to the different service regardless the place where they are physically located. The main forest stand average height extracting algorithm encapsulated to service is integrated in a grid based infrastructure by using SIGRE middleware and SIGApp middleware. The workflow of this experiment system and results are be set out and discussed.

Keywords: *E-Science, forest lidar application, grid, SIGRE*

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1. Introduction

E-Science (or eScience) is computationally intensive science that is carried out in highly distributed network environments, or science that uses immense data sets that require grid computing. The term "E-Science" was created by John Taylor, the Director General of the United Kingdom's Office of Science and Technology in 1999 and was used to describe a large funding initiative starting in November 2000 [1] eScience means sharing documents, information and knowledge in research team and makes convenience to cooperate working. Further more, eScience becomes a social research platform open to anyone who is interested in specifically subject and can easily participate in it.

Recently forest researchers have developed many models and algorithms on earth observation data and field data to extract or predict forest stand information. Unfortunately, many scientists only use desktop software to process data and to do their specifically algorithms. These useful algorithms cannot to be used by others expediently. Sharing the EO algorithms and taking clear of the "information lonely island" need newly information and communications technologies such as eScience technique. Although we have some huge eScience platforms, but their environment and resources are designed for specifically community and have management restrict for disrelated researchers. On the other hand, the common E-Science tools, such as Duckling 3 by Chinese Academy of Science or Jetspeed 2.1.3 [2],[3], only have the functions in sharing documents, information and knowledge in research team. They cannot offer computing deployment function.

The goal of this paper is to put up a web based distributed forest lidar processing service for forest researchers. The service uses grid technology to provide a uniform man-machine interface for user's data uploading and result spreading over the web. The users who interested in the forest stand average height extracting algorithm from lidar data, can upload their own data and get the results. This kind smart eScience tools can integrate research's geo computing program in a grid based infrastructure to the web service publishing.

After a short introduction of the research objective, the paper gives the main architecture and supporting gird for the forest application. We present the forest stand average height extracting algorithm in this system and describe the encapsulation by web service technology. In the fourth part, we lay out the workflow of this system. In the end, some discussions of this work are put up.

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2. Architecture and Supporting Grid

The architecture of forest lidar application grid environment is a distributed parallel processing one that has four layers (Figure1). All the computing resources can be distributed, discovered, and matched astronomically by a runtime environment shortly named SIGRE (full name is the Spatial Information Grid Runtime Environment) by deployed SIGRE instance on the resource nodes conveniently. The forest lidar processing service is deployed in SIGRE. Above the SIGRE, we use SIGApp, a kind of workflow middleware, to organize the service for an application. In this application, SIGApp arranges the data uploading service with the forest lidar processing service. The security mechanism uses the users authority management which takes place in Jetspeed. The forest lidar application is encapsulated as a portlet to embed in Jetspeed framework.

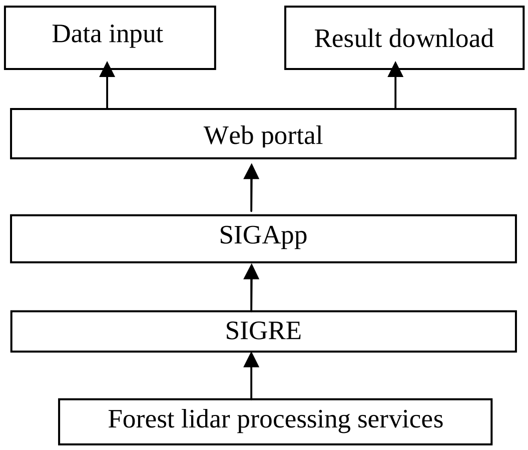

Figure 1. Architecture of forest lidar application grid

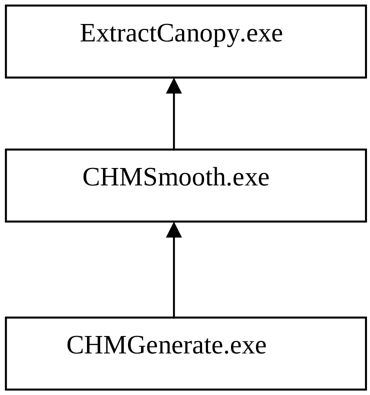

Figure 2. Steps of stand average height extracting algorithm based on lidar data

SIGRE is founded based on the following components----JVM and JRE , web server, and servlet container and they should be downloaded and in-stalled separately for the sake of the user's free choice on them. SIGRE provides a basic job framework and make it possible to create, run, monitor, and manage a job through web service interface [4],[5].

When the resource node is built, the static information of the resources must be registered to the resource registry and discovery service. When the services are invoked executed, the status information about them will be probed and collected by the node monitor. And the information organized and analyzed by the service monitoring service and node monitor will be provided to the resource registry and discovery service for service discovery and matching [4],[5].

SIGRE can only manage the job or web service separately, and that SIGApp is a tools to put the unattached web service working together for the specifically target. The lidar processing web services are arranged in a XPDL file which means a workflow definition document. SIGApp middleware reads the XPDL file information and puts them in a web graphic mode to end user. SIGApp is built with Java and run in java servlet container. With these tools, the forest lidar data stand average height inverse application can be set up easily [6].

Jetspeed is an Open Portal Platform and Enterprise Information Portal, written entirely in open source under the Apache license in Java and XML and based on open standards [5]. We use Jetspeed 2.1.3 as the application portal. Through the provided robust portal security policy, the parameter input and running monitoring of forest lidar processing service can be as portlets to aggregate to the portal by creating a page. Each portlet is an independent application with Jetspeed acting as the central hub making information from multiple sources available through a single web site to use manner [3].

3. Lidar Application Grid for Forest Escience

LIDAR (Light Detection And Ranging) is an optical remote sensing technology that can measure the distance to, or other properties of a target by illuminating the target with light, often using pulses from a laser. Recent years, many researchers use lidar to extract interest information. Researchers want to build lidar data processing gird for more people, but they only had the design no implement [7]. In forest research area, stand average height is an important index for stand site expression, which cannot inverse from traditional optical remote sensing image but from lidar. Dr. Liu develops a double-tangent crown recognition algorithm according to individual tree features using high sampling density airborne LIDAR data (discrete-return , average laser pulse sampling space is 0.52 m ,average footprint diameter is 0.3 m), and then extracts the individual tree heights and computes the stand average height [8].

The present research puts above programs into the gird supporting environment for eScience. The lidar stand average height programs are behaved as functions of a Windows based software in C language DLL mode. The first procedure is to change these three programs form Windows mode to dos mode running programs with parameter file receiving. All the parameters of the input and output of the original programs are prescribed in the fixed format in the parameter file. (See Figure 2) These exe executable files in dos mode can be registered in SIGRE as a job with some descriptions. The CHMGenerate program generates the crown height models image, which is looks like a kind of digital surface model, from lidar pre-treatment digital surface model image and digital elevation model image. The CHMSmooth program smoothes the above crown height model image. The ExtractCanopy program extracts the individual tree heights and computes the stand average height, then put these information into the corresponding stand attribute database file [9,10].

4. User Interface and Implement Results

In the open eScience view, users can upload their data by the web portal interface following the requirements of the specialty algorithm. After using distributed service resources, users can get result data from web interface.

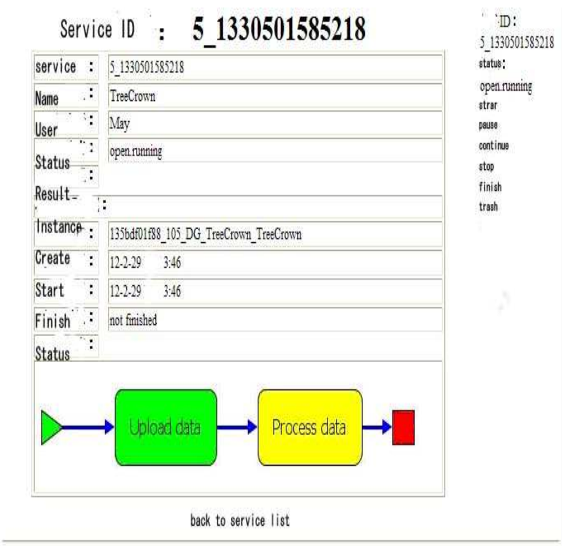

Figure 3. Workflow of forest lidar application

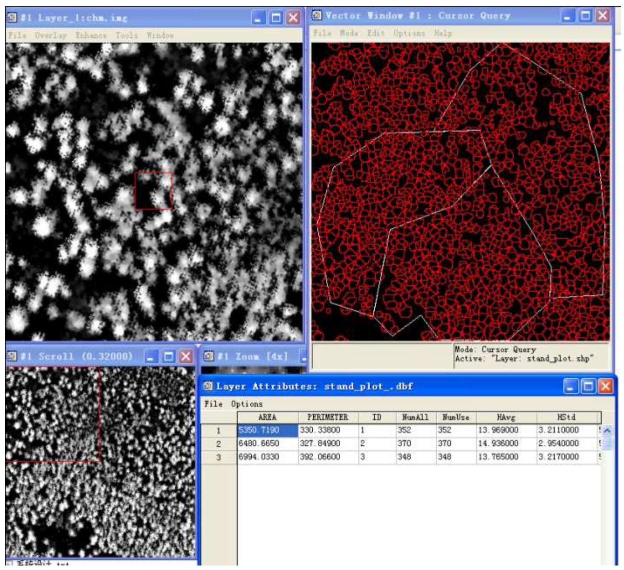

Figure 4. The images of the results

Figure 3 and Figure 4 show the research results of implement forest lidar application on the web. The workflow of this application is to input the parameters of the service, data upload, data select, submit the stand average height extracting service based on lidar data service and data download. The steps of data source uploading and data selecting has user interference.

The SIGApp middleware with XPDL file defined workflow controls the user interface by waiting and pause the workflow running.

First is the web portal interface of service list showing. Then shows the instructions for users how to prepare their data for parameters input. In Figure3, the data uploading is succeeded and service begins. The yellow mark means this step is running and the grey one means it does not start yet. The workflow is finished and the result can be downloading from a URL. The green mark means this step is finished correctly. The right part of the web shows some management function of the job. Figure4 shows the images of the results, in which the red circles are the individual tree crowns get from the lidar data and stand average height attributions are appended in the stand plot database file.

5. Discussions and Conclusions

This paper releases a new framework of distributed lidar processing service using grid technology to integrate the remote user's data for forest researchers, teachers and students in a open eScience environment. This paper not only gives the design of eScience environment, but also puts forward the implement details and validation by constructing stand average height inverse service application with lidar data. This work proves that using grid tools, the traditional desktop forest lidar inverse program can be rebuilt in the coordinated web based eScience environment. The main achievement of this paper is using gird technology and web portal for a community of users contributing and consuming specialty lidar processing service. This technology paradigm can be used for open eScience in scalable, smart, easily deployment way. Anyway, the semantic challenges on the large scale open eScience must be considered in further research work.

Acknowledgments

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