

Research on Accessing Remotely Sensed Data Efficiently Stored in Oracle under Matlab Environment

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Abstract. In order to realize sharing the spatial information, it's very important to manage, store and share remotely sensed data which is considered as an important spatial information resource. At present, there are few researches on how to manage the remotely sensed data stored in Oracle efficiently in Matlab environment. A kind of solution for managing remotely sensed data stored in Oracle in the form of LOB is implemented, meanwhile, it can store and access unstructured data such as remotely sensed data which Matlab Database Toolbox can't. The solution is proved to be feasible, high efficiency resource sharing, high security and reliability.

Introduction

Spatial information sharing is the hot spot of the study of geographic information system currently, along with the increasing of the amount of remotely sensed data and the application fields, as a kind of important spatial information resources, how to effectively organize, storage and manage is critical to facilitate realize the sharing of resources, improve resource utilization, simplified calculation and analysis of the following up.

Remotely sensed data is a typical unstructured data, the management of remotely sensed data is also considered as the management of unstructured data. Generally, the management of unstructured data mainly uses unstructured data management system such as WinFS and Hadoop file system[1]. Unfortunately many file system directory service can't achieve fine-grained level access control, for allowing users access the directory of any content means that all of the contents of the directory can be accessed. In addition, metadata and content can't maintenance synchronously, so the approach still exists certain disparity with the actual demand in data security, total of sharing, various types and performance management.

Matlab is often used to process and analyze various types of remotely sensed data. Database Toolbox toolkit contained in Matlab installation package is used to provide support function interface for relational database and MATLAB for data interaction [2]. Database toolbox interact with data stored in relational database through the interface functions, and also support with multiple database parallel tasks as well as large data sets of segmented input. While it only supports traditional ODBC and JDBC database driver [3]. In addition, for it's poor efficiency of accessing and hardly capable of supporting unstructured data such as binary large object data storage and management[4, 5], something should be able to do to solve problems. In order to store remotely sensed data such as HDF format into relational database and access it, the paper solves the problems that database toolbox did not provide using ADO database driver to connect to the database, meanwhile, it solves the problems that Database Toolbox does not support the storage and access of unstructured remotely sensed data under Matlab environment. The experiment results show that the proposed solution is good at ease of use, data sharing and security, and provides a useful reference for fully sharing the use of big data following up.

Key Technology

Advantage of Using Oracle Manages the Unstructured Remotely Sensed Data. Oracle 11g has outstanding advantages in the field of unstructured data management; it has good performance, security and types in the database management system for the primary support of unstructured data

[6]. Unstructured data stored in Oracle can be correlated directly with the relevant data; synchronous maintenance for content as well as metadata can be realized under the transaction control management, which has advantages of robust tuning and performance management. Oracle supports a specific type of content, including SQL language extensions, PL/SQL, and API JAVA [7], and the application deployment is simple. Generally indexing and partition as well as execution of an operation can be realized through triggers and view level parameters, so applications constructed in the database rather than file system can support larger data sets, with good scalable architecture. Oracle database can also achieve fine-grained security management, so it has high security. Using Oracle 11g to manage unstructured remote sensing data has good performance and can meet the needs of the project mostly.

ADO. ADO is one of the components of Microsoft general data access; developers can access any database type through using ADO provided by API, which not only supports the relational database, but also supports the non-relational database. ADO integrates OLEDB and ODBC, it can use a unified approach to access different data types by using the concept of Provider, which provides a collection of interfaces. ADO can access and modify data stored in different types of databases by way of programming. The three main object members of ADO are Connection, Recordset and Command objects, as well as three sets of objects - Errors, Parameters and Fields set of objects. Connection object manages communication between the applications and databases, Recordset object obtains the query results through connecting to a record set, and Command object queries the database and return records contained in Recordset object, in order that it performs a lot of operation or processes database structure.

When Accessing remotely sensed data stored in Oracle through ADO, it needs to have the appropriate driver, the solution selects the Oracle Corp's OraOLEDB, which supports LOB type of data storage. In case of remoting access, installing the Oracle client is needed.

Scheme of Storing and Accessing Remotely Sensed Data in Oracle under Matlab Environment

Scheme Design Principle. OraOLEDB.Oracle driver is selected to connect Oracle in Matlab environment on the basis of ADO, fields contained in remotely sensed data is considered as matrix respectively, and stored in lob large object data field of Oracle via the cache files. Solution's Communication realization principle as shown below:

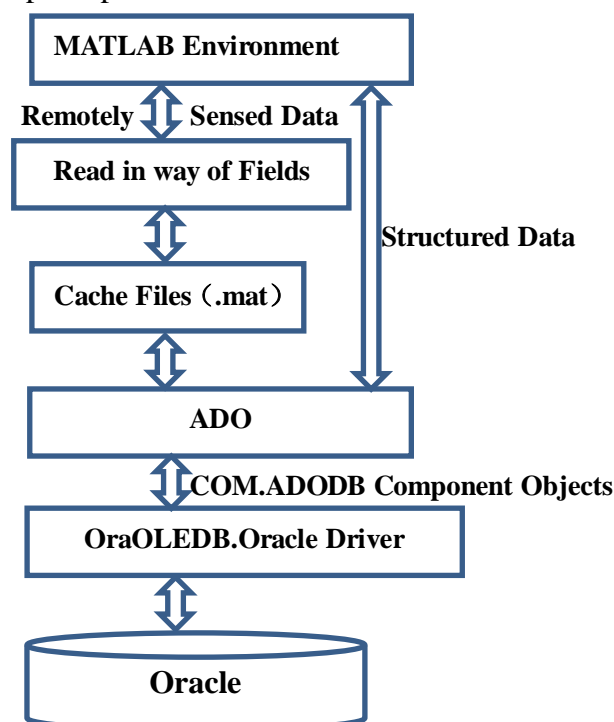


Figure 1. Realization principle of solution

Connections between Matlab and Oracle. When accessing remote sensing data stored in Oracle under Matlab environment, the first step is to establish database connection through the connection string, the connection string is as follows:

```
Connection_str=[...
    'PROVIDER=OraOLEDB.Oracle;'...
    'Data Source=MyDatabaseName;'...
    'User Id=MyID;'...
    'Password=MyPassword'];
```

Examples of Storing Remotely Sensed Data in Oracle in Form of LOB Type. Remotely sensed data contains many basic data such as space, spectrum and radiation resolution [8, 9], each of which is stored in form of two-dimensional or three-dimensional matrix, so it's suitable to store in form of LOB large object data. In this paper, MERSI FY-3A a day of remote sensing image data [10], for example, the file format is HDF5; some of main storage code is as follows:

```
MyDirInfo = dir('my_dir')
// the directory path for remotely sensed data to be stored
addr=[' my_dir ', MyDirInfo.name];
FY3A(1)=double(hdf5read(addr,'20bands_L1B_DN_values'));
FY3A(2)=double(hdf5read(addr,'RefSBCoefficients'));
.....//read all remotely sensed data fields that are included one day
con=actxserver('ADODB.Connection');
con.CursorLocation='adUseServer';
con.CommandTimeout=60;
con.Open(Connection_str);
cmd=actxserver('ADODB.Command');
cmd_txt= 'select * from Table';
cmd.CommandText=cmd_txt;
cmd.ActiveConnection=con;
rds=actxserver('ADODB.Recordset');
rds.CursorType='adOpenStatic';
rds.LockType='adLockOptimistic';
rds.Open(cmd);
stm=actxserver('ADODB.Stream');
stm.Type='adTypeBinary';
stm.Open
for j=1:n //number of fields contained in FY3A
    myfile=[tempname,'.mat']; // build a cache file
    save(myfile,' FY3A(j)'); // store each field as a matrix to cache file
    stm.LoadFromFile(myfile);
    rds.Fields.Item(j).value=stm.Read;
    // Each column in a table corresponds to a field of FY3A
    rds.Update;
end
stm.Close;
rds.Close;
```

Examples of Reading Remotely Sensed Data from Oracle. It's similar to the storage method by using ADO, here only main code of reading is listed as below:

```
myfile=[tempname,'.mat']; // build a cache file
fileID=fopen(myfile,'w');
fwrite(fileID,rds.Fields.Item(column).Value,'double');
// read required FY3A field in way of matrix
fclose(fileID);
load(myfile);
```

Results of the Experiment

The experiment uses the Windows 7 Professional Edition operating system, and remotely sensed data are stored in WinFS and 11g Oracle enterprise version for testing and comparison under the environment of the R2015b Matlab version. For one day's FY-3A MERSI remote sensing image data (6m) as an example, the field data including two-dimensional and three-dimensional matrix, double precision floating-point data types, the experiment executes storage and read operations repeatedly, final result is represents the average of a number of tests. The test results are as follows:

Table 1 Access time testing results

Result evaluation		WinFS [s]	Oracle [s]
storage	Maximum value	1.293	1.462
	Minimum value	0.891	1.143
	Mean value	1.068	1.315
read	Maximum value	0.380	0.395
	Minimum value	0.132	0.126
	Mean value	0.233	0.234

Table 2 Comprehensive performance evaluation of two solutions

Scheme	Security	Sharing	Concurrency	Reliability	Usability
Oracle	high	high	high	high	easier
WinFS	weak	ordinary	ordinary	weak	easy

From the experimental results, it can be included that reading speed of read remotely sensed data from Oracle and WinFS is similar, sometimes more than the latter; speed storing remotely sensed data in file and in Oracle through ADO has some differences, but overall storage time is much more balanced and has stable performance. From perspective of comprehensive performance comparison, the solution has better security and sharing performance than WinFS, especially for multi-user concurrent control, and provides a variety of recovery mechanisms, which has good comprehensive performance.

Conclusions

The paper proposed a scheme to store and access remotely sensed data in Oracle under Matlab environment through ado accessing database, remotely sensed data is stored and managed in form of lob large object data, it solves problem that MATLAB database toolbox does not support for unstructured large object data storage and access. The experimental results show that the solution realizes of remotely sensed data sharing and security protection, and has good easy-using and access speed, as well as good comprehensive performance.

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