DEVELOPMENT OF HIGH-RESOLUTION SATELLITE IMAGE PROCESSING SYSTEM BY USING CBD

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ABSTRACT

High-resolution satellite image processing software should be able to ensure accurate, fast, compact data processing in offline or online environment. In this paper, component software for high-resolution satellite image processing is developed using OpenGIS components and real-time data processing architecture. The developed component software is composed of three major packages, which are data provide package, user interface package, and fast data processing package. The data provider package encodes and decodes diverse image/vector data formats and give identical data access methods to developers. The user interface package supports menus, toolbars, dialogs, and events to use easier. The fast data processing package follows the OpenGIS's data processing standards, which can deal with several processors as components with standard procedural functionalities.

KEYWORDS : COM, Integration, OpenGIS, CBD

INTRODUCTION

It is very important issue to support interoperability between spatial data providers and spatial information consumers and fast reliable software development. To achieve these requirements, a new paradigm such as component-based development methodology is adopted in various spatial information services.

The component based development methodology has been focused in software engineering as new paradigm to produce, select, evaluate and integrate software. The component based development methodology has two advantages, one is reusability of pre-implemented executable components and the other is location transparency in distributed networking environment. The component software which independently runs with other components, can be easily accessed by any one who knows the defined interfaces of the components. The developers provide the interoperability on distributed networking environment and the reusability of pre-developed components.

Many spatial information consumers need to access, process, analyze spatial information through networks in spatial information services. Especially, the developers of spatial image processing software need ability to support characteristics of very huge data, various data formats and different architectures between software vendors. Nevertheless, according as computing environment is shifting to distributed environment, the developers need to establish a standard manner to support interoperability in networks.

In this paper, we introduce OpenGIS recommended components to support interoperability and component software to integrate the systems that produce and use all kinds of data represented in a grid cell or "raster" image coordinate system of the Earth.

Also, high resolution satellite image processing system is designed with interoperability architecture based on OpenGIS components.

DESIGN OF PIPE-LINED FUNDAMENTAL COMPONENTS

Component software is commonly composed of various related component sets to do specific purposes such as data management, radiometric processing, geometric processing, feature extraction, stereographic processing. These fundamental components suggest more than one interfaces composed of several properties and methods. In this paper, two major fundamental component sets are adopted to manage and control data and processes. The one is OpenGIS grid coverage component sets and the other OpenGIS simple feature component sets.[1-3]

OpenGIS grid coverage provides interfaces for basic inter-system image access and for basic kinds of analysis, such as histogram calculation, image covariance and other statistical measurements. That is, the grid coverage specification enables GIS systems with grid coverage components from heterogeneous vendors of image and raster software to query one another over a network, which for most users will be the internet, to copy data or operate on data.[4]

The architecture of the grid coverage specification is composed of three component packages as shown in Figure 1. The specification includes a package for the general coverage specification (CV), a package specifically for grid coverages (GC) and a package for grid coverage processing (GP). The GP package is optional and not required for an OpenGIS compliant implementation.[1]

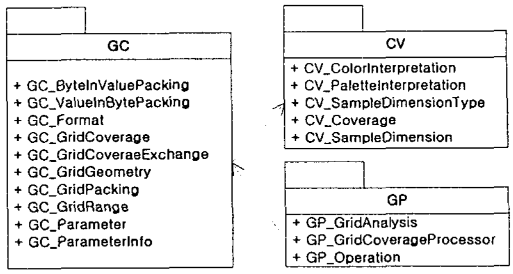


Figure 1. OpenGIS Grid Coverage Component Packages

The OpenGIS simple feature increases the full interoperability of various spatial vector data. The OpenGIS simple feature includes vector based spatial data model called simple feature geometry. In general, GIS manages spatial data such as geometrical data and topological data. GIS which processes huge amount of spatial data basically, must have certified performance and provides various analysis function essentially and several studies have been made on this requirements. One of them, spatial data model must be supported fundamentally, not only geometrical data model but also topological data model. Especially, topology information must be stored and managed fundamentally as part of facility which is network structure and other various spatial analysis part such as TIN analysis. OpenGIS consortium suggested abstract topological model in topic as well as simple feature geometry model in specification. The object model for geometry is shown in figure 2. The base geometry class has subclasses for point, curve, surface and geometry collection. Each geometric object is associated with a spatial reference system, which describes the coordinate space in which the geometry object is defined.[2]

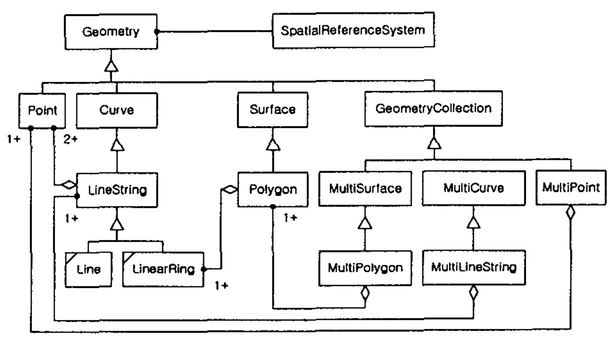


Figure 2. Geometry class hierarchy

In figure 2, geometry is the root class of the hierarchy and an abstract (non-instantiable) class. All geometry objects should support the IGeometry interface. The instantiable subclasses of geometry are restricted to 0, 1 and two dimensional geometric objects that exist in two dimensional coordinate space. All instantiable geometry classes are defined so that valid instances of a geometry class are topologically closed. A GeometryCollection is a collection of one or more geometries. All the elements in a GeometryCollection should be in the same spatial reference system. This is also the spatial reference system for the GeometryCollection. GeometryCollection places no other constraints on its elements. Subclasses of GeometryCollection may restrict membership based on dimension and may also place other constraints on the degree of spatial overlap between elements.[5]

The OpenGIS grid coverage and simple feature provide major roles to access and control grid or vector data efficiently. On this base architecture, object-oriented architecture for individual third-party user defined components should be designed to organize overall integrated software.

DESIGN OF INTEGRATED COMPONENT SOFTWARE

In this paper, third party fundamental components are composed of 10 component sets, which are for coordinate transformation, image representation, map composition, basic image processing, advanced image processing, information extraction, stereographic image processing, stereographic feature collection, laser scanning data processing and visual modeling. These fundamental component sets are merged into three component galleries such as basic component gallery, advanced component gallery and expert component gallery to satisfy different user's demands. OpenGIS components such as grid coverage and simple feature have individual data providers which can encode and decode image or vector formats. OpenGIS grid coverage uses GC_GridCoverageExchange interface to read and write data sources and GC_GridCoverage interface to access data block with geometric information. OpenGIS simple feature converts data source into geometry interface. Figure 3 illustrates the relationship between categorized component galleries.

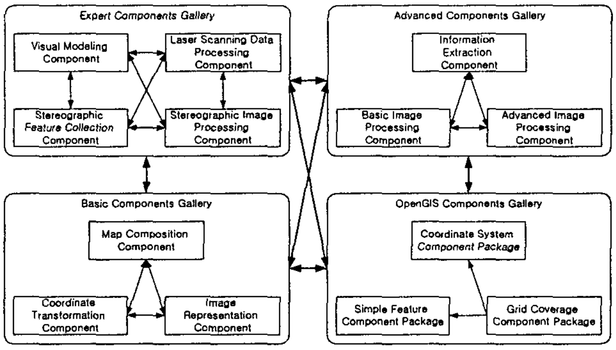
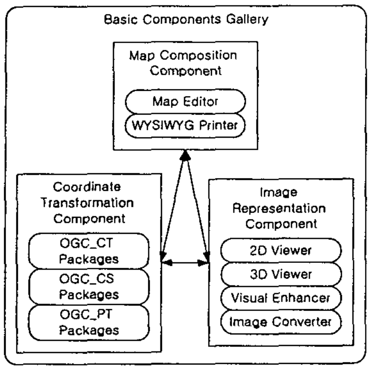
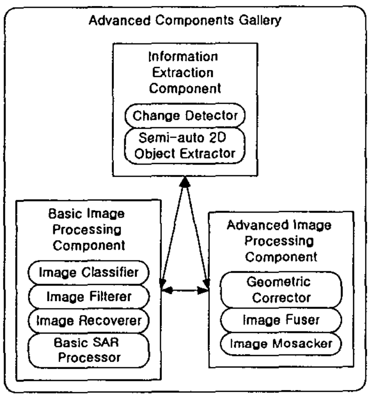


Figure 3. The relationship between component galleries

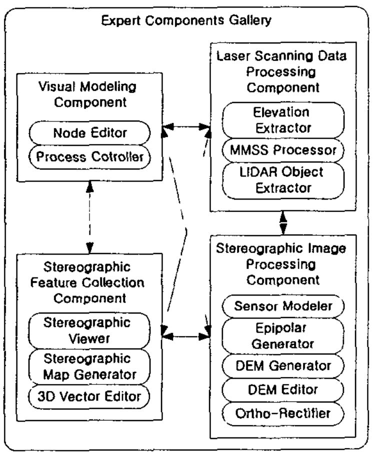
In Figure 3, the three component galleries are proposed and related to each other. Each component gallery may be composed of several fundamental and functional components. The basic component gallery is composed of image representation component, coordinate transformation component and map composition component so that do mainly display images or vectors on the screen and print composite map with geometric processed data. The advanced component gallery is composed of basic image processing component, advanced image processing and information extraction component. The advanced component gallery deals with image data to pre or post-process specific data and extract changes or two dimensional objects in images. The expert component gallery focuses on stereographic processing and three dimensional information handling. In addition, visual modeler uses pre-described components as nodes to make data flow model and execute the established models visually. The each component gallery proposed in this paper is concentrated in its specific functionality of integrated software but other software vendors can put together to build their own service software. Most of all proposed components are executed on pipeline of data and processes but some of specific components are not executed on pipeline when the components need to overwrite a part of data. That is, overwriting on a part of data may break pipeline because of enchroachment upon immutability of OpenGIS interoperability. Figure 4 shows the details of each component galleries.



(a) Details of Basic Component Gallery



(b) Details of Advanced Component Gallery



(c) Details of Expert Component Gallery

Figure 4. Details of Each Component Galleries

CONCLUSIONS

In this paper, the three major component galleries are proposed to integrate various systematic component softwares and support interoperability suggested by OpenGIS consortium. Each component proposed in this paper can be merged or divided to customize component software. In this integration scheme, a new component is designed by using aggregation and containment of component based development methodology.

ACKNOWLEDGEMENTS

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