SOME IDEAS ON THE STANDARDIZATION OF GEOPROCESSING

Wolfgang KAINZ. Research Center Joanneum Graz
Institute for Image Processing and Computer Graphics, Austria

ABSTRACT

Digital spatial data is produced and processed in an increasing number of countries all over the world. The building of national and even global data bases and the resulting need to exchange data make efforts towards a standardization of exchange formats highly desirable. Some countries have already developed agency- or national standards for vector and DTM data. Satellite images are distributed in a more or less standardized form.

Since most of the data is the result of various processing steps it seems worthwhile not only to define standards for data formats, terms, accuracy and quality but also to investigate the possibilities of a unification and perhaps standardization of spatial data processing functions. Analogously to the international graphics standard (GKS) we discuss a concept for the unification of basic spatial data processing tasks. This could be a framework for the dissemination of geoprocessing techniques and a toolbox for the practical work as well.

RÉSUMÉ - Quelques idées sur la normalisation du traitement des données géographiques

Des données numériques spatiales sont produites et traitées dans toujours plus de pays. Par l'installation de banques de données nationales et globales, et par la nécessité d'échange d'informations, il est nécessaire de normaliser des formats d'échange de données. Divers pays ont déjà développé des normes officielles ou nationales pour des données vectorielles et pour des modèles numériques de terrain. Des images satellitaires sont distribuées plus ou moins en forme normalisée.

Parce que la plupart des données est le résultat d'un traitement, il semble profitable de définir non seulement des normes pour les formats, la terminologie, la précision et la qualité des données, mais aussi sonder les possibilités d'une uniformisation et peut-être une normalisation des procédures de traitement des données spatiales. Similairement à la norme graphique internationale (GKS), nous présentons un projet pour l'uniformisation des procédures de traitement des données spatiales. Ce pourrait être un cadre pour la diffusion des techniques de traitement des données géographiques et aussi une boîte à outils pour la pratique.

1. Introduction

The field of geoprocessing are defined by three basic building blocks : data, procedures, and users. Geo processing can be described as the actions of a user who applies various procedures to geo-data and their attributes. These procedures concern the capture, storing, processing and display of information. Different disciplines are involved in the manipulation of geo-data, e.g. cartography, photogrammetry, surveying, remote sensing, computer science and graphics. They all have their own language and technical terms. In order to have a fruitful cooperation people from different disciplines, who work together in geoprocessing applications, have to use a common set of terms to avoid confusion and misunderstandings.

Talking about data and their characteristics we see efforts towards standardisation regarding

data organization
data quality
features
terms and definitions

addressing both raster (remote sensing) and vector (map) data. They are based on the experience of various agencies and organizations.

Not too much is known about steps towards a unification of geoprocessing procedures. Since geoprocessing systems play an important role and are widely used, their architecture could act as a template for setting up a general model of geoprocessing with a clearly defined and standardized set of procedures.

2. Data standards

This section deals with standards for data organization, quality, features, terms and definitions. They facilitate the exchange of information and allow integrated evaluations.

2.1 Data Organization

Data organization means the mapping of real data into a model representation by providing rules for the transformation, the kind of model, and exchange formats for both raster (remote sensing) and vector (map) data.

Each agency responsible for the distribution of remote sensing data provides users with products processed according to their own conventions. It is highly desirable that preprocessing of satellite data of the same mission is standardized to produce comparable data. The way how to specify geographical coverage, pixel size and cartographic projection of the images is important. Data are distributed on magnetic tapes in CCT (computer compatible tape) format (Hubaux et al. 1984).

Analogue map data are based on experimented standards since several decades. National cartographic agencies issued documents with guidlines and rules for map production. The development of digital cartographic methods implied the need to digitize analogue topogra-

phic and cartographic information. Standard for the topological coding and data exchange have been introduced by many agencies and surveys, e.g. Digital Line Graphs (DLG) by the U.S. Geological Survey. In the United States the National Committee for Digital Cartographic Data Standards has proposed a standard for cartographic data exchange (Moellering 1985) based on the international standard on a data descriptive file for information interchange, ISO 8211 (ISO 1985).

2.2 Data Quality

Data quality is defined as an essential or distinguishing characteristic necessary for the data to be fit-for-use.

For remote sensing data the user is normally provided with parameters concerning the radiometric, geometric, spatial and spectral properties of the data. Additional information on cloud coverage or data loss is available, however, each data producer adopts his own parameter set depending on sensor/platform engineering specifications.

A map data quality standard has been proposed (Moellering 1985) describing the five sections required in a quality report : lineage, accuracy, attribute accuracy, logical consistency and completeness of data.

2.3 Features

According to Moellering (1985) the purpose of feature classification is to describe entities as they occur in the world and not as they appear on a graphic representation. The lists of features, attributes and attribute values are not limited to any map series or scale. Cartographic features shall be described by three mandatory and two optional categories : feature, attribute, attribute value, feature class (optional), attribute class (optional).

Recommendations on the classification of land use and land cover data from remote sensing are given in Anderson et al. (1976).

2.4 Terms and Definitions

The interdisciplinary character of geoprocessing demands that people from different branches of the geosciences communicate using clearly defined terms. There are well established and widely accepted terms and definitions referring to conventional techniques in e.g. cartography and photogrammetry. A number of working groups are active to define terms for digital processing of spatial data. Manuals, glossaries and multilingual dictionaries are available. For digital data processing international accepted standards for terminology have already been established.

3. Procedural standards

The architecture of geographical information systems (GIS) can be regarded as a general structure of geoprocessing. The main aspects, input, storage, processing and output of geo-data, are included in a GIS design. Based on data standards as discussed in the previous sections and on the international graphics standard GKS, the Graphical Kernel System, ISO 7942 (Enderle et al. 1984), a general concept of geoprocessing can be introduced.

The basic requirements of a GIS have been identified by many authors (e.g. Dangermond 1982, Kainz 1984, Tomlinson 1984). These include the following tasks :

Input
- Input of Map Data
- Input of Image Data
- Topology Definition
- Input of Attribute Data
- Editing and Updating

Data Base Management
- Attribute Data Base Management
- Spatial Data Base Management

Query and Analysis
- Retrieval by Geographic Area
- Retrieval by Attribute
- Image Processing
- Reclassification
- Overlay
- Zone Generation
- Distance Calculations
- Neighbourhood Analysis
- Terrain Data Handling
- Statistical Analysis

Output
- Map Making
- Report Generation

This is not intended to be an exhaustive list of requirements, but it covers most of the applications of geodata.

Standardization of the above mentioned tasks can be done in two steps. First is the standardization of procedures, i.e. the way how to do things. The second step would be the implementation of procedures with a standardized set of functions.

As an example, the standardization of procedures provides guidlines how to digitize map sheets (number of control points, acceptable residuals, tolerance, etc.), which kind of topological data structure is recommended (cf. Peuquet 1984), which sort of data base management system to use (relational, network, hierarchical), how to do classification, which interpolation algorithms are to be used for DTM generation, how to generalize digital map data, what are the minimum requirements for map design and report generation. This will facilitate data processing and produce comparable results.

The definition of a standardized set of functions could be done similar to GKS and to the efforts to identify IBM's Standard Query Language (SQL) as a standard for data base query languages. Shells have to be defined for implementation in different systems.

Conclusion

The great importance and widespread application of geoprocessing as well as the introduction of digital systems have lead to various efforts towards a unification in the treatment of analog and digital spatial data. Global aspects of many problems imply the exchange and joint evaluations of big amounts of data. By standardizing not only data characteristics and exchange formats, but also working on common and generally accepted procedures in geo-data processing, we can make this task easier and more transparent.

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