

Proposing the Forest Engineering of “Digital Earth”

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ABSTRACT “Digital Earth” is a great scientific system which integrated science with technology and engineering. Basic research, technology supporting and scientific engineering are three main contents of “Digital Earth”, and the core and aim of the “Digital Earth” is the scientific engineering. Forest engineering is one of important scientific engineering and forest vegetation plays a key role in landscape of earth, so the forest engineering of “Digital Earth” will be a great scientific strategy aimed to facilitate the sustainable development of human in the 21st century. Based on the analysis of the forestry engineering, it has integrated technology, various data, effected information and shared resources of character. And the engineering has 4 levels (local level, national level, regional level and global level), which has data collection (RS, GIS, GPS, map etc.), data processing (manipulation, management, virtual reality, network and so on), and information applying (dynamically monitoring, development planning etc.). The forest engineering of “Digital Earth” will be a virtual representation of our planet that enables a person to use the extensive data and information integrated with global forest and environmental resources.

KEYWORDS forest scientific engineering, digital earth, sustainable development, virtual reality, information integrated

1. Introduction

Digital earth put forward by Al Gore (1998) represents the threshold of fundamental change in the attitude towards the ways and means of recognizing earth in the 21st century. At present, it is difficult to well and truly define the conception of digital earth for it is a developing course, but it is very important and imperative to understand digital earth and focus on its advance. Regarding to the current technical conditions, digital earth is described as a virtual digital representation and reappearance of our planet and our environment, integrated by multi-sources, multi-scales, multi-resolutions and multi-dimensions geo-referenced information.

Over last year, many researchers come from different fields, have been devoted to the study of digital earth. Digital earth is regarded as not only a highly integration system crossing multi-sciences and information techniques, but also an impetus to developing geographical information science and intellectual economics in the future. Digital earth is not a simple technical project, but a strategic objective with the characteristics of great prospect and guidelines (Xu Guanghua etc, 1999; Guo Huadng, 1999).

The continuous development of digital earth poses new challenges for geographical information sciences. Digital earth is a great

scientific system crossing basic theory, technology and engineering (Cui Weihong etc., 1999) and engineering is a key to realize digital earth. And engineering of digital earth can be detailed into diversified classification, such as agriculture engineering, trans-portion engineering or intelligent transportation system, forestry engineering and so on.

Forest is regarded as great natural resource and ecological environment in our planet, which has great ecological, economic and aesthetic value. The force and effects of forest, no matter local or global, touch lives of the people. So understanding forest lands-cape changes is critical to effective environmental management and conse-rvation. More and more study focus on forest monitoring (Li Zhixi, 1998). IUFRO, UNFAO and UNEP continually hold conferences about forest monitoring oriented 21st century such as 21st global natural resource conference (Washington, 1995), world forest monitor conference (Poland, 1996), 21st forest ecological conference (Edward, 1998) etc. Many works emphasize the technical movement from their traditional "media-based" approach towards a "digital-based" approach and the strategical movement from traditional utilization towards facilitating sustainable development. In recognition of these, in this paper, we detail the digital forest engineering

characteristics, types and design.

2. The Characteristics of Digital Forest Engineering

Digital forest engineering is a reflection of integration between developing information technology and traditional forest monitor in the 21st century. In general, the characteristics include technical integration, diversified transaction, spatial-temporal information, open and share resource.

2.1. Technical Integration

Modern forest monitor is not limited to a single technical development, more and more multi-technology and multi-knowledge have been permeated into. For instance, the theme of 21st forest ecological conference in Edward, USA, is integrated tools of the 21st forest monitor. It put forward to an organically integration orientation of combining aerophotogrammetry, remote sensing, field sampling, geographical information system, mapping, environmental modeling and global position system and computer network together.

2.2. Diversified Transaction

At present, forest monitor has been developed to orient sustainable development, so its contents and tasks have expanded to the natural resource management, environment conservation, landscape study and bio-diversity protection. Enlarged transaction means the need of diversified data sources, more methods not only about forest and geographical information, but also about social and economic data, especially in study of bio-diversity.

2.3. Spatial-temporal Information

Forest vegetation spatial distribution has the feature of extensity and dynamics. So forest engineering emphasizes spatial and temporal database construction. Remote sensing can provide different temporal and different scale real data in time not only for local environment but also for global changes. Based on the frame of digital earth, precision method e.g. precision farm can be rapidly and efficiently carried out in forest projects also. And integrated with scientific decision support, we can effective manage forest resource and facilitate environment, resource, society and economic sustainable development.

2.4. Open and Share Resource

Traditional forest project is mainly based on field investigation by different departments, and data standard incompatible, which results in data resource waste and utilization value lower. Based

on computer network, not only forest but also reference information can be standardized, digital format stored and exchanged. These will accelerate forest development, furthermore facilitate more and more people to care of environment.

3. The Classification of Digital Forest Engineering

According to the conception of region, digital forest engineering includes local level, regional level and global level. Different level is plotted out by different scale information and serves for different requirement.

Local level is based on local micro forest landscape such as a township, a county or a forestry center; focus on practical management, planning and routine. Regional level composed by many local levels such as a province or a country, focus on regional planning and police making. Global level concern global study and problem e.g. greenhouse effect, tropical forest protection etc.

4. Constructing Digital Forest Engineering

Due to information development, the traditional field of forest engineering has extending. It is urgent to change traditional method into scientific digital method. Digital forest engineering can be regarded as a great advance and innovation in the field of information capture, process and applications.

4.1. Information Capture

As we know, forest ecological system is the biggest system in the land of the world, meanwhile it is open and complex system. Forest ecological landscape covers forest vegetation, vegetation species, forest production, nontimber production, biomass, stock, bio-diversity, wildlife, habitat, plant diseases and insect pests, landuse/landcover, landform, soil, geology, climate and local social-economic situation. Traditional method lags behind information development. According to IUFRO, modern forest is mainly based on digital, and the key technology of forest information capture includes remote sensing, geographic information system and global position system.

4.1.1 Remote Sensing

Remote sensing including aerophotogrammetry brings into a technical renovation of forest monitor. According to the statistics of IUFRO, 9 satellites and 25 sensors can provide information for forest monitor, including wildfire, diseases and insect pests, plant health monitor, survey biomass and vegetation index. The appearance of high resolution and high spectrum sensors appearance

will prompt forest engineering.

4.1.2. Geographic Information System

Map is an important tool of forest monitor, which comes from interpretation on aerophotography. At present, a lot of results are represented in the form of map. Map provides a static and two-dimension abstraction of the real world. Dynamic and three-dimension map, which is produced by GIS, will replace papers and become main representation. GIS takes advantages not only in storing and managing different geographic reference data and visualizing data, but also in analysis, assessment, predict and planning.

4.1.3. Global Position System

Field investigation and sampling is an indispensable component part of forest monitor. Regarded as precision coordination source, it is effective and efficient to use global position system including Differential Global Position System replacing traditional field survey for location. Meanwhile, GPS can provide position information for GIS and RS. Furthermore, GPS has played an important role in precision agriculture. As the same way, GPS can be used in precision forest management and natural conservation e.g. afforestation, killing diseases and insect pests, putting out wildfire, patrol and deforestation.

4.2. Data Processing

Data processing involves a lot of contents. In this paper, three techniques i.e. data standardization, virtual reality and network, which are keys and cores of digital earth, bring new advance of forest engineering.

4.2.1. Data Standardization

New data capture brings new mass information flood. On one hand, in every day information accumulate and overhead the process ability. But on the other hand, available information is short and limited. Data standardization is precondition of developing digital earth. Not only digital earth but also digital forest engineering is based mass data i.e. data warehouse, and different data standards, no matter what come from, need to compatible.

4.2.2. Virtual Reality

Virtual reality provides a new data process way by integrated diversity information and mutual operated among human, data, simulation and computation. At same time, virtual reality provides

availability for people can see, hear, touch, taste, cognize different information to place a premium on new ideas and facilitate theory transforming to applications (Li Hongga etc,1999). Virtual reality combined with geographical science will bring great perspective.

4.2.3. Network

Information highway brings us into digital world. And digital earth through the Internet and intranet, realizes information exchange, process and visualization. More and more WebGIS are developed, which expand information source and bring the conception of digital earth to everybody.

4.3. Application. of. Digital. Forest. Engin-eering

The linkage between digital earth and forestry, will advance forestry development in theory and applications. On one hand, it prompts study of the global problem e.g. global environmental changes, greenhouse effect etc. On the other hand, it facilitate local environment study, e.g. local forest engineering, police making and sustainable long-term development planning,

5. Conclusion

Forest, not only resource but also environment, is a fragile ecological system, which directly related to the sustainable development. It is important and imperative to protect forest by using information techniques. Digital earth stands for the new development of geographical information science. It is a challenge of combining digital earth and forest to construct digital forest engineering.

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