

Digital Space and Earth System with Composite Satellites System

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ABSTRACT Since the authors put forward an article about a multiple small satellite Earth Observation System in the IAF Congress' 98^[1]. Primary author has studied Outer Space and Geographical Information Network System for Sustainable Development that was published in 1998^[2] too. This paper discusses Digital Space and Earth System with Composite Satellites System. In actually, that is a network system. The next century is going soon, the authors have thought that is not only Digital Earth, but also is Digital Space. In the Chinese words that is "Shuzi Tiandi", it just as used Human and Earth System Science (Rendi Xitong in Chinese) instead of Earth System Science in our opinion. All of these are East-culture with West-culture science logic.

KEYWORDS Digital Space and Earth, Small Satellite, Information Models, Information System, Information Society, Sustainable Development.

1. Introduction

It is well understood that Space Technology is now closely to everyday life of the human beings. The Remote Sensing Satellites, Data Collected System Satellites, Global Positioning System Satellites and Communication System Satellites which could make great benefits to people of the world. The satellites system could be indispensable for weather forecasting, sea surface and marine culture observing, land use and agriculture estimating, water resource controlling, geological surveying, all resources and environment monitoring etc. Nowadays, the satellites could use smaller and mini satellite in-group with larger satellite in-system. This is composite satellite system.

On other hand, in 21st century, humankind is facing the information society with sustainable development. It means that we are in a "Coordination Development System of Human and Earth" society which is an open, complex, nonlinear, dynamics and super-system. It could use from outer space data, ground truth data, and social statistics data, such as RS, DCS, GPS, CSS, GIS, GES, MIS, and DSS data etc. which all data are digital data. This is digital space and earth system.

2. Outer Space and Geographic Information Network System

The outer space and geographic information network system is including Satellites, Sensors, Data, Information Models, and Information Systems. The satellites are such as the geo-stationary meteorological satellites system, sun synchronous orbit satellites that are meteorological satellites, land resources satellites and sea satellites, the multiple small satellites for remote sensing, data

collected system, GPS, and communication. The sensors are such optical sensors, CCD sensors, and SAR sensors etc. The data are such as remote sensing data, data collected system data, positioning satellites system data, communication satellites data, ground truth data, social statistics data etc. The information models are such as remote sensing information models, geographic information coded models, planning models, and game models etc. The information systems are such as remote sensing information system, geographical information system, geographical expert system, management information system, and decision support system etc. The outer space and geographic information network system is as shown in figure 1^[2].

(1) Outer Space and Geographic Information Network System

There are two systems in the Outer Space and Geographic Information Network System. One is Digital Space System, the other is Digital Earth System.

(2) Digital Space System

There are remote sensing data, remote-measuring data that are including data collected system data and positioning system data, and remote information, which is communication satellites data etc. In the outer space the satellites should be composed a satellite system that is smaller and mini satellites in-group with larger satellites in-system. Especially, it is easy for the smaller satellite in-group that could change according to propose in different time.

(3) Digital Earth System

Basic level is technique level. It is including spectrum base (SB), Images base (IB), graphs

base

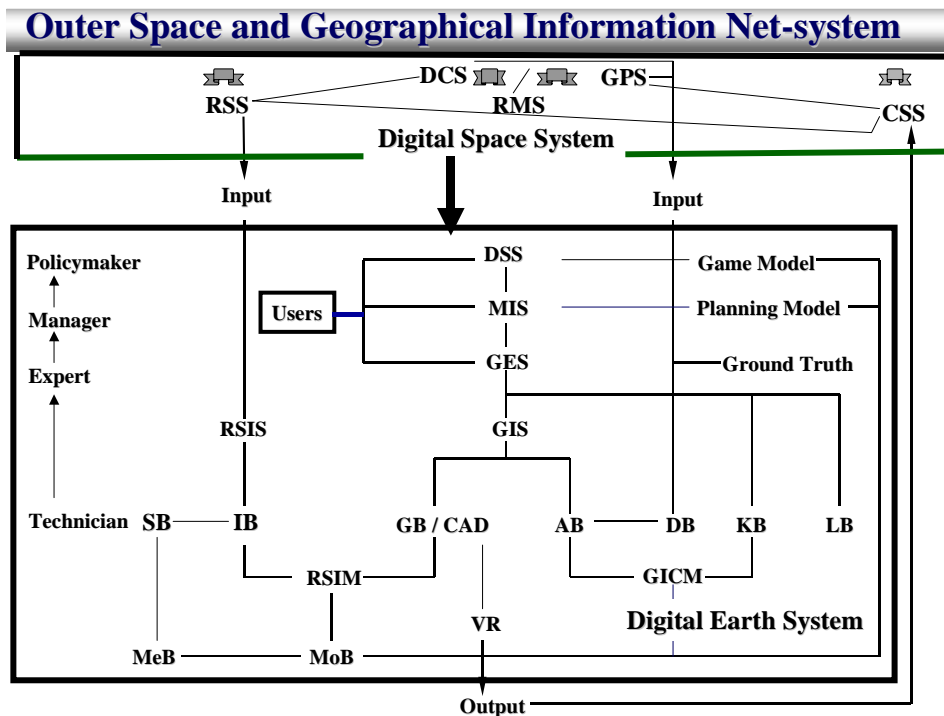


Fig. 1 Outer Space and Geographical Information Network System

(GB), attributes base (AB), database (DB), knowledge base (KB), logic base (LB), models base (MoB), method base (MeB) and virtual reality (VR). The second level is expert level that is geographic expert system (GES). It is including geographical information system (GIS), knowledge base and logic base. The third level is manager level that is management information system (MIS). The fourth level is policymaker level that is decision support system (DSS).

(4) Space and Ground Communication Network
In the figure 1, all of the lines are Internet and Intranet communication network. In author's opinion, the communication satellites could use multiple small satellites, which are mostly on software beside hardware. The ground segments of the composite system are including the receiving stations, the data processing centers and control centers for some special subjects. The other important segment is the TT&C (Tracking, Telemeter and Controlling), which software has been studied and put into practice in the China satellite TT&C center in Xian.

3. Digital Space System and Composite Satellite System

The composite satellite system proposal is based on the following concepts: (1) it should make benefits for the whole world. (2) It should be

relatively economical and could be constructed in a shorter time. (3) It could fulfill the main purpose: to monitor the changing environment on the Earth, especially for the forecasting and monitoring of the natural disasters^[3].

According to these concepts, the following composite system is proposed: (1) the multiple small or mini satellites are for remote sensing system^[4], data collected system, positioning system, and communication system in-group. (2) Some geo-stationary satellites and sun synchronous orbit satellites such as GOES, METSAT, GMS, FY-2, NOAA, FY-1, LANDSAT, SPOT, RADARSAT, CBERS, and etc are for resources, environment and disasters. (3) Such as global positioning system satellites are for positions, time and velocity. (4) Communication satellites are for Internet, and Intranet etc. All of these are in-system of composite satellites. All of them are in digital.

4. Digital Sensors

The optical sensors, scanning sensors, CCD sensors, SIS sensors, radar sensors, SAR sensors and so on should be digital data of remote sensing. All of the analogue images must transfer to digital images. A/D transfer could do in the space satellites or in the ground stations.

5. Data

Nowadays, the huge data of digital space and earth, which are more than 10^{15} data. Remote sensing data, telemeter data, position data, time and space data and social statistics data are different data. So huge and different data should be done meta-data management. In this case, should make data standard, which are analogous criterions.

6. Information Models

There are remote sensing information models, geographical information coded models, planing models and game models etc. The primary author has studied remote sensing information models near 20 years. Recently, has published the book Remote Sensing Information Models^[5], Natural Disaster Mitigation in-group^[6] and Sediment and Soil Sphere Erosion Modeling^[7] etc. There are RSIM for forester fires, RSIM for fell trees, RSIM for water and soil erosion, RSIM for wind and soil erosion, RSIM for floodwater, and RSIM for droughts etc. All of those RSIM that should be a geographical gray non-linear equation using both of mathematics equation and mathematics statistics. The mixed erosion equation is more complex that is a geographical polynomial gray non-linear equation that must use time-special fuzzy condition equation to be solved. RSIM is digital images modeling that has separated physical factors and geographical parameters and indexes. There are a lot of geographical analogous criterions that are non-dimensional factor groups. We have also studied geographical information coded models, planing models and game models too.

7. Information Systems

There are remote sensing information system, positioning information system, data collected information system, geographical information system, geographical expert information system, management information system, and decision support information system etc. All of the information systems are based on software, which are open, complex, dynamic, super-systems^[8]. And all of the systems will on line with Internet/Intranet.

8. Conclusions

- The authors advance not only digital earth, but also digital space, which are including satellites and sensors. That is Digital Space and Earth.
- The authors' advance launching a smaller satellite in-group with larger satellites in system that is Composite Satellite System.
- The authors' advance according to figure 1 to construct digital earth system that are including Data, Information Models and Information Systems.
- The authors' advance increased Internet/Intranet capacity and speed, which should be increased information capital construction and funds.

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