

ANALYSIS OF BIG DATA FROM SPACE

J. Tan^{a, b, *}, B. Osborne^a

^a International Space University, 79, Route du Rhin, Illkirch Graffenstaden, Strasbourg, France - (juan.tan, barnaby.osborne)@community.isunet.edu

^b Beijing Institute of Tracking and Telecommunication Technology, Beijing Road, Haidian District, Beijing, China – tanjuan3557@163.com

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ABSTRACT:

Massive data have been collected through various space mission. To maximize the investment, the data need to be exploited to the fullest. In this paper, we address key topics on big data from space about the status and future development using the system engineering method. First, we summarized space data including operation data and mission data, on their sources, access way, characteristics of 5Vs and application models based on the concept of big data, as well as the challenges they faced in application. Second, we gave proposals on platform design and architecture to meet the demand and challenges on space data application. It has taken into account of features of space data and their application models. It emphasizes high scalability and flexibility in the aspects of storage, computing and data mining. Thirdly, we suggested typical and promising practices for space data application, that showed valuable methodologies for improving intelligence on space application, engineering, and science. Our work will give an interdisciplinary knowledge to space engineers and information engineers.

1. INTRODUCTION

Since 1960s, mankind has attained vast accomplishments in exploring outer space. The aim of space activities is to facilitate our life on the earth and to explore our frontiers as far as we can. Besides breakthrough in space technologies, massive data has been collected through various mission. To maximize the investment in every space program and mission, the data need to be exploited to the fullest.

Big data technology is the product of information technology which aims to meet the challenges faced by increasing amount of information in various fields. It has characterized features of big data and thus is dealing with problems in storage, processing, distribution, and analysis. Space data has common characteristics of big data 5Vs (volume, velocity, variety, veracity, and value) (Ishwarappa & Anureadha, 2015). But space data also have their unique features, comparing to other daily-life big data such as consumer data, on collecting, storing, organizing, and processing. To use space data efficiently and get most outcomes of space activities, we should display the distinctions of space data both in structures and in application models. A unique platform taking account of these factors is also needed to facilitate space data application.

Apart from these, another field worth of study is the data mining techniques. Many emerging use cases have displayed their value in science research and supportive decision. On the other hand, big data and related technology have also enabled much more applications and researches of data mining technology in professional field such as space engineering and space science.

Realizing the potential value of space data, we try to propose a platform for space data application especially in digging

potential knowledge from space data. For better understanding value behind the space data and inspire innovation ideas, we also want to give some typical and promising practices on space data application, which showed valuable techniques for improving intelligence on space application, engineering and science.

Another sub-objective of this paper is to mitigate gaps between space engineering and information engineering which is essential for widespread application of big data from space in information paradigm.

2. RELATED WORK

The conception of big data from space is formed by the gaining momentum of the space data as well as the technological breakthroughs in big data. ESA, the Joint Research Centre(JRC) of European Commission and the European Union Satellite Centre have organized conference on big data from space in 2014 and 2016. The goal of the conferences is to gather the wisdom of researchers, engineers, developers and users in the area of big data from space and focuses on the whole data life cycle, ranging from data acquisition to data management, analysis and exploitation (Soille & Marchetti, 2016).

SSP16 Students of International Space University have carried out their team project study on space big data and presented a comprehensive analysis of activities of stakeholders within the space big data value chain as well as key challenges (ISU SSP16, 2016). In mission and project area, platforms for space data have been tested to take the advantages of big data technology to space mission control. The head of ESAC (ESA's European Space Astronomy Centre) Science Data Center has called for new paradigm to meet the challenges of GAIA

* Corresponding author

