HARPS Challenges to BIG-PV Power Systems

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This talk presents the outline and several current research topics of the research project "System Theory for Harmonized Power System Control Based on Photovoltaic Power Prediction (HARPS)," supported by the EMS CREST research program of JST (April 2015-March 2020).
According to “Long-term Energy Supply and Demand Outlook” proposed by METI in July 2015, the target in 2030 of the photovoltaic (PV) power installed capacity in Japan is 7% of the total electric energy in the entire Japan, which corresponds to about 64GW. This enables us to reduce CO2 emission gaining momentum. However, the PV power includes unpredictable large fluctuations. Thus, it is required to develop new control technologies to achieve a stable electric power supply using PV generation forecasts. In addition, there are needs to fundamentally review frameworks of the system structure of the whole power system to achieve the supply and demand balance. Electric power control systems are going to be renewed along with various kinds of new technologies such as Virtual Power Plant and Real-time Market after the deregulation of electricity and the unbundling of electricity generation and transmission.
The main purpose of this research project is to develop a system theory of next generation power system control in order to achieve a harmonized power supply under large penetration of photovoltaic (PV) power systems enabling PV introduction of 102GW, and further towards PV introduction of 330GW. In particular, this project aims to develop a power system control framework and methodology, fully exploiting PV/demand power prediction, and focusing on, in addition to system operation and user layers, functions and properties of a middle layer consisting of various kinds of power aggregators such as demand-response aggregators, electricity-trade balancing groups, and cooperative electric power converters, in other words, the main topics are as follows:
(i) Electric Power System Design: a system design theory composed of supply layer, middle layer, and consumer layer
(ii) Prediction Technology: a PV generation prediction technology adapted to power system control techniques that achieves a stable power supply
(iii) Control Technology: a power system control theory and technology to realize a harmonized stable power supply from the perspectives of fairness and comfort as well as the economics and environmental friendliness, by fully exploiting PV generation predictions.
See http://harps-crest.jpn.org/ for the further details on this project.

Keywords: Photovoltaic power, Power System Control

Enhancement of Segment Tracing Algorithm for lineament extraction based on topographic characteristics

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The Segment Tracing Algorithm (STA) is one of the effective methods to automatically extract lineament from the satellite image and shaded relief image generated from DEM. This algorithm can extract the lineament by extraction and connection of line elements. The line element is the cell having linear topographic feathers which is recognized by the change of the reflection intensity. Because the shaded relief image and the satellite image depend on the direction that irradiates light, extraction capability varies according to the lineament direction. The aim of this study is to extract lineaments from topographic characteristics based on DEM without using reflection intensity. The extraction processing of the lineament is as follows: (1) calculation of the normal vector of the topographic surface in each cell of DEM, (2) decision of continuous direction, (3) extraction of line elements, (4) connection of line elements, and (5) rearranging for the line. This method of each processing enhanced it, and optimized it.

Keywords: lineament, STA, DEM, topographic characteristics

Improvement of accuracy of metal content modeling using geostatistics in consideration of geological information

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Because most geological data are obtained at irregularly spaced points, a 3D modeling method is indispensable to estimate spatial distribution of value or category. In addition, geological data are multivariate that have several variables at the same point in many cases. For this data type, multivariate geostatistics has been widely used which assigns the optimal weights to each datum through a spatial correlation structure, termed cross-semivariogram. Kriging is a spatial estimator founded on this principle. Correlation of a variable pair naturally differs with the selected variables and also, geological type: the correlation of a pair may be strong in a certain geological type, but weak in the other types. This nominal information such as the geological type is difficult to be considered in multivariate geostatistics. For this problem, this study applies principal component analysis (PCA) to incorporate the dependence of data-pair correlation on geological type and decorrelate it by the orthogonal transformation, which can increase the estimation accuracy and decrease the calculation amount by requiring the calculation of only semivariogram of the principal components.

This idea is tested to a problem of metal content modeling over a deposit, because its accurate estimation is essential to reserve assessment and ore body characterization and moreover, contribute to resource exploration of the same deposit type. Matsumine and Fukazawa mines, typical large kuroko deposits in the Hokuroku district, Akita Pref., northern Japan, are selected for a case study. Kuroko is a Japanese term for massive, compact black-ore mainly composed of sphalerite, galena, and pyrite. Kuroko deposits were originated from felsic to intermediate submarine volcanic activity (e.g. Yamada and Yoshida, 2013). The metal contents of Cu, Zn, and Pb for both the mines and Au and Ag for the Fukazawa mine in the drilling cores were used for the data analyses.

The number of drillholes are Matsumine: 77 and Fukazawa: 58 and the target areas are 420 m ×940 m (along the horizontal) ×390 m (along the vertical) and 1100 m ×2400 m ×450 m, respectively. Main rock types are selected from the geological columns. PCA is applied to a dataset composed of the metal contents and binary data of the geological type: 1 for the presence of a geological type and 0 for the other types. The principal components are used for semivariogram modeling and kriging calculation, and by the inverse transformation of PCA, metal contents and geological type can be given to each grid point. This method, termed PCA-kriging (PCAK) incorporates the information on the spatial correlation structure of data pair and its dependence on geological type into the spatial modeling. The estimation result of metal content distribution is compared with the results of ordinary kriging (OK) and co-kriging (CK).

Common to both the mines and all metals, the CK results are mostly underestimate and, despite the similar distribution patters of OK and PCAK, the PCAK result contains less smoothing effect. This difference is particularly remarkable in a large content range, which causes large difference in reserve assessment between OK and PCAK, such as double amounts of Cu and Pb by PCAK than the OK amount. Another PCAK advantage is to draw a geological model using the geological types output, which is apparently harmonious with the preceding model. Overlay of the high content zones upon the geological

model is revealed to be effective to detection of the ore-solution paths and interpretation of the deposit-generation process.

Acknowledgments: The authors wish to express their gratitude to Dowa Metals & Mining Co., Ltd. and Hanaoka Eco-System Co., Ltd. for providing the precious drilling investigation materials and cooperating to organize them.

References

Yamada, R. and Yoshida, T. (2013) Kuroko deposits and related back-arc volcanism in the Hokuroku district, *Jour. Geol. Soc. Japan*, v. 119, Supplement, p. 168-179.

Keywords: Principal component analysis, kriging, Kuroko, geological model, ore-solution path

Cloud tracking method for the Venus satellite Akatsuki

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We present the novel cloud tracking method developed to estimate horizontal winds from the images obtained by the Venus orbiter Akatsuki. The method is derived from a general consideration, and it is expected to have broad application. This presentation is based on the following papers:

Ikegawa, S., and T. Horinouchi (2016) Improved automatic estimation of winds at the cloud top of Venus using superposition of cross-correlation surfaces. Icarus, 271, 98-119.

Horinouchi, T., S. Murakami T. Kouyama, K. Ogohara, A. Yamazaki, M. Yamada, and S. Watanabe, Image velocimetry for clouds with relaxation labeling based on deformation consistency. Measurement Science and Technology, submitted.

Keywords: Cloud tracking, Atmosphere, Venus, PIV

Development of software WAN accelerator based on HpFP

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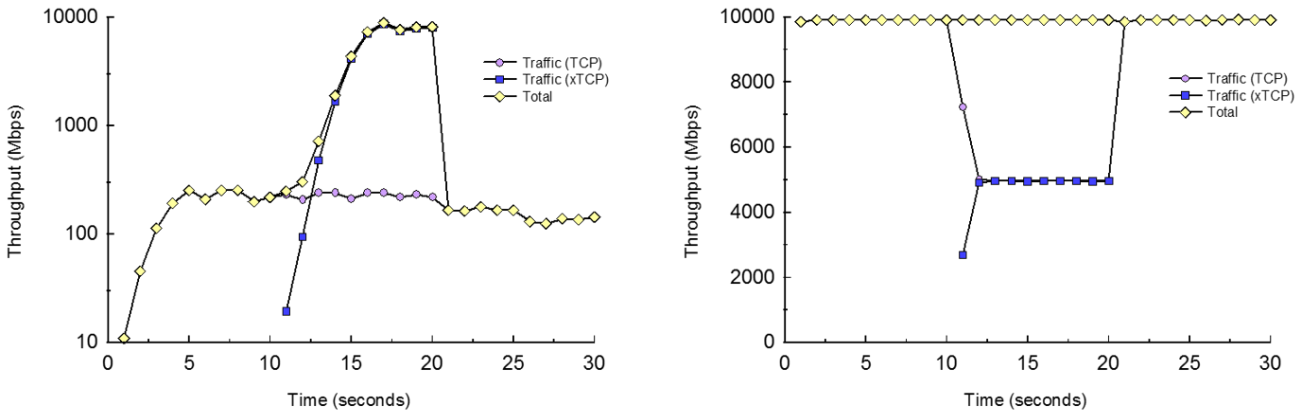
For LFNs (Long-Fat Networks) with 10 Gbps or more and satellite networks with large latency, a variety of TCP-based protocols have been proposed which show high performance on large latency network conditions. However, such TCP protocols are essentially unable to archive large bandwidth on high latency networks accompanied with packet-losses that are inevitable on practical LFNs or satellite networks. To overcome this issue, we designed a new data transfer protocol on TCP/IP transport layer built on top of UDP: High-performance and Flexible Protocol (HpFP). It constantly monitors latency (RTT) and packet losses, and conducts rate control and retransmission control based on them to enable higher bandwidth data transfer than 10 Gbps even on packet-loss conditions over LFNs. The basic concepts are addressed and protocol design of the HpFP are discussed. An applications to tansfer many data files in small size (e.g., 1MB x 10000 files) with almost wire-rate bandwidth (10 Gbps) is also addressed.
In this study we develop a software WAN accelerator based on the HpFP techniques. The objective of development of this protocol is for practical uses on a variety of networks, paying attention to the fairness with other traffices. In the near future, big data transfer with high speed is expected on LFNs such as SINET5.



WAN accelerator throughputs with TCP (CUBIC) on the LFN (long fat network) with packet loss (left) and without packet loss (right)

Development of Remote Monitoring Camera with HD Resolution Working on Raspberry PI

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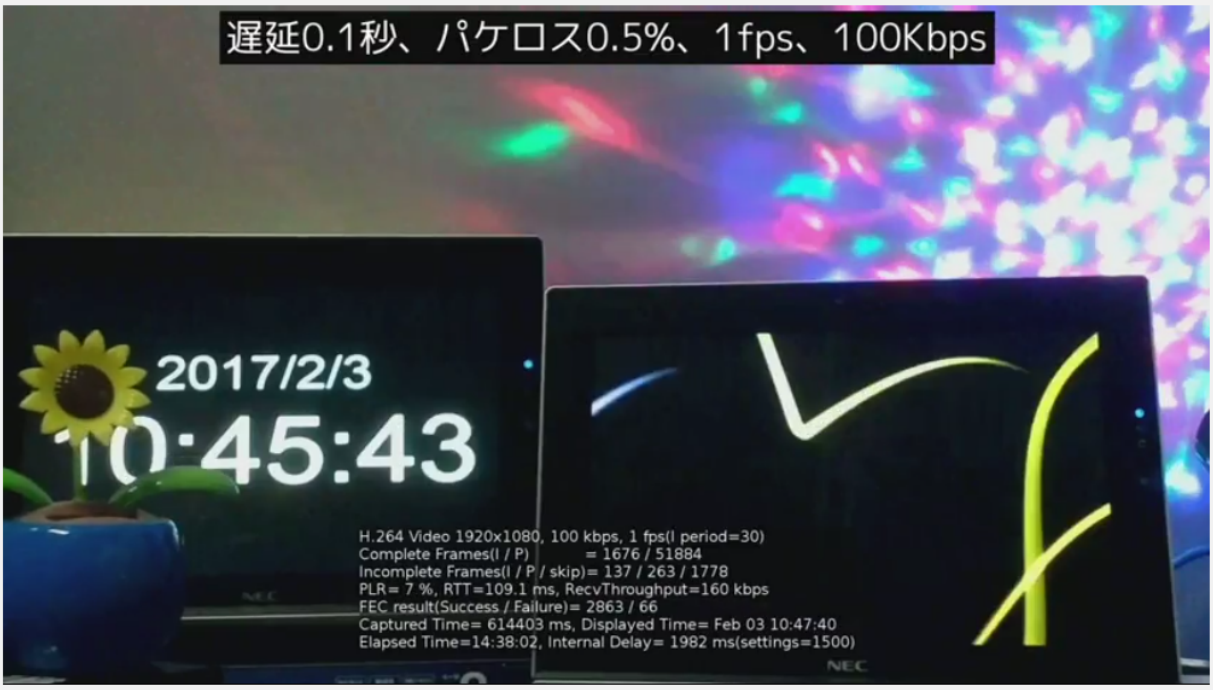
In this study, we introduce a new video streaming tool working on Raspberry Pi (RP). The RP is a series of small single-board computers developed in the United Kingdom by the RP Foundation to promote the teaching of basic computer science in schools and in developing countries. The original model became far more popular than anticipated, selling outside of its target market for uses such as robotics. According to the RP Foundation, over 5 million RPs have been sold before February 2015, making it the best-selling British computer.
The RP is recently arrestive in terms of the IoT (Internet of Things) devices with low cost and programable environment on a Debian-based operating system (OS), Raspbian. For global, regional and local observations of the Earth, light-weight sensors are preferable. No external power let (using solar power device), low cost network like MVNO (but low and unstable bandwidth), small power consumption, low cost in price and other factors are required for the IoT sensor devices.
We implement an original video streaming tool workins on the RP using its own H.264 hardware encode modeule onboard. We include our techniques in the HpFP, a data transfer protocol developed by CLEALINC technology and NICT (National Institute of Information and Communication Techology), such as Path MTU search, pace control, etc. There are wide variety of applications of the RP video streaming system; real-time drone operation, remote water level indicator, volcano monitoring, remote seismograph, thermometer. We demonstrate the low cost but high specification video streaming in the talk.

YouTube JP 検索



月ローバー映像伝送実験（H.264エンコード／画質HD）

NICT サイエンスクラウド

チャンネル登録 1

7 人が視聴中

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ライブ配信開始日: 2017/01/03

カテゴリ エンターテイメント

ライセンス 標準の YouTube ライセンス

Open Science and Research Data Sharing

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Open Science is increasingly an important focus, in terms of not only scientific paper publication, but also it should be more stressed in terms of research data management, as another mode of modern scholarly communications as well as scholarship and research themselves in this digital era. Open Data and Open Science are increasingly becoming hot topics, in parallel to establishing ICSU-WDS (2008), G8 Open Data Charter (2013), deployment of RDA (2013), and so forth, in addition to development of Open Access of journal articles. National guiding principle of open science has been released by the Cabinet Office (March 2015). In this digital era, if Open Science practices become daily reality, e-infrastructure or common digital environment will be necessary platform for many research activities. Contribution from the Earth and Planetary Science community including JpGU and AGU is strongly expected to facilitate new challenges of science based this data management and infrastructure.

Keywords: Open Science, data sharing

Towards enhancement of detection accuracy of geothermal reservoir by a combination of remote sensing analysis and field survey data

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Development of more accurate geothermal-resource exploration is necessary for enhancement of geothermal energy use which is limited because of high exploration cost at present. One of the effective solutions is to improve the regional analysis by remote sensing using satellite imagery and topographic data. A fracture modeling through topographical analysis and an extraction of hydrothermal alteration zone using reflectance spectral data are efficient for the estimation of regional geothermal system. Besides, a combination of field survey result and regional analysis can provide more detailed information about a study area. Based on that background, this study is aimed to identify geothermal fluid paths by remote sensing analysis and field survey. Wayang Windu area located in West Java of Indonesia in which there is a geothermal power plant in operation was selected as a study site. As the remote sensing analysis, lineament mapping using a digital elevation model with *m spacing and estimation of alteration zones by ASTER image are implemented. Moreover, the radon survey was carried out in the study site. Radon survey is suitable to identify geothermal fluid paths because the radon concentration is sensitive the existence of fracture and the pressure and temperature condition of reservoir. Measurement wells with the 5 m depth at the maximum were prepared to measure correctly the radon concentration affected by the reservoir condition and this measurement has been repeated. We integrate these results obtained by different methods to increase the identification accuracy of fluid paths and deepen the geothermal system of the study site.
This research is supported by JST and JICA through Science and Technology Research Partnership for Sustainable Development (SATREPS).

Keywords: Geothermal resource exploration, Hydrothermal alteration, Remote sensing, Radon survey

IIIF-compliant multi-resolution access to spatio-temporal data and its application to Himawari-8 data

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Earth environmental data is large in space and time, and software for accessing data into arbitrary parts with arbitrary resolutions has been requested by many people. Various software systems that have been developed so far tried to fulfill those needs. Firstly, Google maps, and similar Web map services, proposed an access method called tiling that takes advantage of Web technologies. It standardized the unit of data access to a tile to enable the off-line rendering of huge number of tiles, the utilization of cache using fixed URIs, and succeeded in efficient data transmission by combining them with asynchronous access (called AJAX). These set of ideas are now standardized as Tile Map Service by Open Source Geospatial Foundation, and widely used as a standard spatial data service in the age of Web.

On the other hand, temporal data has not been standardized as spatial data. Several open source software libraries to visualize timeline are available, but none of them is regarded as the standard one. The author also worked on this issue in 2011 by developing software called SyncReel, which is used for multi-resolution access to temporal data such as weather chart data for 100 years, or AMeDAS data for 40 years. However, the variety of time series data makes it difficult to standardize the format to describe various events on the same timeline.

Our idea is to take advantage of an international protocol for accessing images called IIIF (International Image Interoperability Format), which was originally proposed for cultural heritage domains such as museums. We tried to apply this protocol to earth environmental data for multi-resolution access in space and time. IIIF is an international community whose activity has increased since around 2014. IIIF defines the JSON-LD format of information that data providers should offer, and a client that interprets the format can enjoy interoperability between different data providers and reduction of cost for implementing viewers. The most basic service is called IIIF Image API, which defines the standardized URI for accessing arbitrary parts of the image. This API does not depend on the type of images, so our idea is that this can be used as a basis for multi-resolution spatial access to earth environmental data.

We introduced this IIIF standard to a system for browsing visible images of Himawari-8 satellite. This system is composed of two sub-systems of a server and a client. The server system uses software called IIPImage, which is compatible with IIIF Image API. IIPImage was originally a high-performance image server developed for browsing high-resolution images in astronomy, but since version 1.0, it has functionality for IIIF. The client system uses software called Leaflet IIIF. Leaflet is a JavaScript library to work with tiled maps, so it matches well to IIIF which also uses tiled access, and it also offers advantage such as using libraries developed around Leaflet. These open source libraries enable us to develop a multi-resolution viewer with zoom-in/out functionality to access Himawari-8 visible images having the size of 11000 by 11000 pixels.

We developed this viewer more to release a new service called Himawari-8 Clipping. This is a service for clipping and a storing a rectangular region drawn on the viewer using a Leaflet-related library called Leaflet Draw. A clipped image is given a new URI with metadata, which may be useful for making the catalog of Himawari-8 images collecting meteorologically relevant scenes through collaborative work on

the Web.

In contrast to multi-resolution access in space, its extension in time is left for future work. The reason is the lack of time-series data in cultural heritage domains, where IIIF was originally developed. However, time-series data is prevalent in scientific domains such as earth environment, and the necessity for standardizing access to time series is significant. Extension into this direction is now under study, but the presentation will refer to recent progress on this issue.

Keywords: multi-resolution access, spatio-temporal data, IIIF, Himawari-8, standardization, image data

A web-based real-time and full-resolution data visualization for Himawari-8 satellite sensed images

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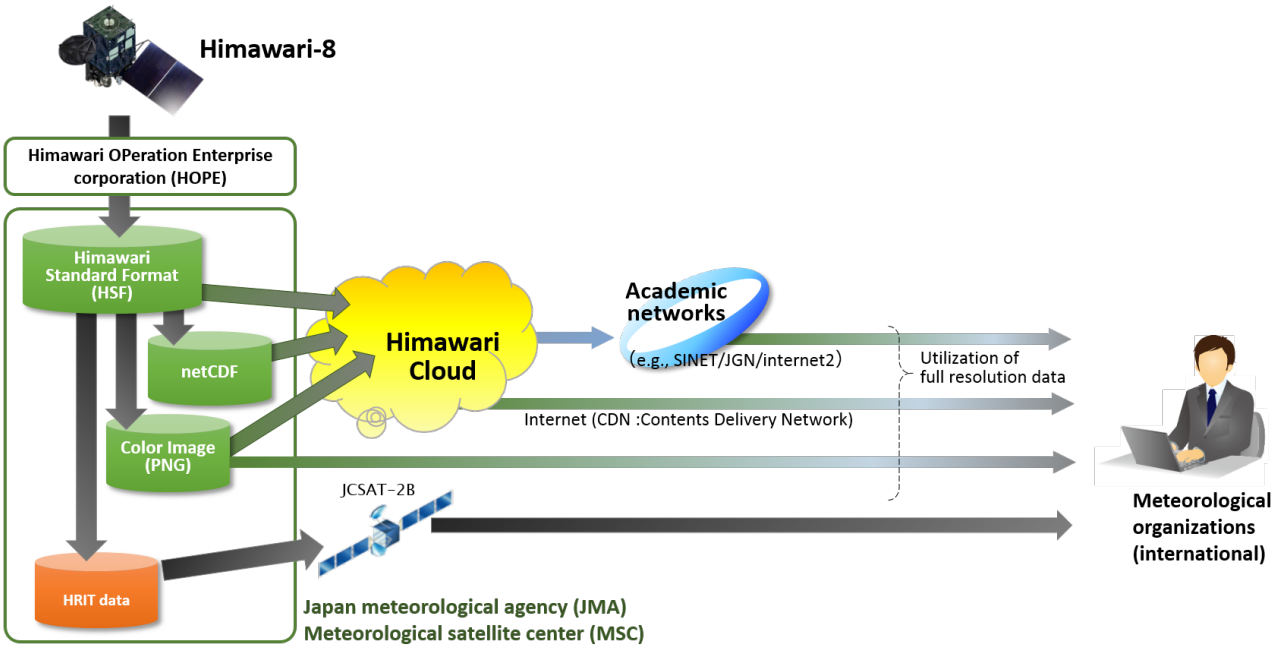
It has been almost four decades since the first launch of geostationary meteorological satellite by Japan Meteorological Agency (JMA). The specifications of of geostationary meteorological satellites have shown tremendous progresses along with the generations, which is now entering its third generation. The third-generation GMSs not only yield basic data for weather monitoring, but also globally observe the Earth's environment. The development of multi-channel imagers with improved spatial resolution onboard the third-generation of geostationary meteorological satellites brings us meteorological data in larger size than those of the second-generation ones. Thus, new techniques for domestic and world-wide dissemination of the observational big data are needed. In this paper, we develop a web-based data visualization for Himawari-8 satellite sensed images in real time and with full resolution. This data visualization is supported by the ecosystems, which uses a tiled pyramid representation for terrain on an academic cloud system. We evaluate the performance of our techniques for domestic and international users on laboratory experiments. The results show that our data visualization is suitable for practical use on a temporal preview of observation image data for the domestic users with high-speed networks. Moreover, in the paper, we discuss a protocol handler for web acceleration developed based on our new network protocol, HpFP (High-performance and Flexible Protocol) [1].

K. T. Murata, P. Pavarangkoon, K. Yamamoto, Y. Nagaya, T. Mizuhara, A. Takaki, K. Muranaga, E. Kimura, T. Ikeda, K. Ikeda, and J. Tanaka, “A quality measurement tool for high-speed data transfer in long fat networks,” in Proc. 24th Int. Conf. Software, Telecommunications and Computer Networks (SoftCOM), 2016. doi: 10.1109/SOFTCOM.2016.7772111



Automatic extraction and tracking of hot spots from time-series three dimensional grid data - application to meteorological radar data -

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A large amount of time-series three dimensional data has been accumulated also in the field of Earth and planetary science. We have developied a method of automatic extraction and tracking of hot spot areas included in a time-series three dimensional data, aiming to discover spatio-temporal pattens from them. The distribution of hot spots is modeled by a mixture of multivariate normal distribution. Hot spots are then extracted by obtaining the model parameters via EM algorithm. We used position of the grid data where the observed value exceeds the threshold as input in previous study. We modified this method to use data values themselves as weight coefficients during EM algorithm. The method was applied to synthetic data and real data of phased array meteorological radar data and the accuracy of detected number of hot spots was siginificantly imporoved. We are aiming to apply this method to detection of localized heavy rainfall precursor from 3D meteorological radar data.

Keywords: data mining, knowledge discovery, mixture model, phased array meteorological radar

The Systems Design and Project Status of the HAKUTO Micro Lunar Rover for Exploration

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This paper describes the project status of HAKUTO rovers, its systems and the results of the field experiment. HAKUTO is the Japanese team participating in the Google Lunar XPRIZE. This team is consisted of a venture company, Tohoku university and pro bono members.
The Google Lunar XPRIZE is an unprecedented competition, challenging privately funded teams to accomplish three main goals: successfully land a spacecraft on the lunar surface, run the rover on the lunar surface at least 500 meters, and transmit high-definition video and image back to earth. HAKUTO has developed a small and lightweight dual rover system to fulfill the above Google Lunar XPRIZE requirement. Demonstration of rovers' performance in space environment is verified by conducting thermal vacuum testing, vibration testing, and field testing at Nakatajima sand dune. Currently, HAKUTO is preparing the Flight Model rovers which are supposed to be launched in 2017.

Keywords: Moon, Lunar Exploration, Rover, HpFP, UDP, TCP/IP