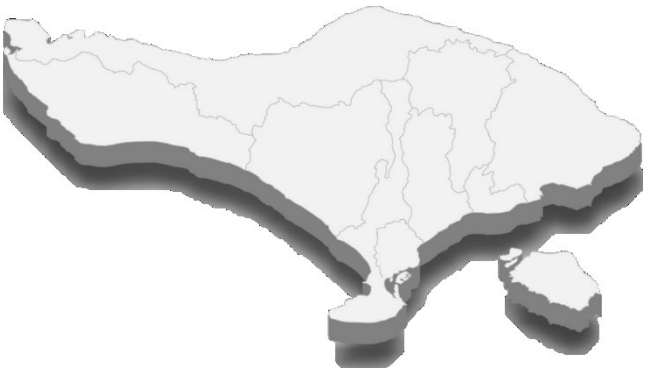
Proceedings of the



2021 IEEE INTERNATIONAL CONFERENCE ON AEROSPACE ELECTRONICS AND REMOTE SENSING TECHNOLOGY (ICARES 2021)

Bali-Indonesia (Virtual), 3-4 November 2021



2021 IEEE International Conference on Aerospace Electronics and Remote Sensing Technology (ICARES 2021) *(IEEE Conference No. #53960)* event become a unique opportunity for the AES (Aerospace and Electronic Systems), GRS (Geoscience and Remote Sensing), Computer Society (related data science & artificial intelligence processing or application) and other IEEE chapters to exchange views and disseminating new trends and advances in the respected fields. The ICARES 2021 is a platform for disseminating timely information both in the advancement of an *aerospace based vehicle and sensor technology including UAV, micro-satellites technology, maritime & land mobile communications, stochastic control design for the* aerospace vehicles*, as well as advancement in the microwave remote sensing, SAR technology, Big SAR Data processing and including Data Science & Artificial Intelligent related to aerospace & geoscience data processing*. ICARES 2021 consist of three paper categories:

Track 1 – **Aerospace & Electronic System (AES)**
Track 2 – **Geoscience & remote sensing (GRS)**
Track 3 – **Data Science & Artificial Intelligent Related to Aerospace and Geoscience & Remote sensing**

Conference Proceedings

2021 IEEE International Conference on Aerospace Electronics and Remote Sensing Technology (ICARES 2021)

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Papers Scope

Topic	*Only for Tracks*
Aeropace & electronic systems	Aerospace and Electronic Systems
Aeronautical engineering	Aerospace and Electronic Systems
Attitude maneuver control	Aerospace and Electronic Systems
Autonomous flight control	Aerospace and Electronic Systems
Advanced modulation theory	Aerospace and Electronic Systems
Adaptive control	Aerospace and Electronic Systems
Ballistic tracking	Aerospace and Electronic Systems
Bistatic SAR processing	Geoscience and Remote Sensing
Communications techniques	Aerospace and Electronic Systems
Control design	Aerospace and Electronic Systems
Convex parameterization	Aerospace and Electronic Systems
Detection in non-gaussian distribution environment	Aerospace and Electronic Systems
Doppler signature classifications	Aerospace and Electronic Systems
Earth terminal systems	Aerospace and Electronic Systems, Geoscience and Remote Sensing
Estimation & detection theory	Geoscience and Remote Sensing
Estimation for guidance, navigation & control of an aerial vehicle	Aerospace and Electronic Systems
Finite elements	Aerospace and Electronic Systems
Geoscience & remote sensing	Geoscience and Remote Sensing
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MTI radar	Geoscience and Remote Sensing
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Intersatellite links	Aerospace and Electronic Systems
Intrapulse radar	Geoscience and Remote Sensing
MIMO radar moving target detection	Aerospace and Electronic Systems
Multi-spacecraft imaging systems	Aerospace and Electronic Systems, Geoscience and Remote Sensing
Nano & Micro satellites designs	Aerospace and Electronic Systems, Geoscience and Remote Sensing
Nanosatellites networking	Aerospace and Electronic Systems, Geoscience and Remote Sensing
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NLOS communications	Aerospace and Electronic Systems
Nonlinear approach to tracking problem	Aerospace and Electronic Systems
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Spacecraft and launch vehicle	Aerospace and Electronic Systems
SAR imaging	Geoscience and Remote Sensing
SAR technology	Geoscience and Remote Sensing
Satellite architecture	Aerospace and Electronic Systems

Satellite payload	Aerospace and Electronic Systems, Geoscience and Remote Sensing
Satellite subsystems & components	Aerospace and Electronic Systems
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Sensor platform & network	Geoscience and Remote Sensing
Space communications	Aerospace and Electronic Systems
Stochastic control systems	Aerospace and Electronic Systems, Geoscience and Remote Sensing
UAV & small planes platforms	Aerospace and Electronic Systems
Ultrawideband SAR	Aerospace and Electronic Systems, Geoscience and Remote Sensing
UAV & satellite communications	Aerospace and Electronic Systems
Variable structure control	Aerospace and Electronic Systems
Telemetry	Aerospace and Electronic Systems
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Atmospheric Measurement	Aerospace and Electronic Systems, Geoscience and Remote Sensing
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Artificial Intelligent in Aerospace Application	Data Science & Artificial Intelligent Related to Aerospace and Geoscience & Remote sensing
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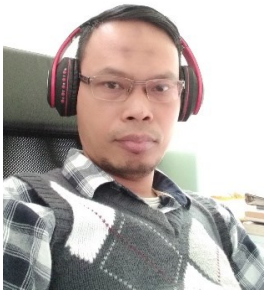

Dear colleagues, distinguished guest, ladies and gentlemen,

Allow me take this opportunity to welcome all of the honorable guests and participants by first praying our grateful and praise to the Almighty God for all His blessings, grace, and mercies that have made us possible to gather here in excellent condition and health. It is a great pleasure for me to finally welcome you to the International Conference on Aerospace Electronics and Remote Sensing Technology (ICARES 2021).

Since 2013 we conduct several successful ICARES conferences which are already published in IEEE Xplore®. But in 2020, due to COVID-19 situation we postponed ICARES and planned the event to be hosted in Bali in 2021 under cooperation with LAPAN-Indonesia. Yet, for the 2021 edition of ICARES, it is still not feasible to organize the conference in the way we would like, with real people, together in a real venue, in the magnificent city of Bali. With much regret, the only responsible choice to make is to organize the conference in a virtual format. Nevertheless, we do everything to make ICARES 2021 much more than a long extended 'zoom' session, to give you a flavor of BALI that may hopefully lead to a physical visit in the future and better times.

In this ICARES 2021, after a rigorous selection and review on both technical substance and similarity checks, there are 30 selected papers will be presented which reflect 70% of the total papers submitted to the committee. Besides Indonesian authors, this conference also presents papers from various countries such as the Philippines, India, Japan, Germany, Spain and Canada. These various papers further show that, nowadays, small satellites have been changing the economics of space. These systems embrace cutting edge commercial off-the-shelf technology, permitting novel and less-expensive ways to perform meaningful observation or communication missions, although there are various technical challenges. There are several synthetic aperture radar, hyperspectral imaging and communication missions on small satellites in operation and in planning.

Going forward, there will likely be more small satellites, each dedicated to a specific mission objective and carrying a single payload. Through this approach, more and more countries around the world are becoming involved in the communication operation and Earth observation from space, not just in using the data and services from the major established systems but also in constructing their own systems. We hope that the ICARES conference, which is attended by remote sensing and aerospace experts, engineers and practitioners around the world, could generate various ideas and recommendations for the development of remote sensing technology and aerospace in Indonesia.

Finally, I want to say thank you very much to all of you, and I hope you could enjoy sharing the knowledge on science and technology in ICARES 2021 and enjoy the virtual symposium with the atmosphere of Balinese culture.

Thank you!

Mohammad Mukhayadi
General Chair of ICARES 2021

Welcoming Speech from Chair of Indonesia GRS/AES Joint Chapter of the IEEE

Dear Aerospace-Electronics-and-Remote Sensing fellows,

Thanks to Allah the Almighty which has bestowed us the opportunity to holding the 5th International Conference of Aerospace Electronics and Remote Sensing, or ICARES – in spite of only a virtually conference due to the pandemic situation.

From the outset (2014) we aimed at ICARES which will serve as the melting point of the researchers, professional and students for exchanging novelties in design, algorithms, standards, technology and approaches. In this south-east part of the world the manufacturing industries population in the fields that the ICARES deals with, are relatively minor as compared to its northern counterparts, both in productivity, innovation, and ideas. There are less aerospace and remote sensing industries, its related design houses, engineering schools and training centers. This situation reflects the perpetual imbalance between North and South, something that the southern engineers should join hands and forces to proliferate the strengthening of the industrial activities, undertaking and business in this very part of the world. With today's burgeoning in the virtual activities and virtual collaboration this gap should have been diminished, immaterial whom and from which origins those engineers should collaborate with one another.

A glimpse of contributions being received, reveals at least the following subjects have given us an indication on some dynamics of the community in pursuing novelties at the ICARES:

Attitude Control, Star Sensor, Attitude estimation, Target Pointing, Augmented Guidance, UAV Detection, UAV Wing Design, Thrust Vectoring Control, Engine reliability, In Orbit Reconfigurable FPGA, Orbital Acquisition, Processing of Trajectory, Drones for Mapping, Classification Algorithms, Microstrip Antenna, Modem Design, Earth Terminal Design, High Resolution Camera Enhancement, Applications.

There seems that some wriggling is prevailing in the domain of design of UAV, rocketry, aircraft and satellites, which is a good sign. The ICARES community should have been trying to strive for more in the effort in acquiring their knowledge and sharpening their skills in the aerospace, electronics and remote sensing technology.

Have a nice and memorable conference.

Bandung, Indonesia, November 3, 2021

Arifin Nugroho
Chair, Indonesia GRS/AES Joint Chapter of the IEEE

Program of ICARES 2021

ICARES 2021: IEEE International Conference on Aerospace Electronics and Remote Sensing Technology 2021

Joint Opening Ceremony of APSAR 2021 & ICARES 2021

Session time	Monday, November 1, 2021 08:00 until 17:00 UTC/GMT +8 hours
Location	Planery Room
Chaired by	Mohammad Mukhayadi, Research Organization for Aeronautics and Space (LAPAN - BRIN), Indonesia

ICARES 2021: IEEE International Conference on Aerospace Electronics and Remote Sensing Technology 2021

Technical Session I: Aerospace and Electronic Systems 1

Session time	Wednesday, November 3, 2021 10:00 until 11:30 UTC/GMT +8 hours
Location	zoom breakout room 3
Talk time	15
Chaired by	Muhammad Saifudin, Research Organization for Aeronautics and Space (LAPAN - BRIN), Indonesia

10:00: *Disturbance Observer-based Attitude Control of The Air-Bearing Platform using a Reaction Wheel*

Harry Septanto (Satellite Technology Center of LAPAN, National Research and Innovation Agency (BRIN), Indonesia); Farohaji Kurniawan (Indonesian National Institute of Aeronautics and Space & NASA, Indonesia); Bambang Setiadi (National Research and Innovation Agency, Indonesia); Edi Kurniawan (National Research and Innovation Agency (BRIN), Indonesia); Djoko Suprijanto (Institute of Technology Bandung, Indonesia)

Abstract: A reaction wheel is a well-known actuator for controlling the attitude of a spacecraft. It is a momentum exchange device that typically consists of a brushless direct current motor with a flywheel attached to its shaft. As the reaction wheel works, a disturbance that is sourced from the motor and its impact can occur. This paper addresses a linear disturbance observer-based attitude control system employing a reaction wheel on a rotational platform called air-bearing. The positive results, as well as a challenge, are presented.

10:15: Star sensor availability of equatorial satellite based on LAPAN-A2 satellite observation

Nova Khamsah (Indonesian National Institute of Aeronautics and Space, Indonesia); Ahmad Zammir Ribah (Satellite Technology Center LAPAN, Indonesia); Wakhid Abdurrokhman (National Institute of Aeronautics and Space, Indonesia); Hidayah Hidayah (Indonesian National Institute of Aeronautics and Space, Indonesia); Satriya Utama (National Institute of Aeronautics and Space, Indonesia)

Abstract: LAPAN-A2 is the first Indonesian small satellite developed by the National Institute of Aeronautics and Space of Indonesia (LAPAN) orbiting at a near-equatorial orbit. Compared to sun-synchronous orbit, the satellite's star sensor in this orbit is prone to obstruction by the sun and its stray light. It is renowned that the star sensor is the most accurate sensor for satellite attitude determination. Hence there is a need to recognize its availability to meet the satellite mission requirements. This paper objects to observe the availability of satellite star sensors in an equatorial orbit using the calculation of LAPAN-A2 satellite telemetry data. The data was obtained from the long-time telemetry (LTT) between January 2019 to December 2019 and validated by real-time telemetry reading. Unlike real-time telemetry data, the long-time telemetry data is the satellite telemetry data acquired and stored in the satellite memory for the past 86 minutes from the telemetry reading. Calculation of the star sensor availability acquired by observing the sun position relative to the satellite limited to 85% of the availability. The result revealed that the star sensor availability of the satellite varies throughout the year with a 61.2°-star sensor angle as the threshold, showing the lowest availability occurs when the sun position is nearing the north and south poles, while the highest availability ensues when the sun position is nearing equator. In summary, there is a high correlation between the sun position with star sensor availability of equatorial satellites.

10:30: In-Orbit Tuning of PI Omega Control of LAPAN-A3 Satellite's Wheel HCP

Rise Hapshary Surayuda (National Institute of Aeronautics and Space of Indonesia (LAPAN), Indonesia); Muhamad Riza Fakhlevi (Nastional Institute of Aeronautics and Space (LAPAN), Indonesia); Nova Khamsah (Indonesian National Institute of Aeronautics and Space, Indonesia); Annisa Sarah (National Institute of Aeronautics and Space, Indonesia); Satriya Utama (National Institute of Aeronautics and Space, Indonesia)

Abstract: A necessity to perform in-orbit tuning of the spare pitch wheel connected to horizon control processor (HCP), namely wheel HCP, arose after the failure of primary pitch wheel during satellite operation. The PI omega control loop is used to control the angular rate of LAPAN-A3 satellite and is essential for maintaining the nadir pointing operation by giving the angular velocity command to the pitch wheel at a nadir rate value. Hence, in-orbit tuning of PI omega control of wheel HCP was performed in order to obtain controller parameters that provide an acceptable output response with the lowest error. The trial-and-error approach was selected as the tuning method because of the unavailability of wheel HCP measurement data at a high sampling rate. The only data available are sporadic telemetry data with large measurement gaps. This study shows that the trial-and-error tuning method is reliable for obtaining an acceptable output response for a fast response system such as a reaction wheel, despite the large gaps of up to tens of seconds in measurement data. The steady-state error at the nadir rate value is 5% for PI parameters at Kp 25000 and Ki 7, which is good enough to have pitch drift in satellite attitude of 0.2° per hour. The simulation of PI omega control of wheel HCP based on a priori knowledge of the physical model is useful to provide insight into the system stability and the settling time of system response which has initial angular rate of satellite near zero.

10:45: Quaternion Slerp for Attitude Estimation of Dual Spin-Stabilized Satellite

Satriya Utama (National Institute of Aeronautics and Space, Indonesia); Annisa Sarah (National Institute of Aeronautics and Space, Indonesia); Rise Hapshary Surayuda (National Institute of Aeronautics and Space of Indonesia (LAPAN), Indonesia); Wakhid Abdurrokhman (National Institute of Aeronautics and Space, Indonesia); Ahmedi Asraf (Indonesian National Institute of Aeronautics and Space, Indonesia); Mukhamad Fajar Amiludin (National Institute of Aeronautics and Space, Indonesia)

Abstract: Satellite in orbit has a lot of challenges. Two of them are attitude stability and attitude determination. One method to stabilize a satellite is by spin it, either the whole body (single-spin) or part of its body (dual-spin). However, this method has a side effect called nutation. In attitude determination, star-sensor has the best accuracy but is vulnerable to stray light that can make it blind. When the star-sensor is blind, the attitude needs to be estimated. The estimation becomes more complicated when nutation exists. The objective of this paper is to implement some methods to estimate this kind of satellite's attitude. First, four well-known methods, LinEuler, Lerp, Slerp, Squad, are implemented to LAPAN-A3's attitude data. This research found that three methods are failed to give a good estimation. Meanwhile, Slerp gives a considerable result with accuracy around 0.222o until 0.462o in the nutation direction (yaw and roll). Furthermore, two methods are developed to improve the estimation accuracy. Mean of multiple Slerp (mSlerp) is the first method. Using this method, the accuracy slightly improving, 0.203o until 0.361o in the nutation direction with a more consistent result compared to Slerp. However, neither Slerp nor mSlerp was able to estimate the nutation. Hence, the next method, Nutation Prediction Slerp, NPSlerp, is developed. This method can achieve far better accuracy until 0.007o by estimate the nutation. The drawback of NPSlerp is the accuracy increase as the length of interpolation increases.

11:00: LAPAN-A2 Microsatellite Performance on Target Pointing Maneuver for Imaging Mission

Ahmad Zammir Ribah (Satellite Technology Center LAPAN, Indonesia); Ahmedi Asraf (Indonesian National Institute of Aeronautics and Space, Indonesia); Nova Khamsah (Indonesian National Institute of Aeronautics and Space, Indonesia); Agus Herawan (Indonesian National Institute of Aeronautics and Space (LAPAN), Indonesia); Patria Rachman Hakim (Indonesian National Institute of Aeronautics and Space, Indonesia)

Abstract: The objective of the target pointing maneuver is to observe in detail a specific area on the Earth's surface when the satellite passes over with the camera direction fixed on the target. In this research, LAPAN-A2 is used to implement the target pointing maneuver to acquire the image in the Earth observation mission. Then, there are evaluations of the performance of the Attitude Control System (ACS) during the maneuver. The maneuver is conducted in the open-loop control mode by giving a specific angular rate profiled as parabolic. AGI System Tool Kit (STK) is used for simulating satellite orbit and determining the angular rate profile, elevation, and azimuth angle by computing access from the satellite to the target. Then, the maneuver is arranged by several command sequences in the X-axis and Y-axis directions. As a result, the maneuver presented in this research shows that the LAPAN-A2 satellite can perform the target-pointing maneuver. Then, the ACS evaluation shows the satellite is quite stable in the roll and yaw axis. However, there is a delayed target lock around 5 seconds, and the initial pitch error of 0.524° led the location to drift off the target to approximately 38 km long.

Technical Session II: Aerospace and Electronic Systems 2

Session time	Wednesday, November 3, 2021 10:00 until 11:30 UTC/GMT +8 hours
Location	zoom breakout room 2
Talk time	15
Chaired by	Akhmad Farid Widodo, National Research and Innovation Agency (BRIN), Indonesia

10:00: Visually Augmented Guidance System Realization for Landing Rocket Model

Larasmoyo Nugroho (LAPAN Pustekroket - Rocket Technology Center & Universitas Indonesia, Indonesia); Sastra Kusuma Wijaya (Departemen Fisika, FMIPA UI & University of Indonesia, Indonesia); Rika Andiarti (National Institute of Aeronautics & Space, Indonesia); Rini Akmeliawati (The University of Adelaide, Australia); Rizanto Juliarsyah (Politeknik Elektronika Negeri Surabaya, Indonesia)

Abstract: Nowadays the development of the Unmanned Aerial Vehicle (UAV) control system technology rapidly increases. Especially the development of auto landing control system based on GPS data. However, the auto landing based on GPS data is considered to be unprecise when landing, because GPS data does not pay attention to the condition of the area and allows landing in any hazardous place. The visual precision landing system guides the quadcopter maneuvers by combining data from vision sensors and GPS. This system uses the MAVlink protocol to communicate data between the sensor board and the flight controller. In this study, it was found that quadcopter could land on the target, but data errors still exist due to the inability of the sensor vision to focus on the target and produced mistakes when scanning the detected block area. Therefore, the miss distance between the landed quadcopter to the target is approximately 1 meter. Eventhough, visual precision landing system could be considered more precise than a solely GPS-guided landing system that has average miss distance 3 meters.

10:15: UAV Detection using Web Application Approach based on SSD Pre-Trained Model

Leonard Matheus Wastupranata (Institut Teknologi Bandung, Indonesia, Indonesia); Rinaldi Munir (Institut Teknologi Bandung, Indonesia)

Abstract: UAV development is being intensively developed by various groups to help overcome various types of problems. Object Detection is important in helping UAVs to do drone chasing and other competition that need visual approach based on image processing and deep learning. Unfortunately, the computational capabilities of the onboard processing unit that attached to the UAV are less than optimal for object detection due to storage and memory size constraints. This paper aims to create the new approach to improve the precision and recall during UAV detection by using web application to do real time detection. To decide a pre-trained model, it is necessary to compare which SSD pre-trained model is suitable to be deployed in this web application. The results obtained are that using the web application approach is better than the onboard processing approach with a high level of precision and recall with an average precision value of 0.85 and an average recall value of 0.837.

10:30: Biplane Wing Gap Influence Study of UAV with Wing-shaped Fuselage using Computational Fluid Dynamics

Dzikrian Diqnada (Bandung Institute of Technology, Indonesia); Wahyu Widhi Dyatmika (Bandung Institute of Technology, Indonesia); Bima Fahimna (Bandung Institute of Technology, Indonesia); Laurensius Rivian Pratama (Bandung Institute of Technology, Indonesia); Ema Amalia (Bandung Institute of Technology, Indonesia)

Abstract: Since the growing trend of UAV-based delivery, some major logistic companies initiate to develop a UAV-based delivery service. UAV-based delivery needs to have a long flight range while maintaining the advantage of fly and land in narrow areas. Therefore, hybrid aircraft that combining fixed wing with multirotor configuration is commonly used. In this study, the airframe that is used for analysis is a quadrotor biplane-tailsitter with a wing-shaped fuselage configuration. To create a proper design, understanding the influence of the UAV's body with the air is essential. The purpose of this research comes from the idea that in biplane configuration, both wings affect each other and interacting with the wing-shaped fuselage. This research aims to evaluate the current wing gap configuration, compare the performance with different wing gaps, and investigate the flow patterns. In this paper, aerodynamic performance is analyzed in 4 wing gap variations, namely 2.5 chords, 3 chords, 4 chords, and 5 chords length with the wing chord as the reference value. The flight condition is 25 m/s and the angle of attack is varied from -10 to 26 degrees. The most optimum aerodynamic performance occurs in 4 chords length of the biplane wing gap.

10:45: Development of a One Axis Thrust Vectoring Control System Demonstrator with Electric Ducted Fan

Naufal Muhammad Farras (Bandung Institute of Technology, Indonesia); Yazdi Jenie (Bandung Institute of Technology, Indonesia); Ony Arifianto (Bandung Institute of Technology, Indonesia)

Abstract: Thrust Vectoring Control (TVC) becomes a solution for condition which need sophisticated control since it has faster responses and it is robust to the flight environment, compared to conventional aerodynamic control. As the development of this technology takes a lot of experiments and may cost a lot, hardware in the loop simulator, or a demonstrator, can help in the learning and the development process. This research purpose is to design and build an indoor TVC demonstrator, using Electric Ducted Fan (EDF) as the thruster, that is capable of simulating the thrust control of a flight vehicle with high maneuverability, such as a launch vehicle (LV). The system is limited with only one degree of freedom, the pitch rotational axis, to be focused more on the demonstrator hardware and control requirements. A Flight Controller (FC) is used as the control mechanism to stabilize pitch attitude. The demonstrator is then built and tested, and capable to stabilize itself to a certain extent using a PID control algorithm. Several steady-state oscillations, however, are observed possibly due to the CG offset. This result indicates the need to improve the hardware design. Nevertheless, the demonstrator provides a decent foundation for future research on TVC.

11:00: Prediction of Remaining Useful Life for Aero-Engines

Rounak B (PES University, India); Manikandan J (PES University (PESU), India)

Abstract: The information on remaining useful life of any component or equipment is always helpful in being prepared for replacements or maintenance, if any. Engine is considered as the heart of an aircraft and the prediction of its remaining useful life has become a topic of utmost importance. Lot of research is in progress towards this area to safeguard the aircraft and passengers from catastrophic events. Model based approach is unfeasible and time consuming for proposed application and hence data driven approach is employed here. In this paper, an attempt is made to predict remaining useful life (RUL) of aero-engine using Long Short-Term Memory (LSTM) with and without Convolution Neural Network (CNN). In order to analyze and assess the performance of proposed models, benchmark NASA CMAPSS dataset comprising of four different sub datasets is employed. It is observed that the LSTM model without CNN performed better over LSTM model with CNN

and the results reported are on par with the results reported in literature on using various other algorithms for RUL prediction using CMAPSS dataset.

ICARES 2021: IEEE International Conference on Aerospace Electronics and Remote Sensing Technology 2021

Technical Session III: Aerospace and Electronic Systems 3

Session time	Wednesday, November 3, 2021 12:00 until 13:30 UTC/GMT +8 hours
Location	zoom breakout room 3
Talk time	15
Chaired by	Robertus Triharjanto, National Research and Innovation Agency (BRIN), Indonesia

12:00: Prototype of In-orbit Reconfigurable FPGA for PDHS

Khairunnisa Khairunnisa (Indonesian National Institute of Aeronautics and Space (LAPAN-BRIN), Indonesia); A Hadi Syafrudin (Indonesian National Institute of Aeronautics and Space, Indonesia); Gafur Hasan Zam Bahari (Indonesian National Institute of Aeronautics and Space, Indonesia)

Abstract: Programmability in satellite has become a stringent requirement to reprogram specific module or subsystem on board and to circumvent incapacitation against space radiation. A reconfigurable FPGA with multi-redundant configuration memories is used to realize these functionalities, as will be imparted within this paper. Actual application involves the configuration data from TTC being transferred to an FPGA inside PDHS which will configure an FPGA in certain payload. The prototype is done by transmitting a raw configuration file through serial communication from a PC to a controller device, an FPGA modified to emulate either JTAG and passive serial configuration schemes, then delivering the data to the targeted FPGA. In this paper, four configuration files are tested separately on both PS and JTAG; each of them programs the FPGA to serially deliver a passage of words in different language. If successfully configured, results are viewed in HTerm window and the generated waveforms are observed on Quartus SignalTap.

12:15: Design and Evaluation of Large Sized Floating Point Matrix Inversion Modules for Onboard Computer

Chetan S (PES University, Bangalore, India); Manikandan J (PES University (PESU), India); Lekshmi V (ISRO Satellite Centre (ISAC, Now URSC), India); Sudhakar S (ISRO Satellite Centre (ISAC, Now URSC), India)

Abstract: Modern satellites and aircrafts employ several algorithms to cater for various requirements onboard including control system, image processing, target recognition, image compression, wireless communication and many more. All these algorithms employ matrix algebra including inverse of a large scale floating point matrix. FPGAs are being employed in almost all onboard computers and systems of aircrafts and satellites. This has spearheaded research in the field of hardware implementation and evaluation of large scale floating point matrix inversion methods. In this paper, FPGA implementation of eight floating-point matrix inversion

algorithms for an onboard computer is proposed using a novel combination of model based design with high level language programming for FPGA based designs. The proposed designs can find inverse of a 120×120 floating point matrix and can be easily scaled to large size matrices.

12:30: Assessing the Effects of Orbital Shift on Diwata-2 Microsatellite Operation through Simulations

Kristian Monay (University of the Philippines Diliman, Philippines); Fritz Rhaem Olivar (University of the Philippines-Diliman, Philippines); Benjamin Jonah Magallon (University of the Philippines-Diliman, Philippines); Matthew Medrano (University of the Philippines Diliman, Philippines); Francisco Miguel Felicio (PHL-Microsat Program, Philippines); Shielo Muta (Philippine Space Agency, Philippines); Czar Jakiri Sarmiento (University of the Philippines Diliman, Philippines)

Abstract: Diwata-2 has been in orbit for three years since its launch on October 29, 2018. Thus, the effects of its orbital configuration are much more noticeable than in its earlier stages. This paper investigates the effects of orbital drift on the current issues that are affecting the operations of the satellite such as satellite communications and image quality. Using five simulations involving the determination of the limits of acceptable passes, culmination events over the Philippines, the shift in time of the passes, and the changes to the satellite's temporal resolution, it was found out that the satellite passes have shifted by over an hour from its design at launch. The rate of its nodal precession has increased, resulting to later passes. The temporal resolution of the satellite also changed from 31 days to 11 at the expense of less area coverage. Using the historical two-line element (TLE) data, future passes were also simulated. It was found out that currently, there is a problem involving blind spot areas at nadir pointing, which covers 58% of the Philippines' entire area. Two predictions were also done to determine when the satellite passes over the 3 PM local time. The first is by using linear regression on the culmination events of the satellite, and the second is by using the satellite's historical TLE. Both predictions were in agreement that the event would happen in August 2023. As such, after this limit, a large portion of the passes would not be ideal for image acquisition.

12:45: Determination of Mean Orbital Elements Using GPS Data for LAPAN Satellite Daily Operation

Ahmedi Asraf (Indonesian National Institute of Aeronautics and Space, Indonesia); Rise Hapshary Surayuda (National Institute of Aeronautics and Space of Indonesia (LAPAN), Indonesia); Ahmad Zammir Ribah (Satellite Technology Center LAPAN, Indonesia); Kamirul Kamirul (Indonesian National Institute of Aeronautics and Space, Indonesia); Mohammad Mukhayadi (National Institute of Aeronautics and Space, Indonesia)

Abstract: In their operation, LAPAN-A2/ORARI and LAPAN-A3/IPB satellites use SGP4 propagator to predict their position and velocity vectors. The SGP4 propagator needs mean orbital elements which are updated by NORAD in the form of two-line elements (TLE). Because NORAD TLE sometimes is not regularly updated which can lead to a huge error when it is propagated, a new way to create mean elements is needed for the satellite's daily operation. This paper discusses the method to determine the mean orbital elements using GPS data for satellite daily operation. The position and velocity vectors measured by the GPS receiver on the satellite are used to find the osculating elements. Then, these osculating elements are converted to mean orbital elements. Only one set of position and velocity vector is used to calculate the mean orbital elements. Then, It is found that even though only one set of position and velocity vector is used, that the determined means orbital elements are comparable to mean orbital elements produced by NORAD. Then, by setting the Bstar is equals to zero, it is concluded that this method that only uses one set of position and velocity vector data is sufficient for the daily operation of LAPAN-A2 and LAPAN-A3 satellites that the orbit is about 630 km and 505 above the sea level respectively.

13:00: Development of Ground Station Performance Information System for LAPAN Satellite Operations

Dicka Ariptian Rahayu (Indonesian National Institute of Aeronautics and Space, Indonesia); Muazam Nugroho (National Institute of Aeronautics and Space, Indonesia); Nurrochman Ferdiansyah (National Institute of Aeronautics and Space, Indonesia); Mukhamad Fajar Amiludin (National Institute of Aeronautics and Space, Indonesia); Patria Rachman Hakim (Indonesian National Institute of Aeronautics and Space, Indonesia); Sonny Dwi Harsono (Indonesian National Institute of Aeronanutics and Space (LAPAN), Indonesia)

Abstract: Indonesian National Institute of Aeronautics and Space (LAPAN) has three micro satellites in orbit: LAPANA1/TUBSAT, LAPAN-A2/ORARI, and LAPAN-A3/IPB satellites. To operate these satellites, LAPAN has five ground stations in Indonesia and ground station in Spitsbergen, Norway. The ground station in Indonesia consists of ground station in Rumpin and Rancabungur (Bogor, West Java), Bukittinggi (West Sumatra), Parepare (South Sulawesi) and Biak (Papua). These ground stations operate daily to support satellite operations, namely Telemetry, Tracking, and Command (TT&C) and satellite data acquisition. The information showing the performance of the TT&C ground station is needed as a reference in carrying out periodic maintenance of the ground stations. The performance of TT&C ground station can be calculated from the ratio of success and failure in sending commands and receiving telemetry data from satellites. To accommodate these data necessities, an information system with the ability to measure the performance of the TT&C ground station is needed. This paper describes the results of the development of a web-based TT&C performance information system for ground stations supporting LAPAN satellite operations. This information system can work well, successfully tested to calculate TT&C ground station performance in July 2021, and has four main views which have dashboard page, Pass data page, Command data page, and summary page of search result by satellite, ground station, and time including chart with three types of charts, namely three graphs with polar, geo-map, and two axes which are x as azimuth and y as elevation.

ICARES 2021: IEEE International Conference on Aerospace Electronics and Remote Sensing Technology 2021

Technical Session IV: Geoscience and Remote Sensing 1

Session time	Wednesday, November 3, 2021 12:00 until 13:30 UTC/GMT +8 hours
Location	zoom breakout room 2
Talk time	15
Chaired by	Harry Septanto, Research Organization for Aeronautics and Space(LAPAN - BRIN), Indonesia

12:00: AIS Data Pre-Processing for Trajectory Clustering Data Preparation

I Putu Noven Hartawan (Udayana University, Indonesia); I Made Oka Widyantara (Udayana University, Indonesia); A. A. I. N. Eka Karyawati (Udayana University, Indonesia); Ngurah Indra Er (Institute Mines Telecom / IMT Atlantique &

IRISA, France & Udayana University, Bali, Indonesia); Ketut Artana (Institut Teknologi Sepuluh Nopember, Indonesia); Nyoman Putra Sastra (Electrical Enginnering Universitas Udayana, Indonesia)

Abstract: Automatic Identification System (AIS) is radio navigation equipment for a vessel that has been required by the International Maritime Organization (IMO). The AIS dataset contains vessel information and vessel position. Various analyses can utilize the availability of AIS's extensive data history. In those analyses, it is necessary to know the vessel's trajectory pattern. With the development of data mining techniques, vessel trajectory patterns can be obtained by clustering. However, AIS data cannot be directly used in the clustering process. Data pre-processing is required due to the complexity of the trajectory data and the need to reduce noises in AIS data with large sizes. This study proposes a pre-processing model with data cleaning, trajectory extraction, and trajectory compression stages. Results show that the proposed model can reduce noise and, at the same time, reduce rows that will affect the following clustering process.

12:15: Implementation of Unsupervised Learning Based On AIS Data of LAPAN Satellites

Nurrochman Ferdiansyah (National Institute of Aeronautics and Space, Indonesia); Muazam Nugroho (National Institute of Aeronautics and Space, Indonesia); Dicka Ariptian Rahayu (Indonesian National Institute of Aeronautics and Space, Indonesia); Rizki Permala (National Institute of Aeronautics and Space, Indonesia); Patria Rachman Hakim (Indonesian National Institute of Aeronautics and Space, Indonesia); Wahyudi Hasbi (National Institute of Aeronautics & Space (LAPAN), Indonesia)

Abstract: Indonesia requires a maritime surveillance system that is capable for monitoring its wide waters territory. Indonesian National Institute of Aeronautics and Space (LAPAN) with LAPAN-A2 and LAPAN-A3 satellites which have Automatic Identification System (AIS) receiver as payloads, make a significant contribution to maritime surveillance in Indonesian territory. The AIS data receives from LAPAN Satellite is raw form data, such as the ship identity (static message) and navigation status (dynamic data), which need to be processed further to maximize the usage and able to provide certain information. This study focuses on implementation of unsupervised learning For AIS Data of LAPAN Satellites using Density-Based Spatial Clustering of Applications with Noise (DBSCAN) with additional parameter to extract information like characteristics of the ship's shipping lane, ship behaviors and find hidden patterns in AIS data of LAPAN Satellite. The results of the analysis show that by adding two new parameters (COG and SOG) to DBSCAN, the results of the clustering performed was greatly improved. The results of optimized DBSCAN provide a dataset that can be used to discover vessel behavior and the characteristics of shipping lanes in an area

12:30: Accurate Sensing Model Simulation for Porang-Tuber Detection

Onny Setyawati (Brawijaya University, Indonesia); Muhammad Fauzan Edy Purnomo (Brawijaya University, Indonesia); Axel Bangert (University of Kassel, Germany); Rodiyati Azrianingsih (Brawijaya University, Indonesia); Rahmadwati Rahmadwati (University of Brawijaya, Indonesia); As ad Aziz (Universitas Wisnuwardhana Malang, Indonesia)

Abstract: In this study, we present two scanning signals of GPRMax model simulation to sense Porang (Amorphophallus muelleri Blume) tuber underground. The need to detect tubers underground is emerged due to dormant period experienced by Porang plants in their third year which in turn caused difficulty to harvest the tubers. Measurement of tubers' water content is also presented. The higher the percentage of water content in tuber, the higher the dielectric constant of tuber. The model simulation tests were performed by varying the tubers diameter, the depths, and number of the tubers underground. Range frequencies used for estimating the depth of tubers were between 1 up to 2.3 GHz. At 1.1 GHz an error estimation of Porang underground was less than 1% at 10 cm in depth. However, at 1.7 GHz the smallest error of only 0.55% was achieved for 6 cm tuber depth detection. In these tests, using of high frequencies was very effective for detecting tubers at shallow depths.

12:45: Optimization of Drone for Coastline Mapping

Eka Djunarsjah (Bandung Institute of Technology & Hydrography Research Group, Indonesia); Agung Budi Harto (Bandung Institute of Technology & Remote Sensing Research Group, Indonesia); Miga Julian (Institut Teknologi Bandung, Indonesia); Frezto Samuel Andrew Sinurat (Bandung Institute of Technology & Geodetic Engineering, Indonesia); Nafandra Syabana Lubis (Bandung Institute of Technology & Geodetic Engineering, Indonesia)

Abstract: Coastline mapping outermost and smallest islands of Indonesia needed to make optimal maritime baseline for maritime boundary. Coastline information usually obtained from satellite imagery which commonly lacking renewal and has low spatial resolution and not referenced to tidal data. Therefore, the utilization of drone could improve the quality of coastline mapping in terms of time and cost consumed. This research discusses how optimal the drone is in carrying out coastal mapping. The type of drone that is deployed in this research is the DJI Phantom 4 Pro, with an accuracy equivalent to handheld GPS device. The coastline extracted by delineating digitally classified orthophoto. Coastline correction carried out using fixed water level from TPXO9 tidal model and coastal slope data. Drone mapping optimization discuss from coastline accuracy, coastline determination method, coastline validating and future recommendations. The mapping process yields four coastlines: HAT, LAT, MSL, and Chart Datum. The coastline obtained in this study satisfies the standards specified in IHO S-44, 6th edition and is categorized in the special-order category. This research result coastline with spatial resolution of 2 cm fit in map scale of 1:1,000. The coastline has also been referenced with tidal data. It is concluded that the mapping process using drone that relies on the accuracy of handheld GPS devices, with the help of TPXO9 tidal model data, is considered optimal to extract coastline from a given location. However, further acquisition of on-site tidal data and control points is recommended.

13:00: Cloud Segmentation Strategy for LAPAN-A2 Multispectral Imagery

Kamirul Kamirul (Indonesian National Institute of Aeronautics and Space, Indonesia); Suisbiyanto Prasetya (Indonesian National Institute of Aeronanutics and Space (LAPAN), Indonesia); Dian Yudistira (Indonesian National Institute of Aeronautics and Space, Indonesia); Farid Armin (Indonesian National Institute of Aeronautics and Space, Indonesia)

Abstract: In this paper, we reported the current result on the development of a cloud segmentation strategy for multispectral imageries (MSI) captured by LAPAN-A2 satellite. The segmentation was performed by involving 3200 sets of images using both deep-learning and classical-based approaches. For the deep-learning side, the U-Net was considered since it is one of the state-of-the-art image segmentation methods. On the other side, HSV (Hue, Saturation, Value) color space-based segmentation was chosen for the classical-based method. The performance of both approaches has been evaluated and compared in terms of their accuracy and speed. The comparison results provided in this paper could be used as a reference in choosing a proper strategy to extract cloud blobs existing on LAPAN-A2 MSI.

Technical Session V: Aerospace and Electronic Systems 4

Session time	Wednesday, November 3, 2021 15:30 until 17:00 UTC/GMT +8 hours
Location	zoom breakout room 3
Talk time	15
Chaired by	Nova Khamsah, Research Organization for Aeronautics and Space (LAPAN - BRIN), Indonesia

15:30: Design Of Microstrip Antenna With DGS Slot For Satellite Applications

Anshari Akbar (Lembaga Penerbangan dan Antariksa Nasional (LAPAN), Indonesia); Eko Tjipto Rahardjo (Universitas Indonesia, Indonesia); Fitri Yuli Zulkifli (Universitas Indonesia, Indonesia); Zhauhar Rainaldy (Lembaga Penerbangan dan Antariksa Nasional (LAPAN), Indonesia)

Abstract: To transmits satellite data with a large capacity to ground stations can be overcome by increasing the bandwidth. DGS (defected ground structure) method can increase the antenna bandwidth and has a miniaturization effect making it suitable for satellite application design. The antenna has been designed with circular polarization to overcome polarization loss. DGS pattern with dual-slot X-shaped is used. DGS dimensions such as slot length, slot width, and distance between DGS slots are optimized using CST software. The antenna was designed by using Roger 5880 and Roger 4350 substrate to obtain a miniaturization effect and wider beamwidth. Measurements on Roger 4350 substrate obtained a bandwidth of 97MHz or 4.3%, Gain 3.63dB at frequency of 2220MHz and beamwidth of 90 degrees. Measurement of the antenna with Roger 5880 substrate bandwidth obtained 92MHz or 4.1%. The antenna gain is 5.85dB at 2220MHz frequency and 85 degrees of beamwidth. Antenna with Roger 4350 substrate has a miniaturization effect of 35.3% on Roger 5880 substrate. Antenna with the use of DGS on Roger 4350 obtained reduction effect is 4.8% and the Roger 5880 substrate obtained reduction effect 1.84%. The results obtained indicate that the DGS method with an X-shaped dual-slot pattern can reduce the antenna size and increase the antenna bandwidth.

15:45: Design of Cubesat Microstrip Antenna with Metamaterial Structure for LoRa Communication

Muhammad Manggala (Telkom University, Indonesia); Edwar Edwar (Telkom University, Indonesia); Wahyudi Hasbi (National Institute of Aeronautics & Space (LAPAN), Indonesia); Naufal Alim Harya Putra (Telkom University & SatCommRadar Laboratory, Nanosatellite Division, Indonesia)

Abstract: Due to Indonesia's position in the ring of fire implies a potential disaster throughout the year, it needs to be mitigated by installing ground sensor data throughout Indonesia including in remote areas, but most places lack communication signals. The satellite-based mitigation communication system is one solution in connecting sensors and ground stations. It requires an antenna that has compact size and high performance to do the mitigation communication system. A rectangular microstrip antenna for LoRa communication in the 924 MHz frequency range for disaster mitigation is proposed to improve the performance of Lora which has

low power and long-distance performance characteristics. The antenna is made with a Rogers Duroid RT6006 substrate and applies a Single Complementary Split Ring Resonator (CSRR) to increase gain and reduce antenna dimensions. Based on the simulation, the antenna return loss 6.15 dB, gain 2.2 dBi, and elliptical polarization with axial ratio 6.98 dB. Measurements show the performance of return loss 19.82 dB, gain 2.6 dBi, and an elliptical antenna with an axial ratio of 7.2 dB.

16:00: Beamwidth Enhancement of Antenna With Cone Structure For Satellite Application

Anshari Akbar (Lembaga Penerbangan dan Antariksa Nasional (LAPAN), Indonesia); Dwi Yanto (Indonesian National Institute for Aeronautics and Space, Indonesia); Aloysius Adya Pramudita (Telkom University, Indonesia); Rizki Permala (National Institute of Aeronautics and Space, Indonesia); Eriko Nasemudin Nasser (National Institute of Aeronautics and Space, Indonesia)

Abstract: Microstrip antenna with wide 3dB beamwidth is presented for satellite application. A simple slot is used to achieved circular polarization with the coaxial feed method. Cone structures are used to enhance the 3dB beamwidth. Cone structures are designed with aluminum and copper material. Then the structure dimension is optimized to obtained wider beamwidth. The result shows that the antenna with copper structure obtained a maximum beam width of 187 degrees and 124.4 degrees to the aluminum structure. The antenna design with copper structure with 133.7 degrees at phi=0 degree and 134.9 degrees at phi=90 degree is chosen. Antenna resonated at frequency 2.22 GHz with gain obtained 2.78 dBi.

16:15: GMSK Modulation Uplink Signal Analysis for LAPAN Constellation Satellite using GNU Radio Simulation

Maulana Ali Arifin (National Institute of Aeronautics and Space, Indonesia); Abdul Karim (LAPAN, Indonesia); Nurul Fadilah (National Institute of Aeronautics and Space, Indonesia); Eriko Nasemudin Nasser (National Institute of Aeronautics and Space, Indonesia); Bina Pratomo (Indonesia National Institute Aeronautics and Space & LAPAN, Indonesia)

Abstract: Indonesia's geographical location is prone to natural disasters such as volcanic eruptions and tsunamis forces to improve its capabilities and development of satellite communication technology. The Low Earth Orbit (LEO) communication satellite placed on the equator is one of the best choices for Indonesia, considering the small number of satellites in the constellation and the lower cost compared to GEO communication satellites. Modulation for LEO satellites, an important aspect of the communication system, becomes the focus of this research. More spectral efficiency, like the one characteristic of Gaussian Minimum Shift Keying (GMSK), encourages one of the appropriate modulations for communication links in LEO constellation satellites. This paper aims to examine the signal of GMSK modulation on LAPAN's constellation satellites. The result shows that the transmitted signal from the user terminal should be more than 36 dBm to get a -118 dBm signal in the satellite. This paper also explores the link budget comparison for each elevation, which shows that the minimum elevation is 15 degrees using a monopole antenna to establish the link.

16:30: User Terminal Prototype Development For LAPAN's Low Orbits Constellation Satellite

Bina Pratomo (Indonesia National Institute Aeronautics and Space & LAPAN, Indonesia); Eriko Nasemudin Nasser (National Institute of Aeronautics and Space, Indonesia); Aulia Haque (National Institute of Aeronautics and Space, Indonesia); Nurul Muhtadin (LAPAN, Indonesia); Maulana Ali Arifin (National Institute of Aeronautics and Space, Indonesia); Moedji Soedjarwo (Senior Researcher, Indonesia)

Abstract: User terminal device development for low orbits constellation communication satellites already develop. This paper describes the design process, user terminal components, operational concept, the test result of the sensor's data acquisition, and data transmission to the satellite data collecting system (simulator).

User terminal was transmitted data at a scheduled time at UHF frequency 440.4206 MHz with GMSK modulation with output power was -4.77dbm, the number of data sent was 1.7KB.

ICARES 2021: IEEE International Conference on Aerospace Electronics and Remote Sensing Technology 2021

Technical Session VI: Geoscience and Remote Sensing 2

Session time	Wednesday, November 3, 2021 15:30 until 17:00 UTC/GMT +8 hours
Location	zoom breakout room 2
Talk time	15
Chaired by	Bustanul Arifin, Research Organization for Aeronautics and Space (LAPAN - BRIN), Indonesia

15:30: Denoising LAPAN A3 High-Resolution Digital Camera Images: a Comparative Study

Agung Wahyudiono (Satellite Technology Center LAPAN, Indonesia); Agus Herawan (Indonesian National Institute of Aeronautics and Space (LAPAN), Indonesia); Muhamad Riza Fakhlevi (Nastional Institute of Aeronautics and Space (LAPAN), Indonesia); Moedji Soedjarwo (Senior Researcher, Indonesia); Patria Rachman Hakim (Indonesian National Institute of Aeronautics and Space, Indonesia)

Abstract: Satellite images are usually degraded due to inaccuracy or limitations of the transmission and storage devices. Many researchers are still trying to remove noise from satellite images. Satellite image denoising techniques should not distort edges in an image. FFDNet is an image denoising solution that was recently developed. FFDNet has several advantages over other existing neural network denoisers, including a faster execution time and reduced memory footprint, as well as the ability to properly handle a wide variety of noise levels with a single network model. This technique is appealing for practical denoising applications because of its denoising performance and minimal computing load. High Resolution LAPAN-A3 imagery has great potential for use in various remote sensing applications. But it has a problem related to its dynamic range which causes very high noise that will appear when we try to increase the brightness of the image. In this paper a different approach for LAPAN-A3 satellite imagery denoising, namely BM3D, FastNLM and FFDNet. This method has tried to compare in terms of denoising performance, with three different cases of AWGN, model, and mixed noise. The result show that FFDNet has the best performance among others, especially when recovering images from AWGN noise. But when try to remove model and mixed noise, all of these methods have almost the same output value, but FFDNet is slightly better than others

15:45: Potential Area for Radiometric Calibration of Satellite Cameras in Indonesia

Sartika Salaswati (National Institute of Aeronautics and Space (LAPAN), Indonesia); Ega Asti Anggari (Pusteksat, LAPAN, Indonesia); Muhamad Riza Fakhlevi (Nastional Institute of Aeronautics and Space (LAPAN), Indonesia); Bambang Sigit Pamadi (Nastional Institute of Aeronautics and Space (LAPAN), Indonesia)

Abstract: Cameras on remote sensing satellites must be calibrated in a timely manner to ensure the quality of the images. This calibration process is done before launch and during on-orbit operation. There are several types of on-orbit calibration, some of them require a calibration area that has to be based on several characteristics. This research was conducted to analyze the feasibility of calibration sites in three areas in Indonesia. Those areas are Jaddih Hill, Kupang Cement Mine, and Bromo Tengger Semeru National Park. An objective method to determine the calibration areas was by observing the image's area from the multispectral camera of the LAPAN-A3 satellite (LISA), the multispectral camera of the LANDSAT-8 satellite (OLI), and Google Earth. Furthermore, it was conducted measuring reflectance and analyzing the uniformity of the area by Coefficient of Variation (CV) calculation. The results show that the Jaddih Hill and Kupang Cement Mine according to the requirements as a calibration area at a range of wavelength from 400 - 900 nm. Meanwhile, Bromo Tengger Semeru National Park is not recommended on those wavelenght.

16:00: Comparison of Machine Learning Classifiers for Land Cover Changes using Google Earth Engine

Sackdavong Mangkhaseum (Kyushu Institute of Technology, Japan)

Abstract: Increasing urbanization causes a variety of environmental changes, not only in regional but in the global scale, especially in developing countries. The developing countries like Lao PDR have very few data on environment and urban management and face many difficulties due to poor data management. Nowadays, using the integration of geographic information system (GIS) and remote sensing provides us with an effective result in determining the land use and land cover changes as well as providing valuable information needed for planning and researching. A new approach has been introduced for detecting and monitoring urban expansion by using the Big Data platform via the Google Earth Engine (GEE) cloud computing. Also, the machine learning algorithms have been recommended in this research, such as Random Forest (RF), Classification and Regression Tree (CART), Support Vector Machine (SVM) and Minimum Distance (MD). In this paper, we conduct GEE combining with multiple sources of satellite optical images time-series from three main satellites, Landsat 5 and Landsat 8 and Sentinel 2. For our dataset, we manually classify our dataset based on the pixel-based approach and object-based approach which were divided into training sample (70%) and testing sample (30%). Accuracy was assessed through metrics derived from a confusion/error matrix of the classifier. From the results, RF and CARF outperformed other classifiers and exhibited overall accuracy both training data and testing sample whereas SVM performed mediocrely and Minimum distance displayed least performance.

16:15: Experimental study of hierarchical clustering for unmixing of hyperspectral images

Jose Prades-Nebot (Universitat Politècnica de València, Spain); Addisson Salazar (Universidad Politécnica de Valencia, Spain); Gonzalo Safont (Universitat Politècnica de València, Spain); Luis Vergara (Universidad Politécnica de Valencia, Spain)

Abstract: Innovative remote sensing image processing techniques has been progressively studied due to the increasing availability of remote sensing images, powerful techniques of data analysis, and computational power. Sub-pixel processing has emerged as an intense area of research considering the possibility of a pixel to belong to different classes in an image segmentation context. It is especially relevant in remote sensing, where different macroscopic or microscopic components could appear to contribute to every pixel. Two main problems are identified in sub-pixel processing: unmixing and mapping. In this paper, a hierarchical clustering method for unmixing (particularly, estimation of the number of materials or endmembers) of hyperspectral images is proposed. The proposed method iteratively performs the estimation for several increasing values of a maximum number of materials and stops until a certain condition is met. The results obtained with five hyperspectral images show that the proposed method approximately estimates the number of materials.

16:30: Remote Sensing-based Socioeconomic Analysis using Task-driven Transfer Learning and Regression

Sree Teja Buddaraju (Lakehead University, Canada); Ananya Bardhan (Lakehead University, Canada); Ramya Sri Boddu (Lakehead University, Canada); Simranjit Kaur (Lakehead University, Canada); Thangarajah Akilan (Lakehead University, Canada)

Abstract: The economic status of each country varies; some countries are well developed while some are underdeveloped. A lower economic status in any place in the world can lead to hunger, malnutrition, and low life expectancy, especially for children and the older generation. For instance, in Africa, most people live below the international poverty line of 1.25 US dollars per day, according to the World Bank Group. One way of solving this problem is through collecting data and building intelligent models to automatically detect the low economic regions so the organizations, like The United Nations Development Program (UNDP), can allocate vital support systems to save the people there from the severity and help them lead a better life. Unfortunately, obtaining such data through human surveys takes too long and requires a lot of resources. Thus, this work aims to provide an efficient solution to this problem. It analyzes the socioeconomic status of the underdeveloped regions, primarily a few selected African countries, by using remote sensing, multimodal data exploitation, machine learning, transfer learning, and computer vision technologies. The proposed framework can make accurate predictions on a particular geographic region's standard of living (wealth index) based on the distribution of nightlight intensity observed through satellite remote sensing. Exhaustive experiments are carried out using data from the National Oceanic And Atmospheric Administration (NOAA), Demographic and Health Survey (DHS), and Google static maps. The experimental results verify that the proposed framework can be used as an effective alternative to the conventional approaches for socioeconomic analysis.

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