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# PROGRAMME

## Thursday, November 24

### Thursday, November 24 8:00 - 9:50

#### Opening

Opening & Keynote Session
Prof. Yukihiro Takahashi, Department of Earth and Planetary Sciences, Cosmosciences, Hokkaido University & Dr. Robertus Heru Triharjanto, Head of Research Organization for Aeronautics & Space (BRIN), Indonesia

Room: Hotel Ballroom

### Thursday, November 24 10:00 - 12:00

#### Aerospace and Electronic Systems - 1

Room #2 (10:00 - 12:00)
Mr. M. Arif Saifudin

Room #2

Please choose Breakout Room 2

**1** **10:00** ***GA Optimization of a Reinforcement Learning-based Controller for the Vertical Landing Rocket Case***

Larasmoyo Nugroho (LAPAN Pustekroket - Rocket Technology Center, Indonesia & Universitas Indonesia, Indonesia); Diva Larasati (Universitas Indonesia, Indonesia); Rika Andiarti (National Research and Innovation Agency (BRIN) & Research Organization for Aeronautics and Space, Indonesia); Rini Akmeliawati (The University of Adelaide, Australia); Prawito Prajitno (Universitas Indonesia, Indonesia); Ery Fitrianingsih (LAPAN - BRIN, Indonesia); Sastra Kusuma Wijaya (Departemen Fisika, FMIPA UI & University of Indonesia, Indonesia)

A reward function in reinforcement learning is the formalization of the objective. Finding the ideal reward function might be challenging, and a search strategy may be required. Genetic Algorithm is a suitable approach for reward function search due to its robustness. The Deep Deterministic Policy Gradient (DDPG) algorithm, which is the focus of this research, is a reinforcement learning-based controller whose performances are increased after the Genetic Algorithms optimizes the agent's reward functions. The outcome is contrasted with PID and DDPG controllers from earlier

**6** **10:15** ***Effect of Magnetorquer Activity on the Measurement of Earth's Magnetic Field in LAPAN-A3 Satellite***

Suraduita Mupasanta (National Research and Innovation Agency, Indonesia); Hidayah Hidayah (Indonesian National Institute of Aeronautics and Space, Indonesia); Mukhamad Fajar Amiludin (National Institute of Aeronautics and Space, Indonesia); Abdul Karim (LAPAN, Indonesia); Maria Syenni Kabes and Satriya Utama (National Research and Innovation Agency, Indonesia)

In 2021, Indonesia's National Institute of Aeronautics and Space (LAPAN) become part of the National Research and Innovation Agency (BRIN), LAPAN develops and operates three earth observation satellites to improve the country's monitoring. LAPAN-A3, the third satellite developed by LAPAN, had a scientific mission to measure the earth's magnetic field by using a magnetometer sensor. However, the magnetometer onboard satellite not only measures the strength and direction of the earth's magnetic field but also a disturbance field induced by spacecraft electronics. Moreover, to avoid severely disrupted missions causing attitude error, the satellite depends on its subsystem to maintain its accuracy by using magnetorquer for correction. To exclude the disturbance of the magnetic field produced by the electronics, two magnetometers are operated. However, the LAPAN-A3 satellite only utilizes one magnetometer, hence it has a different approach. In consequence, the effect of magnetorquer activity on the measurement of the earth's magnetic field in the LAPAN-A3 Satellite has to be analyzed. In this research, a pseudo-inverse method is used to fix the difference in magnetometer data due to the changing of current in the magnetorquer on the LAPAN-A3 satellite. The method's result is a matrix function with its residual in each 3 magnetometer's axis. A change of 1 mA in the X magnetorquer will give -43.2803 nT in the X direction, -45.9198 nT in the Z direction, and -0.8086 nT in the Y direction. It can be seen that by using pseudo-inverse, the magnetometer measurement can be corrected.

**13** **10:30** ***Performance Measurement of SDR based AIS Transmitter***

Maulana Ali Arifin (National Research and Innovation Agency, Indonesia); Wahyudi Hasbi (National Research & Innovation Agency (BRIN), Indonesia); Narender Kumar (Space Application Center, India); Nova Khamsah (Indonesian National Institute of Aeronautics and Space, Indonesia); Eriko Nasemudin Nasser (National Institute of Aeronautics and Space, Indonesia)

As the largest maritime country, Indonesia needs a maritime monitoring system. It encourages the Indonesian Research Center for Satellite Technology to develop a satellite carrying a satellite-based Automatic Identification System (AIS) receiver. Following the successes of the previous satellite, the currently developed satellite, which is scheduled to be launched in the next few years, will also carry a satellite-based AIS receiver. In developing a satellite-based AIS receiver, an AIS transmitter with adequate flexibility is needed to carry out various testing. This paper aims to investigate the performance of the SDR-based AIS Transmitter. Two kinds of SDR for comparison are LimeSDR Mini and HackRF One. The output RF power, operating frequency, occupied bandwidth, and harmonic signals were measured. The result shows that the output RF power is around 7 dBm for HackRF One and 14 dBm for LimeSDR Mini with direct transmission. However, with the amplifier implemented, the total RF output power for both SDRs is around 33 dBm ±0.2 dBm, which complies with the carrier power error standard. The frequency operation also meets the requirement with less than 150 Hz drift. Likewise, the occupied bandwidth matches the requirement with less than 11 kHz. Unfortunately, the harmonics for LimeSDR Mini and HackRF One could not meet the standard. Nevertheless, implementing additional filter can solve the harmonics problem.

**19** **10:45** ***Evaluation of Wing Gap Variation on Box Wing UAV with Computational Fluid Dynamics***

Faiq M Arif, Muhammad Faza Abel Jonggara Marpaung, Matthew Hu, Dzikrian Diqnada and Ema Amalia (Bandung Institute of Technology, Indonesia)

Closed-loop wing design improves aerodynamic performance by suppressing vortices at the wingtips. This allows the reduction of drag and improvement in stall performance. The non-planar geometry of this configuration opens many possibilities for its development. To properly optimize this design, it is necessary to explore which parameter affects the performance of this configuration. This study investigates the effects of varying the gap between the wings in a closed-loop configuration on the aerodynamic performance of the test model. The test model was based on an existing Dara Aviation D-1 UAV wing design. A total of three variations were made from the base model, with a wing gap of 0.5, 0.75, and 1 mean aerodynamic chord. These models were analyzed using Computational Fluid Dynamics, employing the Reduced Averaged Navier Stokes method and the K-Epsilon turbulence model. The angle of attack varied from -4 to 20 degrees and the flow velocity was 25 m/s. The result of this analysis indicates that increasing the wing gap in a closed-loop wing configuration resulted in greater lift and stall resistance.

**26** **11:00** ***A Reflectarray Antenna Based on Diamond-Ring Slotted Elements With Enhanced Reflection Phase***

Bagas Satriyotomo and Seongmin Pyo (Hanbat National University, Korea (South))

This paper presents the design and investigation of a reflectarray antenna with diamond-ring slotted elements operating at a frequency of 20 GHz. The diamond-ring slot applied to the design can extend the reflection phase range of the unit-cell. The reflectarray antenna has a dimension of 190 × 190 mm2 with a total of 505 elements in a circular aperture and a focus of 150 mm. A rectangular horn antenna with a symmetric beamwidth of 35° and 14.4 dBi gain is proposed as the antenna feed. The designed antenna has improved gain with a value of 27.2 dBi directed to (θ = 0°, ϕ = 0°) and a 5.8° beamwidth.

**30** **11:15** ***Online Tuning of Pre-trained Deep Neural Network for Guidance Against Non-cooperative Pursuer***

Du Runle (National Key Laboratory of Science and Technology on Test Physics and Numerical Mathematics, China)

In the astronautics, it is widely acknowledged as a hard problem that using neural network to handle the intelligent observation and guidance when dealing with non-cooperative pursuing vehicles. Due to the difficulty of obtaining training data set from non-cooperative vehicles, the inconsistency between training data and utilization data, application of neural network controller is by far very limited. In order to tackle this problem, an online training scheme of neural network is proposed in this paper aiming to boost the observation and counter action abilities against non-cooperative pursuer. In the proposed methodology, the deep neural network controller is pre-trained through dataset from generative network before deployment, and fine-tuned online through real time observations data set. In this way, the calculation pressure is alleviated for onboard computer and the contribution of real time observation data set is utilized more correctly, thus guaranteeing the efficiency and effectiveness of online training. Simulation results suggested that, both in the observation ability and counteractive guidance to avoid the pursuer, the proposed method all trumped traditional networks without online training, which resulting a higher chance to survive the pursuit.

**37** **11:30** ***Automatic Bayesian Range Estimation for Passive Bistatic Radar using Slice Sampling via Histograms***

Md Shahnawaz Hussain (Birla Institute of Technology Mesra & IEEE, India); Srikanta Pal (BIT Mesra, India)

Estimating the range for a Passive Bistatic Radar (PBR) is a critical problem for the signal processing research community. An efficient solution to this problem, in terms of time-complexity and estimation accuracy, has been proposed recently. This solution implemented maximum likelihood estimator (MLE), a classical technique, using the Markov chain Monte Carlo (MCMC) method to maximize the likelihood function. Specifically, the hybrid Metropolis-Hastings (MH) MCMC method was used. In our study, we adopt the Bayesian framework to solve this problem in which the parameters of interest are considered random variables instead of unknown deterministic constants as in classical approaches. The Bayesian model accounts for the inherent randomness of the PBR system. It also incorporates prior knowledge about the parameter to be estimated into the estimator. This improves the estimation accuracy. Bayesian techniques are comparatively less computationally expensive for high-dimensional and multi-modal problems like PBR. To compute the global maximum of the target probability distribution function (pdf), we have chosen three MCMC methods, namely, MH, hybrid MH, and slice sampling. Out of these three, the slice sampling technique is simpler to implement and can adapt to the characteristics of the target pdf, making it suitable for automated use and software development. It can also be concluded from our experiments that slice sampling, in conjunction with the histogram method, can be slightly faster than MH and hybrid MH sampling methods for a particular case, as shown in the comparative table in Section V of this manuscript.

**44** **11:45** ***A Design of ADS-B Receiver Antenna using Truncated Circular Microstrip Patch in Cubesat Form Factor***

Gilda Priscila, Levy Olivia Nur and Edwar Edwar (Telkom University, Indonesia)

Automatic Dependent Surveillance-Broadcast (ADS-B) is an aircraft surveillance technology which is used to monitor the aircraft traffic. To extend the ADS-B monitoring area, an ADS-B receiver can be installed on a low earth orbit (LEO) satellite, e.g. a nanosatellite. An antenna is needed to be installed on the nanosatellite to capture the ADS-B signal from the aircrafts. In this work, an ADS-B receiver antenna is presented. The challenge in this work is to design the ADS-B receiver antenna to be fit into a cubesat platform, a popular nanosatellite form factor. This antenna design follows antenna microstrip configuration. This is non-deployable antenna type which can be used directly after the cubesat released from the launcher. It uses circular patch with a truncated structure to produce circular polarization. This antenna substrate contains two layers of RO3006. This method is used to increase the antenna gain performance. This work result shows that the antenna has successfully satisfied the requirements set on this work.

## Aerospace and Electronic Systems - 2

Room #3 (10:00 - 12:00)

Mr. Aditya Bayu Erwindu

Room #3

Please choose Breakout Room 3

**50** **10:00** ***Semi-empirical Thermal Modelling of LAPAN-A3 Satellite Using Machine Learning Method***

Robertus Triharjanto (Research Organization of Aeronautics and Space); Ricky Sutardi (Bandung Institute of Technology, Indonesia); Ridanto Eko Poetro and Luqman Fathurrohim (Institut Teknologi Bandung, Indonesia); Desti Suryanti (Research Organization of Aeronautics and Space, Indonesia)

Understanding LAPAN-A3 thermal characteristics is the key to improve the next generation Indonesian micro-satellite thermal design. LAPAN-A1 until LAPAN-A3 use passive thermal control system by means of heat distribution by their structures, and heat radiation coating. Data-driven approaches in satellite thermal analysis are increasingly used to reduce the complexity in first principle thermal modelling that require high accuracy in the satellite component's thermal properties. This paper presents a simple semi-empirical thermal model to predict satellite temperature using machine learning method trained on real satellite telemetry data. The model can deduce the variables needed to predict satellite temperature changes. The proposed algorithm is implemented with a 7-node model of LAPAN-A3 (6 nodes for each side and 1 node for middle plate) and trained with data from 19 to 20 May 2018 to create satellite node temperature predictions. From initial performance evaluation, the model shows promising results and has potential for real-life usage in future satellite developments.

**57** **10:15** ***Serial Bus as Communication Between Microcontroller and AD9824 for Multi Spectral Camera***

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

A multispectral camera for LAPAN-A4 microsatellite will be developed using charge-coupled device (CCD) to capture image and 16 ADCs to convert the CCD's analog yields into digital signals. To connect the ADCs and the camera, design of embedded system connection is needed with microcontroller as the main processor and serial bus as the communication protocol. This research aims to integrate 16 ADCs of AD9824 with ATMega128 microcontroller using serial bus communication. Tests are conducted by using collimator and by executing different ADCs with different gain values, resulting in several images with distinctive characteristics. From the test data, the microcontroller can execute commands and make telemetry requests to ADCs. In addition, it can be seen that the maximum value of digital number of each image is different, ranging from 7934 to 9212, when each ADC is separately activated with maximum gain input value of 36 dB and the digital number reaches maximum value of 3581 when all ADCs are deactivated.

**62** **10:30** ***Design and Evaluation of an Electronic Eye for Fire Detection in Human Space Capsule***

Monish B Moger, Abhishek H, Pranav B, Pubali Roy and Priya Bharadwaj (PES University, India); Akash Gupta and Payal Sharma (SAC-ISRO, India); Manikandan J (PES University (PESU), India)

Fire is often considered as a good friend, as it helps human in several ways, but the same is also considered as a dangerous foe, once it gets out of control. Fire can burn houses, buildings, forests, vehicles and almost anything in no time. In addition to this, it also depletes oxygen from the surrounding atmosphere, thus leading to casualties due to lack of oxygen, smoke and suffocation. The situation worsens if plastics, harmful chemicals and gases get burnt, as the fumes produced could be toxic and the casualties would further increase. Hence there is an urge to design early fire detection systems that can sense the initiation of fire and in turn activate the extinguishers to extinguish the fire, reducing the loss of property and life. In this paper an attempt is made to design and evaluate Electronic eye (E-Eye) for early fire detection in a human space capsule. Two variants of E-eye are proposed and their performances are compared. An attempt is also made to employ the concepts of machine learning using Generative Adversarial Network (GAN) models for fire detection. Maximum recognition accuracy of 100% with a prediction time of around 80ms was achieved using the proposed model. The proposed work is an outcome of a funded project from Indian Space Research Organization. The proposed prototypes can be easily employed in other places too such as houses, offices, storeroom, garage, etc.

**69** **10:45** ***Link and Doppler Analysis for LEO Constellation Space-Based IoT***

Nurul Fadilah (National Institute of Aeronautics and Space, Indonesia); Maulana Ali Arifin (National Research and Innovation Agency, Indonesia); Aulia Haque Qonita (National Institute of Aeronautics and Space, Indonesia); Nayla Najati (Research Center for Satellite Technology, BRIN, Indonesia); Bina Pratomo (National Innovation and Research Agency & BRIN, Indonesia); Dwiyanto Dwiyanto (BRIN, Indonesia); Eriko Nasemudin Nasser (National Institute of Aeronautics and Space, Indonesia)

Indonesia's geographical condition, which has many rural areas, needs satellite technology to extend the communication network coverage. Based on this need, Indonesia is developing an LEO constellation satellite, and one of its missions is IoT services in the UHF frequency band. This paper aims to calculate and analyze a communication link design between ground and satellite for IoT services on constellation satellites. In addition, the frequency shift due to the satellite movement is also investigated. The result shows that the minimum elevation to establish communication for uplink and downlink is 27 degrees with 0 dB link margin and 0 degrees with 2.69 dB link margin, respectively. Furthermore, the maximum doppler shift is 9217 Hz at 0 and 180 degrees satellite's elevation.

**75** **11:00** ***Doppler Analysis for the S-AIS Receiver for the Indonesian LEO Constellation***

Nurul Muhtadin, Nayla Najati, Rosza Madina, Maulana Ali Arifin, Nurul Fadilah, Nova Khamsah, Aulia Haque Qonita, Anshari Akbar and Rifki Ardinal (National Research and Innovation Agency, Indonesia)

The S-AIS (Space-based Automatic Identification System) receiver is one of the payloads to be carried by the NIO project for the maritime monitoring mission. The project will ensure sustainable maritime monitoring in Indonesia. The performance of the developed S-AIS receiver needs to be well characterized in particular Doppler shift that occurs due to satellite motion in the orbit. Calculation of Doppler shift is carried out to obtain minimum requirements that must be achieved by the developed S-AIS receiver. This value needs to be verified by testing the device through different scenarios. The test was carried out in the laboratory where the device was connected with a cable to the AIS transmitter. This test configuration is conducted to reduce interference so that it is obtained accurate results.

**79** **11:15** ***Preliminary Design Electronic Power System (EPS) Low Earth Orbit (LEO) Communication Microsatellite***

Desti Ika Suryanti and Dewi Anggraeni (BRIN, Indonesia); Ery Fitrianingsih (LAPAN - BRIN, Indonesia); Eriko Nasemudin Nasser (National Institute of Aeronautics and Space, Indonesia)

the development of satellite technology provides great benefits in various fields, one of which is eliminating the distance limit in communication between human beings inside the hemisphere. Satellite technology's role is not simple in the telecommunications sector, in almost all fields such as the defense, marine, plantation, and agriculture sectors. Electronic Power System (EPS) is a crucial part of a satellite system that can generate, store and distribute power to all satellite electronic devices. If the EPS fails, the power supply to all electronic devices in the satellite device may be disrupted. This paper describes the preliminary design of EPS for LEO micro-communication satellites based on basic satellite level parameters such as orbital altitude, orbital slope, mission operation, and mission duration. The results of this study are an EPS for satellites with 28 V bus voltage, which distributes current and voltage on each channel

used at 3.3 V, 5 V, and 12 V and can control the current and voltage when overloaded. This EPS also provides a minimum of 4 Automatic Fuses (AF), a minimum of 13 Fuses (FS), and a minimum of 25 switches (S) to control each device in the satellite system.

**85** **11:30** ***Comparative Study of Deployable Satellite Solar Panel Structure between CFRP and Al-7075 Honeycomb***

Sri Ramayanti and Ahmad Fauzi (BRIN, Indonesia); Eriko Nasemudin Nasser (National Institute of Aeronautics and Space, Indonesia); Ery Fitrianingsih (LAPAN - BRIN, Indonesia); Poki Agung Budiantoro (Research Center of Satellite Technology - BRIN, Indonesia)

Research Center for Satellite Technology currently develops satellite constellations using deployable solar panels. This satellite will orbit in an equatorial Low Earth Orbit at an altitude of 600 km and inclination of 0o. The objective of this research is to compare the structural performance of CFRP and Aluminum honeycomb deployable solar panel structures with mass reduction consideration. This method starts by determining the requirements from the launcher and then designing the structure base on HDRM location and face material. The design is divided into two types: HDRM on the side and in the center of the panel. Each design employs CFRP and Al-7075 as the face material. Meanwhile, the design uses Al-5056 as the core material. Modal analysis and static analysis are performed to analyze the structural behavior of solar panel structures. The static analysis used in this work is a combination of quasi-static and random load. The obtained result shows the solar panel with CFRP material where HDRM on the side panel provides the best option compared to other designs. The excellent margin of safety (MOS) over the allowable stress on CFRP as face material and Al-5056 as the core material of the solar panel structure can validate the adequacy of this material. The choice of CFRP materials can also reduce the total mass of solar panel structures.

**91** **11:45** ***Thermal Design and Analysis Deployable Solar Panel Low Earth Orbit Equatorial Satellite***

Poki Agung Budiantoro (Research Center of Satellite Technology - BRIN, Indonesia); Ahmad Fauzi and Sri Ramayanti (BRIN, Indonesia); Ery Fitrianingsih (LAPAN - BRIN, Indonesia); Eriko Nasemudin Nasser (National Institute of Aeronautics and Space, Indonesia); Desti Ika Suryanti (BRIN, Indonesia); Widodo Slamet (Badan Riset dan Inovasi Nasional & Center for Satellite Technology, Indonesia)

Solar panels on satellites are a very important requirement as the main power source for the needs of satellite operations in orbit. Solar panels on satellites facing the space environment will experience temperature degradation under different conditions in their orbital trajectories. These conditions usually occur in winter with a direction perpendicular to the solstice, deployable solar panels (DSP) will experience maximum worst-case conditions and cause maximum temperature changes. Therefore we need a DSP that can survive in extreme space environmental conditions and maintain the temperature of the solar panel at its working temperature so that there is no decrease in efficiency which can result in a decrease in the power generated. DSP consists of solar panels and deployable plates. In this paper, finite element modeling, simulation, and analysis are used to validate the DSP thermal design using the FEM NX Space System Thermal software in transient conditions

## Data Science & Artificial Intelligence

Room #1 (10:00 - 12:00)

Mr. Muazam Nugroho

Room #1

Please choose Breakout Room 1

**98** **10:00** ***Deep learning for Ground Penetration Radar Reflection Images in Civil Structures Investigation***

Galih Prasetya Dinanta (National Reseach and Inovation Agency (BRIN), Indonesia); Doni Fernando (BRIN, Indonesia); Nugraheni Setyaningrum (National Research and Innovation Agency (BRIN), Indonesia); Fanny Meliani (Agency for the Assessment and Application of Technology (BPPT), Indonesia); Joko Widodo (National Research and Innovation Agency, Indonesia); Andie Setiyoko (Research Center for Remote Sensing (BRIN), Indonesia); Rahmat Arief (National Research and Innovation Agency, Indonesia)

Ground Penetrating Radar (GPR) is one of the NDT (Non-Destructive Techniques) in the geophysics field. Most Geoscientists accept the instrument's capability to conduct near-surface mapping. On the other side, the technology in deep learning vastly developed in many sectors, affecting the perspective of radar-images post-processing. The problem occurred when a lot of identical objects were detected in the GPR section. Hence, the interpreter will face difficulties when performing manual object detection on a large scale of the dataset. In this study, the deep learning algorithm attempted to be employed to forage the civil structures and deal with overtired work interpretations. This study specifies five structures from the dataset: Pile, Pipe, Powerline, Rebar, and Void/Collapse Structure. All objects are confirmed buried in the subsurface when field measurement is conducted. This study introduces a new approach to improving accuracy called IC-CNN (Integrated Contouring in Convolutional Neural Network). The IC-CNN method is expected to become an advanced technique to achieve solid identifications for GPR data through an object contour and object localization. The B-Scan of GPR Images was employed for the analysis. However, the primary processing of GPR data has been conducted to make it adequate as relevant input. As a result, it presented a correlation with a 95% confidence level. Furthermore, IC-CNN gave significance ± 3.5 % rather than CNN for the GPR B-scan data, which was concluded after 2,500 iterations. In final, the IC-CNN is promising as long as it is well-processed.

**105** **10:15** ***Outlier Rejection on Payload Metadata System Time of LAPAN-A3 Satellite using Sequential RANSAC***

Satriya Utama (National Research and Innovation Agency, Indonesia); Chusnul Tri Judianto (BRIN, Indonesia); Suraduita Mupasanta, Wakhid Abdurrokhman, Nur Salma Yusuf Hasanah and Amrullah Abdul Qadir (National Research and Innovation Agency, Indonesia); Khairunnisa Khairunnisa (National Research and Innovation Agency (BRIN), Indonesia); Patria Rachman Hakim (National Research and Innovation Agency, Indonesia)

System time is one of the most pivotal metadata of a satellite payload, thus having outliers on the system time can lead to failure in the data processing. Therefore, an outlier rejection method is crucial to cleanse the metadata before partaking in further processes. In this research, three variants of the random sampling consensus (RANSAC) algorithm are selected to deal with outliers in the system time of the LAPAN-A3 satellite. Default RANSAC, RANSAC with least square, and RANSAC with median value are chosen to be tested to the synthetic data with a variation on the outlier ratio and standard deviation. RANSAC with the least square variant shows superiority in

precision, recall, and robustness. Furthermore, a sequential RANSAC is built to deal with multiple structures on the metadata of LAPAN-A3. The method can estimate the outlier with a precision of 0.9 and a recall of 0.6.

**111** **10:30** ***Application of Random Forest Algorithm on Sentinel-2A Imagery for Garlic Land Classification***

Khairunnisa Khairunnisa and Annisa Annisa (IPB University, Indonesia); Imas Sukaesih Sitanggang (Bogor Agricultural University, Indonesia)

Garlic production in Indonesia is not sufficient to meet the needs of the community, which caused the government to adopt garlic import policy. Garlic productivity needs to be increased to reduce the imports and achieve garlic self-sufficiency in 2030. Sembalun is one of the centers of garlic commodity production in Indonesia. This study aims to classify garlic fields in Sembalun based on the garlic's growing phase. The data used in this study are Sentinel-2A Level-1C images in July 2021 with four bands of 10 m resolution and NDVI value, as well as drone image data as ground truth. The algorithm used to perform image classification is Random Forest. This study uses two dataset scenarios with the best model accuracy in predicting new data is 65.90% in the second scenario using the NDVI feature. The classification model without using the NDVI feature gives an accuracy value of 58.40%. Based on the accuracy value, the model with the NDVI feature is able to provide better predictions.

**117** **10:45** ***GeoAI for Disaster Mitigation: Fire Severity Prediction Models using Sentinel-2 and ANN Regression***

Syamani D. Ali, Ichsan Ridwan, Meldia Septiana, Abdi Fithria, Arfa A. Rezekiah, Adi Rahmadi and Mufidah Asyari (University of Lambung Mangkurat, Indonesia); Hidayatul Rahman and Gita A. Syafarina (Regional Development Planning Agency of South Kalimantan Province, Indonesia)

Wildfire is a common disaster that hits Indonesia every dry season, especially on the islands of Kalimantan and Sumatra. In order to reduce the impact of fire hazards, preventive measures are needed before the occurrence of fires. One of them is by setting up an information system such as EWS. The aim of this study is to create an effective image- and machine learning-based predictive model of the severity of forest and land fires based on vegetation conditions prior to burning. Three parameters of prefire vegetation conditions, namely vegetation greenness indices, vegetation moisture, and vegetation senescence, were selected as independent variables to predict the postfire dependent variable, i.e., fire severity. There are 25 vegetation greenness index options tested, using either ANN regression or multiple linear regression. The vegetation moisture information is represented by the Normalized Difference Moisture Index (NDMI). The vegetation senescence information is extracted using the Plant Senescence Reflectance Index (PSRI). Meanwhile, the wildfire severity is measured using the Burned Area Index for Sentinel-2 (BAIS2). All vegetation conditions and wildfire severity information were extracted from Sentinel-2 imageries. The topology of ANN regression models is configured from one to six hidden layers. More than 100,000 pixels are used as samples, which are then separated into training samples and validation samples. The results of model development and testing show that ANN regression with Inverted Red-Edge Chlorophyll Index (IRECI) as a vegetation greenness parameter is the model that has the highest accuracy in predicting wildfire severity.

**124** **11:00** ***Threat Analysis on Industrial Control System Based on Attacker's Behaviours using Honeypots***

Arssy Hasyir Nursidiq (Swiss German University & Alpha Citra Cyber Indonesia, Indonesia); Charles Lim (Swiss German University, Indonesia & Universitas Indonesia, Indonesia)

Industrial Control System (ICS) is a system that has been used in the maintenance and management of critical infrastructures. Which are usually distributed, such as power distribution system, gas, water, transportation, and production. The ICS is commonly having several components such as a Programmable Logic Controller (PLC), Human Machine Interface (HMI), Master Terminal Unit (MTU), and lastly Remote Protocol Unit (RTU). The protocols of Industrial Control System (ICS) is lack of authentication and confidentiality it causes the Industrial Control System easily compromised by the attacker. To get more knowledge about type of attack that compromised Industrial Control System (ICS) we used honeypot to emulate the Industrial Control System (ICS) and collect the data from the attacker. The data from honeypot will be analyzed and map to MITRE ATTACK to get knowledge about the Tactic, Technique, and the Procedure. The results, we can see what is the purpose from the attacker when they are compromise Industrial Control System (ICS) based on the data that has been mapped to MITRE ATTACK.

**130** **11:15** ***Wind Estimator Using Attitude Measurement From Quadrotor Flight Under Wind Disturbance***

Siti Noormiza Makhtar and Elya Mohd Nor (Universiti Pertahanan Nasional Malaysia, Malaysia); Fareisya Zulaikha Mohd Sani (UPNM, Malaysia); Fakroul Ridzuan Hashim (Universiti Pertahanan Nasional Malaysia, Malaysia)

There is a limitation to fly a quadrotor in the lowest layer of atmosphere, the troposphere level. Thus, it is difficult to evaluate the performance of the quadrotor under presence of wind. The main objective of this project is to validate the quadrotor control performance under the proposed wind prediction model. A wind estimator model was designed using neural network models to validate the quadrotor model with PID controller, flying under external disturbance. The performance of the wind estimator model was evaluated based on error measurement. Thus, the actual flight data and the estimated data were compared and being evaluated in order to obtain the best performance for the quadrotor flight control. The simulation results of the wind estimator signified that the model has been successfully developed according to the setting parameters. Thus, the outcome of this project shows that Neural Network Fitting can be embedded inside the quadrotor and work together with existing PID controller to control the quadrotor in robust environment.

**136** **11:30** ***Study and Evaluation of Machine Learning algorithms for Aerospace applications***

Isha Jain (Manipal Institute of Technology, India); Manikandan J (PES University (PESU), India)

Machine learning algorithms are being explored and employed for various applications and have become the most sought topic of research in the modern era. It is a well known and accepted fact that a single machine learning algorithm cannot perform well for different applications. In this paper, an attempt is made to explore, design and evaluate eleven machine learning algorithms for four aerospace applications: O-ring failure prediction (classification and regression), Airfoil self noise prediction test (regression), Dynamics test (regression) and steel plate fault detection (classification). The performances of all the eleven algorithms were compared using the metric classification accuracy for classifiers and R2, RMSE metric for regressors. The algorithms were ranked based on their performance for all the above mentioned applications and the performance of proposed models are also compared with the results reported in the literature to conclude that the performance of proposed models are on par with the results reported in the literature. The proposed work can be easily extended to other Aerospace applications too.

142 **11:45** ***Mapping Threats in Smart Grid System Using the MITRE ATT&CK ICS Framework***

Ahmad Balya Izzuddin (Swiss German University & National Cyber and Crypto Agency, Indonesia); Charles Lim (Swiss German University, Indonesia & Universitas Indonesia, Indonesia)

The smart grid system is an integration between power distribution systems with communication networks. A smart grid offers various benefits, but at the same time inherits various vulnerabilities from the implemented information and communication technology (ICT). Many devices in smart grid systems implement the TCP/IP stack to exchange data, which can lead to significant new cyber attack vectors, such as malware, man-in-the-middle (MITM), Denial-of-service (DoS), and replay attacks, as well as various other cybersecurity threats. One approach to deal with these security issues proactively is through threat modeling. We can utilize some tools to gather the threat data targeting the smart grid, such as using honeypots, then analyze the collected threat data to obtain the threat model in order to study the attackers' behavior. In this paper, we collected threat data targeting the smart grid system by deploying GridPot honeypot and analyzed the collected threat data by mapping them to the MITRE ATT&CK for ICS framework. This experiment shows that the threats targeting the smart grid systems are real, and could harm any smart grid system in the world.

# Thursday, November 24 13:00 - 14:30

## Aerospace and Electronic Systems - 3

Room #2 (13:00 - 14:30)

Ms. Suraduita Mupasanta

Room #2

Please choose Breakout Room 2

149 **13:00** ***Performance Investigation of Link Failure Line-of-Sight (LOS) Communication UAV***

Fuad Surastyo Pranoto (National Research and Innovation Agency, Indonesia); Nurul Chasanah (BRIN & Technology Centre for Aeronautics, Indonesia); Irma Rismayanti (BRIN, Indonesia); Yanuar Prabowo (Research Center for Aeronautics Technology BRIN, Indonesia); Try Kusuma Wardana and Danartomo Kusumoaji (BRIN, Indonesia)

In this paper, telemetry performance between UAV and GCS is examined by evaluating RSSI values of UAV and GCS during flight. The research aims to review the performance of telemetry communication between UAV and GCS during operation. Several parameters, such as airspeed, altitude, power, and range or GPS locations are analyzed to obtain relation to RSSI of UAV. The telemetry module uses RFD900X on both sides. There are external and internal factor that caused the degraded performance the LOS UAV telemetry. The internal factor is the drop of electrical voltage in the UAV, especially during the takeoff phase can cause the degraded performance of the LOS telemetry system. A decrease of 2.6% of voltage can degrade the performance of telemetry by -40 dBm. While the external factor is the presence of a cellular Base Station along the flight path of the UAV can cause the link loss phenomenon that can render the UAV LOS telemetry unusable. In this flight test, the UAV flies at an altitude of 300 m above sea level and still interferes with the cellular Base Station.

155 **13:15** ***Development of Low-Cost Sun Sensor for Small Satellite Based on Photodiode Sensor***

Adelia Revani Sastaviyana (National Research and Innovation Agency, Indonesia); Deddy Amin (Satellite Technology Center National Institute of Aeronautics & Space LAPAN, Indonesia); Mohammad Mukhayadi (Research Organisation for Aeronautics and Space, LAPAN - BRIN, Indonesia); Muhammad Arif Saifudin (National Research and Innovation Agency, Indonesia)

Sun sensor is one of the attitude determination sensors used on satellite. In the previous generation of LAPAN satellites, sun sensor was built using solar cells. For LAPAN-A4, a new idea of low-cost sun sensor using COTS photodiode is suggested. The type of photodiode proposed to be used is OSRAM BPW 21 with consideration of its maximum sensitivity wavelength and radiant sensitive area specifications. Moreover, the method used in designing this low-cost sun sensor using BPW 21 photodiode only requires inexpensive instrumentations. This method also offers simple and flexible observation steps. In this sun sensor design, BPW 21 photodiode is connected in series with a resistor. 10-bit ADC feature of Atmel ATmega128 is used to convert the photodiode voltage into DN value. The value of the resistor used can affect the result of the DN value, so determining the right resistor value is important. Several observation steps were performed to ensure that the photodiode is sufficient for use in space and to determine the right resistor value that has to be used to avoid saturation condition when BPW 21 photodiode faces the sun directly in space. The results of the observation steps show that BPW 21 photodiode is sufficient for use in space and the configuration of BPW 21 photodiode in series with a 1.8 kΩ resistor is the best to avoid such saturation state. The use of this resistor value also allows the sun sensor to optimally respond to a wide range of angles of incidence of sunlight.

162 **13:30** ***Comparative Study of Isogrid Structure vs. Honeycomb Sandwich Panels Structure as the Main Structure***

Moh. Farid Huzain (Technology Center for Satellite, National Research and Innovation Agency (BRIN), Indonesia); Puji Rianto (Technology Center for Satellite, National Research Innovation Agency (BRIN), Indonesia)

LAPAN-A4 is the Indonesian fourth's microsatellite. LAPAN-A4 is planned to be launched as an auxiliary payload on PSLV, so the satellite has a maximum mass of 150 kg. Since the total mass of the LAPAN-A4 components to be loaded into the satellite is ±123 kg, the main structure can only weigh 27 kg. As a result of the mass restriction, solid 7-series aluminum plates as a structure are no longer feasible. The main structure's mass problem can be solved by using isogrid aluminum plates or honeycomb sandwich panels. LAPAN has never had experience using either of those types of structures as the main structure, so it is necessary to conduct a study before determining the choice of this main structural material. This paper will present the comparison results of the two structural solutions above by simulating the LAPAN-A4 main structure models to measure the value of each natural frequency using the finite element method. The first natural frequencies on the X, Y, and Z-axes of the isogrid structure are 102, 65, and 104 Hz, respectively, while the results for the honeycomb sandwich panels structure are 103, 85, and 139 Hz. Both simulations have met the requirements, but the natural frequencies of the isogrid structure on the Y-axis and Z-axis are still too close to the minimum natural frequency required, while the honeycomb sandwich panels structure has a greater range of the minimum requirement. Therefore, using honeycomb sandwich panels as the main structure for the LAPAN-A4 will make it much safer.

167 **13:45** ***Combination of EBG and DGS to Improve MIMO Antenna Isolation***

Efri Sandi (Universitas Negeri Jakarta, Indonesia)

In this study, the design of the addition of an 8x8 MIMO microstrip antenna structure using a combination of electromagnetic band gap (EBG) and defected ground structure (DGS) techniques is described. Through the combination of techniques, it is expected to suppress the mutual coupling effect between MIMO antenna elements, thereby increasing antenna isolation that can support MIMO antenna performance. This design uses FR-4 epoxy material with ε_r = 4.3 with 64 MIMO elements at 3.5 GHz frequency for 5G C-Band application. The simulation results and antenna measurements show an increase in the isolation between antennas compared to without the addition of EBG and DGS structures. These results indicate that the use of a combination of EBG and DGS structures on MIMO antennas can improve isolation which is expected to improve antenna performance for 5G technology applications.

**173** **14:00** ***Analysis and Simulation of Axial Flux Permanent Magnet Synchronous Motor for Hybrid UAV Propulsion***

Joshua Levin Kurniawan, Bevan Bintang Setiawarman, Dhafin Anshar Prisetya, Rafael Aditya Cahyo W and Yazdi Jenie (Bandung Institute of Technology, Indonesia)

In recent years, a wide range of unmanned aerial vehicles (UAVs) applications has gained popularity. Due to the size of battery pack limitation, engine-propelled UAVs have become an appealing alternative as they possess high endurance (due to their high-density fuel). However, most modern UAVs include electronic instruments. In the operation, the UAV still requires a battery as the primary electrical power source. Various efforts have been made to connect the electronic system with the vehicle's prime mover system, one of which is by using a hybrid propulsion system. In this paper, a hybrid propulsion system based on a 2-stroke internal combustion engine (ICE) along with Aksantara's axial flux Permanent Magnet Synchronous Motor (PMSM) that acts as a generator and internal engine starter is proposed. This design will implement axial flux configuration PMSM to enhance the endurance and range of the proposed hybrid propulsion system. To obtain the hybrid propulsion performance result, the axial flux PMSM is numerically calculated using Finite Element Method (FEM) by utilizing Ansys Maxwell. The overall in-flight propulsion system performance will be evaluated using Simulink software. From the simulation, the implementation of the proposed axial flux PMSM hybrid propulsion system will show benefits in terms of endurance and range compared to other propulsion systems.

**N/A** **14:15** ***A Systematic Review of Methods for Cleaning FOD on Runways***

Yuri L. Silva, Christofer Alex Diaz Arapa, Álvaro Jesús Huamaní Mejía, Elvis Supo and Jorge Luis Apaza Gutierrez (Universidad Nacional de San Agustín de Arequipa, Peru); Paul Eduardo Pinto Salas (Fuerza Aérea del Perú, Peru); Mario Joel Alvis Esquivel (National University of San Agustin, Peru)

Foreign objects (FOD) that can be found on runways represent a great danger for aircraft on take-off or landing; FOD cleaning systems for runways fulfill two basic tasks: "Detection" and "Cleaning"; which have been developed in different works and researches in the last years, generally treating both tasks as one. Over time, a great advance in detection systems was obtained, starting at first from the traditional method, commonly called "FOD Walk", employing visual inspection by human personnel, to the use of radars and cameras that employ complex detection algorithms. On the other hand, in the cleaning task, the progress is not the same, since in many airports and air bases around the world the inefficient FOD Walk is still used, however, in some places there are automated cleaning systems that become efficient, using robots or vehicles that clean the FOD. In this paper we will review all these methods, classifying them and analyzing their operation to show their advantages, disadvantages, the quality with which they perform the work, and the opportunities they offer when using a specific method. In the end, a discussion and conclusions are offered that will help future researchers on the subject.

## Geoscience and Remote Sensing - 1

Room #1 (13:00 - 14:30)

Mr. Agung Wahyudiono

Room #1

Please choose Breakout Room 1

**186** **13:00** ***Evaluation of Multispectral Image for Mangrove Health Assessment Using Sentinel 2A and Field Spectrometer***

Nirmawana Simarmata (Institut Teknologi Bandung & Institut Teknologi Sumatera, Indonesia); Ketut Wikantika (Bandung Institute of Technology, Indonesia); A Ki Asmoro Santo (Institut Teknologi Sumatera, Indonesia); Soni Darmawan (Itenas, Indonesia); Agung Budi Harto (Bandung Institute of Technology & Remote Sensing Research Group, Indonesia)

Mangrove health is one of the parameters to show the quality of mangrove forest ecosystems that can be compared with other locations. To preserve mangroves as an ecosystem with high services, it is necessary to map the health of mangroves. Ketapang Subdistrict, South Lampung Regency is one of the areas where the conversion of land into a pond area has a significant impact on mangrove damage. This study aims to identify mangrove health based on the vegetation index from Sentinel 2A imagery and spectral measurements in the field. The research methods used are supervised classification with support vector machine algorithm, GNDVI, SAVI and TSAVI, and direct measurement of object reflection. the result of the GNDVI, SAVI, and TSAVI correlation coefficient (R2) values are 0.71, 0.6, and 0.66 respectively. If the value of the correlation coefficient is in the range of 0.50-0.70, it can be said that the relationship is very strong between parameters. Mangrove health classification is classified into 3 classes: poor, moderate and healthy. The mangrove health area obtained ranged from poor class 17.0 ha with an area percentage of 7.13%, medium class 23.78 ha with a percentage of 9.98% and healthy class 197.63 ha with a percentage of 82.89%. The total area of mangroves is about 238.42 ha. Based on 30 sample points of field observation, the results of the accuracy test show an overall accuracy of 86.67%.

**193** **13:15** ***Acceptance of Information on the Distribution of Smoke and Locations of Fire (HotSpot) Resulted from Remote Sensing Data***

Budhi Riyanto, Chusnul Tri Judianto, Igif Gimin Prihanto, Parwati Sofan, Hendy Gunawan, Wiji Prasetio, Muhammad Priyatna and Adis Jayati (BRIN, Indonesia)

Forest/land fire is one of the causes of economic and health losses that have a massive impact. Forest/land fires can also disrupt relations between countries when the transboundary haze rises. Remote sensing data produces the fire hotspots (HotSpot) in daily observation. The HotSpot products are disseminated to users through a website or application with an android interface. This research examined the user responses in receiving HotSpot information using the Technology approach Acceptance Model (TAM) and Best Worst

Method (BWM) in Indonesia. The results show that the factors influencing the acceptance of space-based smoke and HotSpot information are Attitude Toward System (ATT) and Facilitating Conditions (FC). In addition, the level of acceptance is at the level of being accepted by the user with a criterion weight index of 5.077 and a consistency value ratio (CR) of 0.024 < 0.4747.

**200** **13:30** ***Stereo vs. tri-stereo: Preliminary results on Anthropogenic-induced landform change detection using satellite derived remote sensing data***

Zylshal Zylshal (National Research and Innovation Agency, Indonesia); Sartika Sartika (Research Center Of Remote Sensing & BRIN, Indonesia); Athar Abdurrahman Bayanuddin (Indonesian National Institute of Aeronautic and Space, Indonesia); Sutan Takdir Ali Munawar (LAPAN, Indonesia); Yohanes Fridolin Hestrio, Sarip Hidayat and Indri Pratiwi J. (National Research and Innovation Agency, Indonesia); Andie Setiyoko (BRIN & University of Indonesia, Indonesia); Wiwin Setiawan (Barru Regency, Indonesia)

The Trans-Sulawesi railway construction runs for 144 km from South to North of the South Sulawesi's east coast. The railway line mostly was built on an embankment over agricultural flat, while on the hill, the railway line built in an incised slope. These actions essentially alter the surrounding landform. The changing landform could have its effect on how the surface runoff flow during the rainy season. In this study, we explore the potential of satellite-derived digital elevation models (DEMs) on detecting the changed landform over the Takkalasi Watershed. We employed the SPOT-7's tri-stereo acquisition mode, acquired on 17th April 2020. In these preliminary results, we compare the DEM results from each pair combination as well as the combination of all three pairs. The use of different tie-points (TP) and ground control points (GCP) were also investigated. Fast Fourier Phase Transformation algorithm were employed for the TP extraction, while the semi-global matching algorithm were employed for the epipolar DEM extractions. The produced DEMs then validated using the reference data taken from dGPS, UAV DEM, as well as the ICESat-2 ATL08 data. Our initial results shows that the best DEM generated is produced by combining the all three pairs of SPOT-7 acquisition and using only nine (9) GCP with the average vertical Root Mean Square Error (RMSE) of 5.44 meter, followed by using both TP and GCP with average RMSE of 5.84. At 3 m ground sampling distance, the incised hill is easier to detect on SPOT-7 DEM compared to the embankment.

**207** **13:45** ***Analysis of Drought at Terai Regions in Uttarakhand using Multiple Remotely Sensed Data***

Aland Edbert Manurung (University of Leicester, United Kingdom (Great Britain)); Heiko Balzter and Fernando Espirito-Santo (University of Leicester, Institute for Environmental Futures, United Kingdom (Great Britain))

With developments in remotely sensed imageries, nowadays satellite images provide more narrow wavelength bands in higher resolution and frequent revisit time such as Sentinel-2. Sentinel-2 can be used to generate Normalized Difference Water Index (NDWI) which explains the water or moisture content of the object of interest. In this study, ERA5-Land total precipitation data and Sentinel-1 SAR C-band were also used to assess drought that happened in Terai Region around Uttarakhand in 2021. Study area is divided into three study sites: Lower Terai, Reservoir, and Hilly Area to accommodate three different landscape condition. The results show that NDWI values fluctuates between 0.25 to -0.05 around croplands but not in the densely vegetated area. Also, the changes in NDWI values around Lower Terai do not follow the changes in Hilly area because of different channel system. The results from three remotely sensed data also show that the minimum NDWI value was captured around November to December 2021 in Lower Terai and Hilly Area, while in Reservoir area it was in September. Overall, the three datasets had shown the ability to detect changes in moisture and water in Terai region, Uttarakhand.

**214** **14:00** ***Investigating Transpressional Structure Zone in Northern Wadaslintang Reservoir: from Photogrammetry & Remote Sensing to Geo-Model***

Ardhan Farisan (National Research and Innovation Agency, Indonesia); Puguh Dwi Raharjo (Gadjah Mada University & National Research and Innovation Agency, Indonesia); Eko Puswanto (National Research and Innovation Agency, Indonesia); Muhammad Gazali Rachman (Universitas Pembangunan Nasional Veteran Yogyakarta, Indonesia & University Brunei Darussalam, Brunei Darussalam); Nanda Ajeng Nurwantari (University of Pembangunan Nasional Veteran Yogyakarta, Indonesia); Agus Men Riyanto and Dimas Aryo Wibowo (National Research and Innovation Agency, Indonesia)

This study was carried out by integrating a field study with the advantage tools of the drone survey (photogrammetry), outcrop data, remote sensing, geospatial software, and their plugins for investigating and modelling the architecture of northern Wadaslintang Reservoir. The result of Digital Outcrop Models (DOM) has confidence in us for our structural analysis. This study collects aerial photogrammetry data in three (3) areas with different acquisition methods and parameters for flight are usable. The result shows that three (3) areas have different structural patterns. To improve this paper, we interpreted structural geology patterns to understand kinematics and make cross-sections for sub-surface analysis.

**221** **14:15** ***Combining connectivity analyses with remote sensing to elucidate flow and sediment connectivity of two adjacent subbasins in the Lake Tana basin***

Anik Juli Dwi Astuti, Stefaan Dondeyne and Jan Nyssen (Ghent University, Belgium)

Sediment connectivity is the ability of a system to transfer water and sediment within a catchment. It is controlled by driving forces (rainfall and land cover), static aspects (geomorphology and soil), and dynamic aspects (surface runoff) of the catchment. The connectivity index is commonly used to measure sediment connectivity, even though it usually only looks at structural landscape features. The aims of this study are 1) to assess flow and sediment connectivity using the Borselli's index (IC) and the modified index of connectivity (MIC) and 2) to compare flow and sediment connectivity between two catchments in the Lake Tana Basin. The modified connectivity index was calculated by adding soil erodibility, rainfall erosivity, roughness index, and surface runoff. Remote sensing data were used to estimate the driving forces of connectivity, structural aspects of connectivity, and also functional aspects of connectivity. Landsat 8 OLI was used to identify the land cover, and remotely sensed rainfall estimates (TAMSAT) were used to quantify the precipitation in the catchments, while the Shuttle Radar Topographic Mission (SRTM) was used to identify slope gradient and roughness index. The IC values were higher than the MIC values, whereas the MIC values have a wider range of values compared to the IC values. The IC and MIC values in the Gumara were higher than those in the Rib.

## Thursday, November 24 15:00 - 16:30

## Geoscience and Remote Sensing - 2

Room #1 (15:00 - 16:30)
Mrs. Nova Maras Nurul Khamsah
Room #1
Please choose Breakout Room 1

228 **15:00** ***Aerosol Index and Machine Learning for Fire Smoke Mapping using The Second-generation Global Imager (SGLI) Data over Tropical Peatland Environments***

Galdita Aruba Chulafak and Anjar Ilham Pambudi (National Research And Innovation Agency - BRIN, Indonesia); Parwati Sofan (BRIN, Indonesia)

In this study, we explored the second-generation global imager (SGLI) of Global Change Observation Mission-Climate (GCOM-C) data to map biomass fires over tropical peatlands in Indonesia. The Absorbing Aerosol Index (AAI) derived from the near-Ultraviolet spectrum of SGLI at 250 m spatial resolution was examined statistically to perform smoke and other aerosol sources mapping. The mean values of AAI were statistically different among smoke, cloud, and other aerosols; however, the histogram distribution of AAI over those objects suggested a mixture of AAI regions between smoke and cloud. Machine learning algorithms overcame this limitation. Random Forest (RF) algorithm performs better than the Support Vector Machine (SVM) in mapping smoke from the cloud and other aerosol sources using all bands of SGLI, including the non-polarization bands, polarization bands, and AAI image. RF performs 87% overall accuracy in classifying four objects, i.e., smoke, cloud, other aerosols, and free-aerosol background objects. The RF accuracy increased to 97% in mapping two classes, i.e., smoke and non-smoke, with the error of commission and omission at 4% and 3%, respectively. This finding provides a high potential for using SGLI data by RF algorithm for smoke detection over tropical peatland regions. More training samples of smoke in various conditions can enrich the artificial intelligence smoke database, which can be adapted as the input for developing the RF modeling using other hyperspectral sensors.

235 **15:15** ***Pan Sharpening Performance Comparison for Land Use Classification Application, and Its Effect on LISA LAPAN-A3 in Accuracy Improvement***

Agung Wahyudiono (Research Center for Satellite Technology - National Research and Inovation Agency (BRIN), Indonesia); Agus Herawan (National Research and Innovation Agency, Indonesia); Patria Rachman Hakim (Indonesian National Institute of Aeronautics and Space, Indonesia); Ega Asti Anggari (National Research and Innovation Agency, Indonesia); Elvira Rachim (LAPAN, Indonesia); A. Hadi Syafrudin (National Institute of Aeronautics and Space, Indonesia)

Pan-sharpening is one data fusion application that aims to increase the spatial resolution of the multi-spectral image by merging a low-resolution multispectral image with a high-resolution panchromatic image. This process is commonly used to increase the quality of images in the application of land use classification. This research aims to see and learn about the performance of the pan-sharpening method in terms of Land Use Classifications. 5 different methods are compared to see each performance in classification. Moreover, not only using a single-platform data, which is multi-spectral (MS) and panchromatic (Pan) image from Landsat 8, this research also tries to fuse 2 data from a different platform, which are MS from LISA LAPAN-A3 and Pan from Landsat 8. It found that each pan-sharpening method has a different result in terms of accuracy when applied to single-platform data and cross-platform data, nevertheless, some improvements in accuracy were slightly found in pan-sharpened LISA's product to a 9.31% increase.

241 **15:30** ***Relationships of Class Number Variation and Image Classification Accuracy in LAPAN-A3 Multispectral Imager***

Ega Asti Anggari and Agus Herawan (National Research and Innovation Agency, Indonesia); Wahyudi Hasbi (National Research & Innovation Agency (BRIN), Indonesia); Patria Rachman Hakim (National Research and Innovation Agency, Indonesia); Sartika Salaswati (National Institute of Aeronautics and Space (LAPAN), Indonesia)

LAPAN-A3 has a multispectral imager payload that can be used for earth observation. One of its uses is for land use and land cover classification. To find out the suitability of the classification results with the actual data, it is necessary to calculate accuracy. This study aims to find out the relationship between variations in the number of classes and the accuracy of the classification results. The research was conducted in 4 study areas in Indonesia, namely Mandailing Natal Regency (North Sumatra), Pandeglang Regency (Banten), Semarang City (Central Java), and Kupang Regency (NTT). It can be concluded that the accuracy is very good in the classification of 2 classes where the accuracy value is more than 95%. Good accuracy in the classification of 4 classes with an accuracy value of more than 85%. The accuracy is good enough in the 6 class classification with an accuracy value of 80%. The blur effect is the reason of the decrease in accuracy due to the less optimal ability to separate spectrals.

248 **15:45** ***U-Net Based Water Region Segmentation for LAPAN-A2 MSI***

Kamirul Kamirul (The National Research and Innovation Agency, Indonesia); Astriany Noer (Badan Riset dan Inovasi Nasional, Indonesia); Silmie Vidiya Fani (Institut Sepuluh Nopember & LAPAN, Indonesia); Stevry Yushady CH Bissa (National Research and Innovation Agency, Indonesia)

In this work, we analyzed the performance of a deep learning-based segmentation method in extracting water regions from multispectral imageries (MSI) taken by LAPAN-A2 microsatellite. The interested water regions include open seas and the river as well as their branches. The capability of detecting and segmenting the water component on LAPAN-A2 MSI is important as the satellite was dedicated to support maritime surveillance missions on Indonesian waters. Therefore, this capability will help a future water object detection to encapsulate its region of interest, i.e., water. The segmentation has been performed by employing a state-of-the-art of deep learning-based method, U-Net, using 696 training images. This method is considered due to its capability to provide promising accuracy without requiring an extremely extensive amount of training dataset. According to the experiment, the trained U-Net has shown a satisfying result with an accuracy of 89.13% as measured using Intersection over Union (IoU) metric.

253 **16:00** ***Active fault mapping reveals four major fault zones interact and cause compartmentalization of Eocene reservoirs in eastern Borneo***

Muhammad Gazali Rachman (University Brunei Darussalam); Afroz Ahmad Shah (University Brunei Darussalam, Brunei Darussalam)

Tarakan Basin, located in North-East Borneo, is the largest proven hydrocarbon field in contract with the neighboring Berau Sub-Basin. The geology of the two basins is similar; however, the lack of hydrocarbons in one poses questions about the role of geological structures in trapping hydrocarbons. Therefore, we have used 8m spatial resolution imagery of the Digital Elevation Model Nasional

(DEMNAS) dataset to map the geological structures, including faults, folds, and primary sedimentary structures such as the trace of bedding planes. The mapping was done in ArcGIS Pro, a competent mapping and information managing tool. Faults are identified by mapping geomorphic features such as triangular facets, ridge axis, alluvial fans, deflected streams, etc. The bedding planes are mapped using the Rule of Vs, and the traces of fold axes are inferred from the bedding orientations. The relative age relationship is used to differentiate active from inactive structures, including mapping faulted Quaternary landforms such as fans, river terraces, volcanic landforms, etc. The mapped geological structures are overlaid on the existing geological maps to map the faulted reservoir rocks. The results show a dominance of NW-SE trending reverse faults bordering the north plunging anticlines. The faults are active, as suggested by the young, faulted topography and back-tilted Quaternary fans. A prominent ~E-W trending reverse fault has pierced the earlier NW-SE trending structures, indicating a young faulting phase. The faults interact, drill through the Eocene to Quaternary stratigraphy, and form reservoir compartments.

**260** **16:15** ***Analysis of Aerial Photography with Unmanned Aerial Vehicle (UAV) Using eCognition Developer to Estimate the Number of Trees in the Forest Area***

Fahmy Rinanda Saputri (Universitas Multimedia Nusantara, Indonesia); Widastama Angga Permana (Perhutani, Indonesia)

This study aims to analyze UAV aerial photographs for population estimation and estimate the potential of stands using UAV technologies to measure the number of populations/numbers of trees based on aerial photos. The process of interpreting/interpreting/processing aerial photo data from UAVs that leads to the need for data expected to be obtained from UAVs has not led to accuracy and accuracy. With this study, it is hoped that it can help calculate the number of populations/number of trees based on aerial photos using UAVs and as comparative data to the results of treatises. This research can also be used as reference data for the calculation of biological assets and for preparing the Perhutani Forest Sustainability Regulation Plan (RPKH) by calculating the number of trees. Based on the results and analysis using eCognition Developer software, the following conclusions were obtained for identifying Mangium trees through three processes: sample selection, generating templates, and testing templates. The results of the tree calculation automatically obtained a threshold of 0.699, with a total of 518 trees detected

## Geoscience and Remote Sensing - 3

Room #2 (15:00 - 16:30)

Mr. Satriya Utama

Room #2

Please choose Breakout Room 2

**265** **15:00** ***Development Of Web-Based Application Using RESTful API As Utilization Tool Of AIS Data LAPAN Satellite***

Nurrochman Ferdiansyah and Dicka Ariptian Rahayu (National Research and Innovation Agency, Indonesia); Abdul Karim and Rizki Permala (National Research and Innovation Agency)

Automatic Identification System (AIS) is a system that able to provide ships informations and exchange them from ship to another ship, ship to receiving station, or from receiving station to another receiving station by utilizing VHF communication frequency automatically. The exchanged ship Informations contain ship's unique Identity (ID), ship's position, navigational status, and speed of the ship. All those Informations can be used for several maritime monitoring purposes such as ship tracking, navigational purpose, Vessel Traffic Service (VTS), search and rescue, and accident investigation. LAPAN Satellite Technology Center has two satellites, LAPAN-A2 and LAPAN-A3 which carry AIS receiver as one of their payloads. LAPAN-A2 operates in the low Equatorial orbit and LAPAN-A3 operates in the low Polar orbit. Hundreds of thousands of AIS data can be acquired every day by utilizing AIS payloads from those two satellites. To optimize the use of AIS satellite data, a web-based application using RESTful API was made. This application helps it's user to find, search and displaying ship's information on web-based application. It can be concluded that the less optimal use of AIS data and the absence of a system to map the AIS data of the LAPAN-A2 and LAPAN-A3 satellites can be overcome by the development of this system. . And this system will help BRIN in general or Research Center For Satellite Technology in particular to disseminate the results of the AIS data obtained by LAPAN-A2 and LAPAN-A3 in an informative and interactive manner to the general public.

**271** **15:15** ***Comparison of CART Algorithm and Cropping Calendar in Estimating Paddy Growth Stage in Karawang Regency, West Java***

Nadira Fawziyya Masnur, Nurul Izza Afkharinah and Elisabeth Gunawan (Bandung Institute of Technology, Indonesia); Agustan Agustan (Agency for the Assessment and Application of Technology (BPPT) & PTPSW-BPPT, Indonesia); Swasetyo Yulianto (Agency for Assessment and Application of Technology (BPPT), Indonesia); Kusprasapta Mutijarsa (Institut Teknologi Bandung, Indonesia); Abdul Karim (Brawijaya University, Indonesia)

Classification And Regression Trees (CART) is one of the classic and simple algorithm in predictive modeling machine learning. This study aims to compare the result of paddy growth stage estimates based on CART model of Sentinel-1A Synthetic Aperture Radar (SAR) data and Cropping Calendar (KATAM). The construction of the CART model utilises real data field from Area Frame Sampling (Kerangka Sampling Area or KSA) in Karawang Regency observed on 2020. The CART algorithm makes predictions using a tree structure or hierarchical structure. The CART algorithm focuses on finding a decision tree model that has a Gini impurities value = 0. The rules for classifying Class based on the physical polarization spectrum which is represented by pixel digital number from Vertical-Vertical (VV), Vertical-Horizontal (VH), and VV/VH of SAR image properties. This study found that the initial planting time is different. The CART model estimates the initial planting time is on September, while the KATAM estimates on November-December.

**277** **15:30** ***Estimating the Distribution of Paddy Growth Stage in Karawang, West Java Based on Gradient Boosting Algorithm***

Nurul Izza Afkharinah, Elisabeth Gunawan and Nadira Fawziyya Masnur (Bandung Institute of Technology, Indonesia); Agustan Agustan (Agency for the Assessment and Application of Technology (BPPT) & PTPSW-BPPT, Indonesia); Swasetyo Yulianto (Agency for Assessment and Application of Technology (BPPT), Indonesia); Kusprasapta Mutijarsa (Institut Teknologi Bandung, Indonesia); Abdul Karim (Brawijaya University, Indonesia)

Paddy is an important and strategic commodity to supply food needs in Indonesia. Karawang Regency in West Java Province is well known as rice producer due to its natural resources and farming system. This study aims to estimate the distribution of paddy growth stage in Karawang Regency based on the classification results using the Gradient Boosting algorithm. The classification was carried out

to conduct training on monthly data so as to produce predictions of the distribution of paddy growth stage area. There are 8 classifications defined, including water bodies, early vegetative, late vegetative, generative, harvesting & land preparation, not paddy fields, others, also settlements and roads. As validation material, Area Frame Sampling (Kerangka Sampling Area or KSA) data of Karawang Regency 2020 was used and comparisons were made using the Rainy Season Paddy Cropping Calendar for the October 2020-March 2021 period of Karawang Regency as an evaluation of the results. The results of the accuracy test for estimation of the distribution of paddy growth stage using the Gradient Boosting algorithm show that this algorithm has a good level of suitability and confidence level between rows and columns in the process of estimating the paddy growth stage in Karawang Regency as evidenced by the overall accuracy dominant value is >75% and the kappa statistics dominant value is > 0.7.

**284** **15:45** ***The Assessment of Random Forest Algorithm in Identifying Paddy Growth Stage in Karawang, West Java***

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This study tried to estimate distribution and area of land cover by focusing on the area of the paddy growing phase using the Random Forest model on Sentinel 1A data and Area Frame Sample (Kerangka Sampling Area or KSA) observation data as reference data. Sentinel-1 data from Karawang Regency, West Java was taken monthly for a one-year period starting from January 2020 to December 2020. It was found that the results of extrapolation with the Random Forest algorithm have similar trend and patterns to the results of the KSA. Still, compared to the Cropping Calendar (KATAM) model of the Agricultural Research and Development Agency, the initial planting period of paddy in Karawang Regency, the results of the identification of the Random Forest algorithm appeared two months earlier.

**291** **16:00** ***Performance of rainfall satellite threshold to predict landslide events in Girimulyo District***

Ragil Andika Yuniawan (Universitas Gadjah Mada & Ministry of Public Work and Housing, Indonesia); Ahmad Rifai (Universitas Gadjah Mada, Indonesia); Andy Subiyantoro (University of Twente & Ministry of Public Works and Housing, Indonesia); Fikri Faris (Universitas Gadjah Mada, Indonesia); Vilman Sidik and Hadi Prayoga (Institute Teknologi Nasional Yogyakarta, Indonesia)

Landslides often occur in Indonesia, especially in the mountainous areas where there are many steep slopes. Conversely, disaster mitigation in mountainous areas also receives less priority than in urban areas. To overcome this problem, an effective and efficient disaster mitigation effort requires in mountainous areas without spending much money. This study aims to calculate the threshold value of rainfall that triggers landslides using satellite data in the mountainous area. This information is expected to be a mitigation effort against landslides in mountainous locations. This study took the place of the administrative boundary of the Girimulyo district. Rainfall data using GPM satellite compared with the local ground station. A total of 50 landslide events that occurred in the Girimulyo district from 2017-2021 were used as inventory for analysis in this study. Information on landslide events was obtained from the local government and validated through field investigation. The result shows that rainfall data from satellite and local ground station show a good correlation with the landslide events, proved by AUC values 0.893 and 0.761, respectively. However, in further statistical analysis, the rainfall threshold derived from satellite data outperformed the rainfall threshold derived from the local ground station

**297** **16:15** ***Semi-automatic Landslide Detection Using Google Earth Engine, a Case Study in Poi Village, Central Sulawesi***

Andy Subiyantoro (University of Twente & Ministry of Public Works and Housing, Indonesia); Cees J Van Westen and Bastian V Den Bout (University of Twente, The Netherlands); Ragil Andika Yuniawan (Universitas Gadjah Mada & Ministry of Public Work and Housing, Indonesia); Arif Rahmat Mulyana (Ministry of Public Works and Housing, Indonesia)

Fast and accurate landslide detection is important for landslide early warning systems. However, data available from local authorities and news reports vary in accuracy (time and location). In this work, we present a new method for identifying landslides, based on Google Earth Engine (GEE) and time-series analysis of Sentinel-2 optical satellite images. The method uses vegetation loss as a proxy for disturbance caused by earthquake-related landslides, and applies a change detection algorithm to compute the Normalized Different Vegetation Index (NDVI) and Relative Different NDVI (rdNDVI). As a test case, we applied this approach to the area of Palu, Central Sulawesi, which was hit by a major earthquake on September 28, 2018. Using time series data from 2015 to 2020, we were able to accurately capture the massive landslide in Poi Village caused by this earthquake. Using GEE had many advantages: the process is semi-automatic, fast and versatile, and the boundaries of the landslide zones can be auto-generated. In addition, the analysis does not require expensive high-resolution data. Our results demonstrate the potential of this new method to produce landslide inventories in a fast, accurate and low-cost manner.