ICASA-MATRIX
International Joint Conference on Aerospace and Aviation
Mechanical and Advance Materials Research Exchange 2020

Bandung, 25-26 November 2020

Organized by:
WELCOME TO ICASA-MATRIX 2020

Following the success of the 1st International Conference on Aerospace and Aviation, ICASA 2018 in Institut Teknologi Bandung, ITB as well as the 1st Mechanical and Materials Research Exchanges, MATRIX Symposium in Bali, Indonesia hosted by MIMEC 2015 UTM; and in order to strengthen and wider our scientific field, the International Joint Conference of ICASA-MATRIX 2020 is arranged.

Theme of ICASA-MATRIX 2020 is, “Supporting Our Sustainable Development through the advancement in Aviation Science and Mechanical Engineering”. ICASA-MATRIX 2020 will deliver in online or virtual conference basis and aims to provide a platform for collaborations among professional societies and to enhance technical exchanges among participants.

The Conference will include technical sessions, workshops, special plenary lectures, and oral presentations. Please get an update from us through https://icasa-matrix.com/

We hope to see you at Online Joint Conference ICASA-MATRIX ITB 2020 on 25-26 November 2020.
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Prof. Erry Yulian Triblas Adesta presently is Professor of the Faculty of Engineering Gombak Campus, International Islamic University (IIUM) and Chair of Agile and Sustainable Manufacturing Research Unit (ASMARU). He is an Immediate Past Dean of the Faculty of Engineering in 2019 (previously the Dean for the year of 2017-2018) and was the Deputy Dean of Postgraduate & Research at the Faculty of Engineering, IIUM (2012 - 2016). He got doctoral degree from Department of Manufacturing System Engineering, The University of Huddersfield, UK.
Prof. Tatacipta Dirgantara presently is Dean Faculty of Mechanical and Aerospace Engineering, Institut Teknologi Bandung. He is Professor in Computational Mechanics. Besides, he is also Chair of Lightweight Structures Research Group. He got doctoral degree from Department of Engineering, Queen Mary, University of London.
Prof. Bambang Kismono Hadi presently is Professor of Faculty of Mechanical and Aerospace Engineering, Institut Teknologi Bandung. He is a member of Lightweight Structure Research Group. He got doctoral degree from Imperial College, London.
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Classification Cherry’s Coffee using k-Nearest Neighbor (KNN) and Artificial Neural Network (ANN)

Sri Anita\textsuperscript{a}, Albarda\textsuperscript{b}

\textsuperscript{a} School of Electrical Engineering and Informatics Institut Teknologi Bandung Bandung, Indonesia

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Abstract. After harvesting cherrys coffee farmers still use the conventional way of choosing coffee cherrys that are suitable for harvest. This makes it very difficult for farmers because the coffee plantations are planted in the mountains, the constraint is not only the difficulty of water but also the availability of containers that must be able to load a lot. This makes it very difficult for farmers if the dry season comes. In this study, proposing the use of IT to solve problems with energy saving. This way used machine learning for classification. It is hoped that this method can save energy and facilitate coffee farmers. The main goal is the results of this study can prove that the results of a computer cherry coffee classification analysis results are the same as the classification done using the human eye that has been done. This paper used elements of 3 (three) indicators to 17 (seventeen) elements of the assessment indicators. The method used for texture recognition is the Gray Level Co-occurrence Matrix (GLCM) method. The Artificial Neural Network (ANN) and k-Nearest Neighbor (k-NN) algorithm was used in this study. The result of classification using ANN accuracy 24,41\% and using KNN accuracy 72,12 \%.

Keywords: machine learning, RGB, GLCM, KNN, ANN, classification, cherry’s coffee, image processing
Oils and Water Absorption Behavior of Biduri (Calotropis gigantea) Fibers

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Abstract. This article reports on the oil and water absorption behavior of Biduri (Calotropis gigantea) fibres at room temperature. The material measured is a 100% raw material for Biduri (Calotropis gigantea) fibre, from 0.3 g to 1.5 g, and nonwoven structures made from 50/50, 60/40, 70/30, 80/20 and 90/10 mixture of biduri and polyester. FTIR characterized the biduri fibre, and the viscosity of used oil measured using Brookfield viscometer. The higher oils absorption at weight 0.3 g, 45.53 g/g, and water absorption at weight 0.3 g, 1.47 (g/g). The higher oil absorption at nonwoven structure showed at 90/10 composition, 42.86 g/g. It showed Biduri fibres is a natural absorbent that exhibits excellent hydrophobic and oleophilic properties.

Keywords: biduri, Calotropis gigantea, oil absorption, oleophilic
Design of a Flapping Mechanism for Mini Flapping-Wing Unmanned Aerial Vehicle Mimic Dragonfly

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Abstract. In this research, we design and build a mechanism for a mini flapping-wing unmanned aerial vehicle (FW-UAV) with the shape of Orthetrum sabina dragonfly but in size about ten times bigger. The flapping motion is excited by two brushless motors, one for the forewings and the other one for the hindwings. The rotation motion of the brushless motor transferred to the wing shaft through a set of gears. The ends of the wing shaft are bent, so when it rotates, it creates a circle shape. These bent ends of the wing shaft are going through a slot in the wing’s output link, while this output link is attached to a pin joint on the shoulder. The circular motion of the end of the wing shaft allowed the output link to create a flapping motion on the output link. Without the artificial wings, this mechanism allowed the output link to generate a flapping frequency of 34.3 Hz at 60% throttle. In terms of control, a servo is installed on each side of the FW-UAV. The rotating motion of the servo is used to change the angle of the flapping plane of the output link. The total weight of the flapping mechanism is 414.2 gr.

Keywords: flapping mechanism, flapping wing, UAV design, dragonfly, biomimetic
WATER QUALITY MONITORING SYSTEM IN GURAME FISH CULTIVATION BASED ON ESP32

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Abstract. The growth of carp, influenced by food, is also influenced by the quality of water as its habitat. Water suitable for use as a habitat for carp is freshwater. Therefore, goramy farmers need to maintain water quality for the survival of carp. Water quality is influenced by several parameters including temperature, pH, and water turbidity. The standard temperature of carp ranges from 24 °C to 30 °C, pH values 4 to 11, water turbidity remains bright at 20 cm or more. The method used is to create a water quality monitoring system based on ESP32. The water quality monitoring system uses a temperature sensor, pH sensor, and water turbidity sensor based-on the ESP32. Temperature sensor testing can work at temperatures of 20 to 50°C, testing pH sensors ranging from pH values 4 to 9.18, and turbidity sensor testing at visibility ranges of 0.1, 10, and 20. The water quality monitoring system developed has been validated and has worked well.

Keywords: WQMS, ESP32, Fish Cultivation.
FLIGHTS ARRIVAL DELAY PREDICTION MODEL AT HUSEIN SASTRANEGERA AIRPORT USING MACHINE LEARNING

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Abstract. Along with growing air transport market in Indonesia and Asia-Pacific and development of informatics technology and data processing has been opening opportunities in development of industry 4.0 technology in the world of air transport industry. Alongside with massive volume of air traffic and data traffic in huge volume making it a valuable thing. Data science and statistics has becoming a tools which generally used in the world that increasingly aware to data collection. Development of open source platform based on Python and R programming language is opening new era of data processing so as it widely used by data analyst in various study fields. With development in technology of data processing, data science and machine learning, data utility is not bounded to analysis but with various approach can be utilized to solve problems and achieve goals. One of them is data utilization to make predictive model which could help in developing air transport industry. In this research, study of data science application and data processing against flights arrival delay with study case in Husein Sastranegara Airport to develop flights arrival delay predictive model through supervised learning process based on Python programming language will be conducted. Evaluation will be conducted against machine learning algorithm success in developing classification model for flight arrival delay prediction, data feature which determine prediction result and data correlation alongside with comparison of different data preprocessing method against model performance. Furthermore, explanation to machine learning algorithm will be performed using LIME (Local Interpretable Model-Agnostic Explanations) module. Machine learning model result showed achievement level of maximum accuracy as large as 91% and AUC value from ROC graph as large as 0.96.

Keywords: Arrival delay, classification model, data science, data preprocessing, machine learning
Comparison Study of Various Color-Based and Contour-Based Pumpkin Counter Method for Aerial Farm Monitoring

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Abstract. One of the uses of UAVs in agriculture sector is aerial monitoring, such as counting the amount of pumpkin in a farm for yield calculation. In this work, various color-based and contour-based methods for counting pumpkin are studied. Each method studied in this work is tested on thirty samples using OpenCV as an image processing library on Python, and their accuracy, precision, and sensitivity are calculated to compare their performance. Then, each type of performance data parameters is normalized and summed, to compare each methods’ performance. Of all the methods tested in this work, Simple Binary Threshold yields the best result.

Keywords: computer vision, image processing, comparison study, aerial farm monitoring
Image Processing System for pH Classification Using Biosensors

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Abstract. Increasing environmental pollution has an impact on pH imbalance. One of the innovations in detection with pH imbalance by utilizing biosensors. Butterfly Pea (Clitoria Ternatea) is a plant that can be used as a biosensor to detection pH. In its development, it is necessary to have a system for pH classification because the Butterfly Pea (Clitoria Ternatea) extract has a similar color at a certain pH. The purpose of this research is to create an image processing innovation for pH classification using a biosensor. The method used in this research is by using a camera to get the RGB value of the pH color of the biosensor and it is processed using Raspberry pi 4 with python language. he operation and results of the classification will be shown on the TFT LCD. Biosensors will be classified in 14 conditions, namely pH 1-pH 14. Based on the test results, it is known that the system can work properly and accurately for pH classification using biosensors.

Keywords : Image Processing, Classification, pH, Biosensors, Butterfly Pea
Image Processing System for pH Classification Using Biosensors

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Abstract. Increasing environmental pollution has an impact on pH imbalance. One of the innovations in detection with pH imbalance by utilizing biosensors. Butterfly Pea (Clitoria Ternatea) is a plant that can be used as a biosensor to detection pH. In its development, it is necessary to have a system for pH classification because the Butterfly Pea (Clitoria Ternatea) extract has a similar color at a certain pH. The purpose of this research is to create an image processing innovation for pH classification using a biosensor. The method used in this research is by using a camera to get the RGB value of the pH color of the biosensor and it is processed using Raspberry pi 4 with python language. He operation and results of the classification will be shown on the TFT LCD. Biosensors will be classified in 14 conditions, namely pH 1-pH 14. Based on the test results, it is known that the system can work properly and accurately for pH classification using biosensors.

Keywords: image processing, classification, pH, biosensors, butterfly pea
ABSTRACT ID#12

Design of High Manoeuvrability Unmanned Aerial Vehicle for Target Drone Purposes

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Abstract. The current military technology development is affected significantly by Unmanned Aerial Vehicles (UAVs). One example of this is the unparalleled dependency to UAVs for realistic target practice. These specific types of UAVs are referred to as target drones. To be used as a target drone, the UAV must be designed to be able to handle a relatively high speed and extreme manoeuvre as well as being lightweight. In this design work, the diameter of the propeller and the fuselage of the drone are selected to have a low blockage ratio, while still providing the space for the electronic systems. Furthermore, the drone design also considering the load and structural strength to support extreme manoeuvre up to 6G. Non-sweep planform and MH aerofoil are chosen for the wing geometry as those configurations are the best suited for the mission. All moving tail configuration is selected for the longitudinal control means to enable the drone to perform the high G manoeuvres. The drone is equipped with an electric propulsion in tractor configuration. The final design weighs 3 kilograms, with a wingspan of 1.4 meter. The overall structure of the drone is built using glass fiber reinforced composite and is manufactured using vacuum bag technology.

Keywords: unmanned aerial vehicle, target drone, uav design, configuration, manoeuvrability
Indonesian Glider GL-1 Spoiler Preliminary Design and Computational Fluid Dynamics Analysis using EASA CS-22 Performance Requirements

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Abstract. GL-1 is an Indonesian glider which is currently being developed using EASA CS-22 as its basis requirements. Spoiler is an important control mechanism in glider as it is used to control the glide slope of a glider. The design of spoiler includes configuration and dimension such as span, height, and position in wing. One of the requirements for spoiler design in EASA CS-22 is approach and dive performance. Compliance to the performance requirements needs aerodynamics analysis to find lift loss and drag gain due to spoiler extension. Several variable of spoiler dimension, such as the length, the height, and the gap, is varied to obtain a spoiler design which comply to the requirements. To simplify design and aerodynamic analysis process, a method of obtaining 3D aerodynamic characteristics from 2D airfoil with spoiler simulation is developed. 3D CFD simulations is used as a validation and to develop correcting factors. The spoiler dimension which complies to requirements are: 1.4-meter span, 90mm height, and location at 24 to 43% wing span.

Keywords: Sailplane, Performance, CFD Simulation, Spoiler Design, EASA CS-22
ABSTRACT ID#14

On-Board Drone detection for Drone Chasing and Collision Avoidance through a Single Mounted Camera

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Abstract. We proposed a method for detecting flying drones and UAV with real-time on-board computation through a single camera mounted on a different drone, we approach this method from a machine learning perspective, giving an object detection model that could detect and localized multiple drones in a given image, the constraint of this problem are that with the on-board computation, the model will have to have a lightweight and fast inference process, this leads us to choose SSD Mobiilenet V2 model architecture to train and test how effective it is for detecting drone. Our method could be used for complex activities such as drone chasing or drones collision avoidance.

Keywords: drone detection, machine learning, onboard computation, drone chasing, collision avoidance
Performance Comparison Analysis of Flattened Whitcomb Winglet Using Computational Fluid Dynamics

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Abstract. Wingtip modification is one of the methods to improve the performance of UAV in a cost constraint and simplicity worth considering. In this study, the low-cost wingtip modification is manifested by using a readily available 3mm plywood and laser-cutted to form a flattened whitcomb winglet geometry as the base design. This low-cost wingtip modification is implemented to Senja UAV, a mapping and monitoring capable UAV developed by Aksantara ITB, a student-led UAV research team. The original design of Senja UAV incorporates a blended winglet design. In this paper, the performance of Senja UAV with 3 different wingtip geometries, namely the flatplate whitcomb based geometry winglet, blended winglet, and wingless, are compared using CFD investigation. The results had shown that flatplate-whitcomb based geometry winglet is capable of reducing induced drag. However, it is still less-capable than the blended winglet design. At low angle of attack, its profile drag makes the performance, in terms of $C_L/C_D$, worse than the wingless design.

Keywords: UAV, winglet, flatplate, drag, computational fluid dynamics.
Aerodynamic Analysis of Folded-Flat Plate Airfoils Constructed from Low Reynolds Number Airfoils

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Abstract. In this research, we did an aerodynamic analysis of eight folded-flat plate airfoils constructed from eight low Reynolds reference airfoils. The folded-flat plate airfoils are made by taking two straight lines: from the leading edge of the reference airfoil to the point of its maximum camber then to the trailing edge. The thickness of the folded-flat plate airfoils is 2% chord. A half-circle curve is applied to the leading edge and a sharp edge is created on the trailing edge starting from the 95% chord. The folded-flat plate airfoils and the reference airfoils then applied to a rectangular wing with a chord length of 50 mm and a span of 400 mm. The wing has a dihedral angle of 5 deg. Each wing then analyzed using Digital DATCOM with a flight velocity of 5.5 m/s. Form the result, the folded-flat plate wings have a lower lift curve slope in value of 78.9-92.4% than its reference airfoils. On the contrary, the maximum lift to drag ratio of the folded-flat plate wings is higher in the range of 3.8-10.2% than its reference airfoils.

Keywords: folded-flat plate airfoils, low Reynolds number airfoil, aerodynamics analysis, Digital DATCOM
Preliminary Design of Bionic Flapping Wing Vehicle

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Abstract.

This paper deals with the preliminary design of bionic flapping wing vehicle. The design is driven by its requirement and objective namely the maximum weight should be less than 0.5 kg with 1.5 m wingspan. In the conceptual design, the wing planform, wing structures and system of flapping mechanism will be considered to find the initial configuration and then continued the sizing of the flapping vehicle. The design of flapping vehicle becomes increasingly complex due to firstly the generation of time-dependent aerodynamic forces and moments from unsteady flow around the flapping wing, secondly, flexible wing structure which generates higher thrust may cause a structure failure and thirdly, a flapping mechanism system generating differential flapping motion for the vehicle maneuver. The aerodynamic analysis will carry out for given flapping motion model using Computational Fluid Dynamics method based the solution of unsteady Reynold Averaged Navier-Stokes equations and the structure analysis is conducted with the input of aerodynamic loads using Finite Element Method to find critical stresses that may cause a structure failure. The wing platform has elliptical shape with airfoil maximum camber of 6% chord at a quarterchord. The outer body and wing are made of foam laminated by glass fibre with the foam density of 0.045 g/cm³. The horizontal tail is made of mylar film with density of 1.38 g/cm³ and its area of 168.3 cm². Two controlled servos will be used as a solution of differential flapping. The architecture of electrical system will be made to analysis of the distribution of data and power. The selection of system components is performed by considering weight constraint. The flight maneuver is achieved by changes in flapping frequency, flapping amplitude, and sweeping angle. As simulated results, the amount of total lift is 2.09 Newton generated at 6 Hz flapping frequency.

Keywords: design, bionic flapping vehicle, aerodynamics, CFD, electrical system
Aerodynamic Analysis of Folded-Flat Plate Airfoils
Constructed from Low Reynolds Number Airfoils

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\textbf{Abstract.} Fighter aircraft often require unconventional maneuverability that civil aircraft cannot perform. The conventional flight control devices are not sufficient for this maneuver. Thus, to be able to perform unconventional maneuvers, additional control devices may be required, such as the thrust vectoring system (TVS). This paper will discuss the effect of TVS implementation in improving maneuverability. In this work, a dynamic model of F-4 Phantom is used as the basis for the study. The dynamic model of the aircraft with TVS is constructed analytically and numerically. The nonlinear model obtained from the modeling process then linearized at a particular flight condition and some TVS deflection values. Further, the linear system and control approach is employed for evaluating and designing the linear controllers for stabilization and maneuvering tasks. The closed-loop system, which is implemented in the MATLAB/Simulink environment, then numerically simulated and observed for analyzing the effect of implementing different TVS deflection on the required control effort in high angle of attack maneuvers. The simulation results show that the TVS can affect the performance of the closed-loop system in stabilization tasks. While at some deflection values, TVS can also help to reduce the required control effort to tracking attitude reference command when executing the high angle of attack maneuvers.

\textbf{Keywords:} Thrust Vectoring System, High Angle of Attack Maneuver, Flight Control System, Flight Dynamics, Aircraft Modeling
Dynamic response analysis of aircraft with actuation system failure: open-loop and closed-loop cases

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Abstract. On flight control implementation, the control surface actuator system plays one of the key roles that will significantly affect the closed-loop performance of the aircraft. The actuators must provide the required effort for moving the control surface so that the desired control action can be reached. Any failure on the actuator system will limit or degrade the operation of the control surface, so that it will affect the performance of the system in controlling the aircraft, or even worse, may bring the aircraft into an unsafe condition. In this project, the effect of some control surface problem due to actuator failures are modeled, simulated, and analyzed. To reconstruct the situation, the control device failure model is integrated into the flight dynamic model of an aircraft. The numerical model of the equation then is used for simulating the aircraft response under some failure condition. It can be seen from the simulation results that control surface failure can significantly affect the trim condition of the aircraft, since the failures can change the balance of forces and moments that work on the aircraft. The simulation results also show that for some control surface failures they may initiate an asymmetrical response from the aircraft dynamics. On closed-loop simulations, where some type of flight control systems for stabilization and maneuvering tasks are implemented, control surface failures may affect the performance of the control system. The results of the study suggest that any possibilities of control surface failure must be anticipated, by using a robust control scheme or other reconfigurable schemes that can cope with the change in the dynamic characteristics due to the failures.

Keywords: actuation system failure, dynamic response, stability, control, flight control system
Distributed Robust Adaptive Output-Feedback Synchronization

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Abstract.

This paper addresses the output synchronization of heterogeneous uncertain linear systems in the presence of input disturbance. The synchronization problem is solved by introducing the distributed model reference adaptive control. The distinguishing features of the proposed approach are the capability to synchronize the entire network output by using only the control input and the output of neighboring systems. It also provides synchronization in the presence of bounded control input disturbance. The control input disturbance is handled by extending the proposed method with the sigma-modification. By using the distributed matching condition assumptions, the coupling gains between the agents can be updated adaptively. The distributed robust adaptive controller is first analyzed by using the distributed Lyapunov function. Its effectiveness is validated in the simulation of the cart inverted pendulum systems stabilization problem.

Keywords:
Feasibility Analysis of Development of Jet Aircraft Tire Retreading Facilities in Indonesia and Its Development Strategy

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Abstract - Airplane tire retreading is the process of reconditioning an airplane tire layer after several take-offs and landing times. Airplane tire retreading can be done between 3-5 times depending on the wear rate of the tire layers. The total number of aircraft operating in Indonesia is 1259 according to data from the DKPPU, and data from INACA 'Indonesia Aviation Outlook 2017’ the number of Wide Body jets is 36 and Narrow Body is 414. From these data, the tires with the largest population and the same size is the aircraft tires B737-800/900/ER and A320-200/300 with the number of tires on the Nose Landing Gear/NLG are 726 EA and in the Main Landing Gear/MLG are 1452 EA. The available information states that the need for retreading tires for all Jet aircraft in Indonesia is around USD 13 million per year. About 80% or around USD 10.4 million per year is spending on retreading aircraft tires for B737-800/900/ER and A320-200/300. This is a big opportunity of the need for retreading tires of B737-800/900/ER and A320-200/300 aircraft owned and operated by Indonesian airlines, which is around USD 16 million per year. However, MRO (Maintenance Repair & Overhaul) Indonesia cannot take this opportunity because it still does not have the ability to retread airplane tires. For this reason, the authors conducted a feasibility analysis for the construction of aircraft tire retreading facilities for the B737-800/900/ER and A320-200/300 aircraft in Indonesia and conducted a strategic analysis necessary for the construction of the tire retreading facility to be successful. From the feasibility calculation, it is obtained 29.6% ROI (Return On Investment) and 4.8 year PBP (Pay Back Period) shows that the construction of the B737-800/900/ER and A320-200/300 aircraft tire retreading facilities is very feasible. Several strategies to achieve this are collaborating with Original Equipment Manufacturer/ OEM, seeking strategic partners, asking for support from the Government (the Ministry of Industry) by submitting the tire retreading facility development to the Aerospace Industry Roadmap.

Keywords: Tire Retreading, MRO, OEM, Feasibility, Aerospace Industry Roadmap
Modelling and Design of Flight Control for Quadrotor in Ballistic Airdrop Mission Under Wind Perturbation

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Abstract. Airdrop mission are often carried for areas that are difficult to reach using land route and do not have the infrastructure for manned aircraft. The benefits of using Unmanned Aerial Vehicle (UAV) for airdrop mission are getting much more attention with the rapid development of unmanned technology since last decade. The purpose of this paper is to develop a mathematical model of a quadrotor to carry out ballistic airdrop mission in a windy environment, modelled in the Matlab/Simulink software. The quadcopter based on nonlinear dynamics model which is obtained by using Newton-Euler equation, equipped with sensor model, and free-fall payload model. The sensor consists of Inertial Measurement Unit (IMU), barometer, and Global Positioning System (GPS). Sensor fusion algorithm is developed to estimate attitude and position of quadrotor using Kalman filter, as well as to estimate the wind speed. A Proportional, Integral, and Derivative (PID) based controller is designed to obtain the attitude and position control of quadcopter using estimated state of quadrotor. Then, the quadrotor will carry out an airdrop mission by following a simple automated waypoint navigated system. The results of the ballistic airdrop show good precision and accuracy in a high speed, but emphasize the importance of validation model.

Keywords: ballistic airdrop, UAV, quadcopter, sensor, control system
Development of a one axis thrust vectoring control system demonstrator with electric ducted fan

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Abstract. In this 21st century, space explorations are now joined by private companies, such as SpaceX, which not only focused on conducting the space mission but also to do it economically. Therefore, many reusable launcher vehicles (LVs) are being developed, which requires a sophisticated control system to support its high-level maneuvers, such as the flip-over maneuver. Thrust Vectoring Control (TVC) becomes a solution for such 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 an 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. The research is done by doing a literature study, designing, manufacturing, and conducting several experiments of the system stabilization by measuring the deviation angle based on the thrust manually input using a radio controller. To simulate any instability, the system’s center of gravity (CG) is shifted 1.66 cm from the rotation axis and hence provide a constant disturbance. 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. The demonstrator performs well in stabilizing the pitch, achievable with at least 50% of Thrust. Several steady-state oscillations, however, are observed possibly due to the air recirculation and 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.

Keywords: axis thrust, vectoring control, electric ducted fan, flight controller
Novel Kriging Application for Passive Impact localisation in Composite Structures

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Abstract. There is increased interest to develop impact monitoring systems in composite structures due to their susceptibility towards Barely Visual Impact Damage (BVID) which is difficult to detect and may cause significant reduction in strength. Most algorithms developed give a deterministic prediction of the impact location (a point coordinate), which may not be completely useful in terms of inspection as no algorithm has perfect accuracy. In this paper, we propose a novel application of kriging coupled with Bayesian updating for passive impact localisation using experimental impact (random impacts from hand-held hammer) induced lamb wave measurements from PZT sensors attached to a carbon fibre composite specimen with a 160 x 120 mm sensing area. Using the proposed method, we were able to estimate the location as well as the estimation uncertainty of impacts from steel and silicone hammer tips using the Time of Arrival difference of recorded lamb waves from different sensors. The proposed kriging method showed similar point localisation accuracy compared to the benchmark reference database method (6.33 mm vs 5.21 mm for steel and 43.36 mm vs 41.93 mm for silicone). However, as the proposed kriging method is able to quantify the uncertainty of the estimation (unlike the reference database method), it is the accuracy of the estimation range that is more important. Here, the kriging method was able to give an estimation range with errors much lower (0 mm for steel and 17.77 mm for silicone) than that of the point localisation errors of the reference database method, providing a more robust and useful estimate of impact location for practical application.

Keywords: Kriging method, barely visual impact damage, impact monitoring
Design of VTOL-Fixed Wing UAV Model System Based on Matlab/Simulink

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Abstract. The VTOL-Fixed Wing UAV combines the hovering capabilities of the quadcopter and the endurance capabilities of the fixed wing types in one aircraft system. Its main goal is to eliminate the need for runway access in the take-off and landing process. As the initial stage of the research, a mathematical model was designed to determine the characteristics of the system based on the parameters and input given. In this paper, the VTOL-fixed wing UAV model is modeled based on Aerosonde UAV’s parameters with the addition of four BLDC motors to get the hover flight mode. The modelling process was focused on the longitudinal motion of the system and the whole model will be simulated into Matlab/Simulink. The flight scenario carried out is hovering to 10 meters height and then entered to fixed wing mode to reach a cruising altitude of 20 meters. The system response to the given input is quite good, where the steady state error in VTOL mode is 0.8% and in fixed wing mode is 0.5% with 5% overshoot.

Keywords: VTOL, fixed wing, quadcopter, hybrid, UAV
Investigation of Aerodynamics Interactions in Car Racing in Overtaking Maneuver

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Abstract. Aerodynamics analysis is getting more common in the sport vehicle application. Aerodynamics plays a vital role in racing, making it one of the primary investigations done by the racing team and researchers to investigate how the aerodynamic phenomenon may occur around the car during maneuvers to make it an advantage. This research describes the aerodynamic phenomenon around racing conditions using steady computational fluid dynamics simulation for a simplified racing car without any interaction with another car, followed by aerodynamic simulation on the interaction between two cars, including approaching and passing conditions. The turbulent flow is captured by solving the Reynolds-averaged Navier-Stokes with K-epsilon turbulence model to describe the outer portion of the boundary layer as well as the wake regions of the boundary layer. The value of drag of the rear car and the downforce are reduced as the consequence of the wake while the front car experiences an increase of drag value as the rear car is approaching closer. The research is targeted to obtain the best possible scenario for the less advantaged following car.

Keywords: Aerodynamics, Wake, Computational Fluid Dynamics, Race Car, Stability, Strategy
Numerical Simulation and Optimization of Thin-Walled Prismatic Columns Subjected to Axial Impact Loading

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Abstract. In this study, the numerical simulation and optimization of the thin-walled prismatic columns subjected to dynamic axial loading were conducted to get the most optimum design. The square (SQ), circular (CR), multi-corner with 12 corners (MC12), multi-corner with 20 corners (MC20), and multi-corner with 12 corners plus shape (MC12+) thin-walled column cross-sections were analyzed. The numerical simulations were performed using the explicit finite element method, while the response surface was constructed by the Kriging surrogate model. The effect of different thickness and perimeter of columns to the crushing parameters such as the mean crushing force ($P_m$), crushing force efficiency ($C_F$), and the specific energy absorption ($SEA$) of various crash boxes were compared. Then, the most efficient crash box was recommended. The results show that increasing the column thickness is more efficient than increasing the crash box’s perimeter to get a better mean crushing force ($P_m$). We observe that high crushing force efficiency ($C_F$) can be obtained by increasing and decreasing the thickness and the perimeter, respectively. Moreover, the highest value of specific energy absorption can be obtained by minimizing both thickness and perimeter. The results also show that MC20 has the best structural efficiency in terms of $P_m$ and $SEA$ than SQ, CR, MC12, and MC12+.

Keywords: Numerical simulation, optimization, Thin-Walled Columns, Axial Impact, Surrogate Model
Numerical simulation of a bird-strike on an island-hopping aircraft windshield for various conditions

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Abstract. This paper presents a study of the windshield structure response of an island-hopping aircraft under bird impact load. The study was conducted using finite element numerical simulations in which a representative bird strike model was developed. The bird model used in the simulations was based on that developed by other researchers, i.e. a hemispherical cylindrical shape with a Smooth Particle Hydrodynamics element type. The windshield model was modelled in 3D form. It was modelled alongside the surrounding clamping fixtures, though unlike the windshield, it was modelled in 2D form in the effort to simplify the model. First the model was validated through numerical verification of existing simulation and experimental results. Then windshield responses were evaluated for four parameters, namely the impact direction, strain rate, altitude and temperature, and damping factor. The safety of the structure was analyzed based on the mechanical properties of the material, including ultimate strength and failure strain. The results showed that the four parameters indeed affect the response of the windshield. The most fatal one was the impact direction, while others displayed very minimal effects.

Keywords: Island-Hopping Aircraft, Bird-strike, Windshield, Smooth Particle Hydrodynamics, Finite Element
Crashworthiness Analysis of Hybrid Steel-Composite Double-Hat Multi-Corner Thin-Walled Column Under Axial Loading

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Abstract. In this paper, the crushing characteristics of a hybrid steel-composite thin-walled column subjected to axial loading are numerically evaluated. The columns, with double-hat multi-corner cross-section, were made of steel columns and externally reinforced with the Glass Fiber Reinforced Plastic composite. The analysis was carried out by evaluating the effect of composite layer addition on the maximum crushing force, mean crushing force, crushing distance, specific energy absorption, and crushing force efficiency of the steel columns. The results show that a hybrid steel-composite structure's energy absorption performance is higher than the sum of the single materials' performance separately.

Keywords: crashworthiness, hybrid steel-composite, double-hat multi-corner, thin-walled column, axial loading
Topography Optimisation and Damage Tolerance Analysis of a Small Passenger Aircraft MLG Fitting under Constant-Amplitude Loading

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Abstract. This paper discusses the process of topology and damage tolerance optimisation for a Main Landing Gear (MLG) fitting through Generative Design, which has changed the design tactic of structural component to not only come up with the best configuration of a structure to comply the Design Requirement and Objective, but also to able to handle the applied loading condition. Four loading cases for the topology optimisation process and the static strength simulation were carried out, while the damage tolerance analysis was performed using a Constant-Amplitude loading due to the Maximum Take-off Weight of the aircraft. A comparison in terms of the static strength and damage tolerance for both the original and the topology-optimised fitting was conducted to see and prove the integrity of the topology-optimised fitting compared to the original one. The results showed that the topology-optimised MLG fitting has a lighter weight. Furthermore, the inspection interval of the new fitting, which is the desirable output from the damage tolerance analysis and beneficial for the maintenance and repairs of an aircraft, is proven to have a comparable performance to that of the original one.

Keywords: fracture mechanics, crack, constant-amplitude, topology optimisation, weight reduction
Runway Excursion Contributing Factors Analysis Based on Flight Operational Quality Assurance Data

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Abstract. Safety is of paramount importance in aviation. It is the key element of the existence of the aviation industry. Its complexity requires participation from related parties such as operator, manufacturer, regulator, as well as research institution to work together to make aviation safer. In the operator level, the so-called Flight Operational Quality Assurance is performed in a daily basis for improving safety by analyzing the flight operational data. It is now becoming part of airline’s Safety Management System. In analyzing the flight data, an airline usually utilizes a commercial software that is capable of detecting events based on specified criteria. One event is Runway Excursion (RE) in which the aircraft is veer off or overrun from a runway surface. It is the most interest for the airline to know the contributing factors of this event. This paper aims at evaluating and analyzing flights that have a tendency to experience runway overrun and identifying the factors that contribute to this event. The analysis is carried out based on Flight Operational Quality Assurance along with statistical analysis approach. The parameters used in the analysis include altitude, airspeed, ground speed, local conditions, attitude angles, control surfaces, landing gear configuration, acceleration, engine condition, and aircraft distance with respect to threshold point. The statistical parameters such as correlation coefficient is used to find the correlations between parameters and determine the significant parameters that contribute to the occurrence of the runway overrun. The analysis is performed on 250 real flight data. Based on analysis conducted in this paper, it is found that airplane speed at touchdown, $N_1$ at touchdown, and the use of ground brake system contributes significantly to the runway overrun.

\textbf{Keywords}: correlation coefficient, runway overrun, contributing factor, flight operational quality assurance data
Stochastic Modeling of Aircraft Flight Parameters in Terminal Control Area Based on ADS-B Data

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Abstract. A critical step in developing good traffic management (ATM) system simulation model is to build a kinematic model of an aircraft movement that can represent the real conditions. This study aims to obtain flight parameters for aircraft operating in the terminal control area of Soekarno-Hatta International Airport using Automatic Dependent Surveillance-Broadcast (ADS-B) data, which is openly available on FlightRadar24. Flight parameters were measured for several flight phases, such as take-off, initial climb, climb, cruise, descend, and final approach. In addition to these flight phases, flight parameters at waypoints on the arrival and departure were also measured. Furthermore, all flight parameters are modeled stochastically through the probability distribution function (PDF) approach. The best model for each parameter is obtained using the Maximum Likelihood method (MLE) with some fitting criteria such as Kosmolgrove Smirnov Test. The use of ADS-B data along with the stochastic model presented in this paper provides comprehensive information on flight behavior, which can be further utilized for an aircraft simulation model of an Air Traffic Management system.

Keywords: ADS-B, flight parameters, terminal control area, simulation model
Comparative Study of Mechanical, Physical, and Chemical Properties of Three Species of Timor Sea Stony Coral

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Abstract. East Nusa Tenggara has a high coral diversity and may have potential as a source of biomaterials. Therefore, a research of three coral genera (Siderastrea sidereal, Acropora donei, and Favites complanata) have been conducted to obtain their physical and chemical properties. The three species were taken from the Timor Sea, East Nusa Tenggara at the position of 10.18 South Latitude and 123.53 East Longitude. The physical characteristics, namely density, porosity, and compressive strength have been determined and analyzed for their feasibility as a candidate for bone grafting biomaterials. In addition, the microstructure, chemical composition, crystallinity and changes in the crystal phase with respect to temperature in the coral material were determined. The knowledge of physical and chemical properties of the three stony coral species can provide opportunities for their potential as bone grafting material, a source of CaCO3 minerals, as well as a study of environmental problems that may be faced by these corals due to habitat pollution and global warming.

Keywords: Biomaterial, Timor Sea Coral, Siderastrea sidereal, Acropora donei, Favites complanata
HALE UAV ITB Perpetual Flight Performance

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Abstract. One of the challenge in designing and developing High Altitude Long Endurance (HALE) UAV ITB is to obtain the ability endurance of more than 24 hours (perpetual flight). The ability to fly for a long time needs to consider combination of: high aerodynamic efficiency, high motor-prop efficiency, hybrid battery-solar panel energy source, light weight structures, efficient control, and optimum flight mission. This paper discusses about strategy and method to calculate perpetual flight mission for the case of HALE UAV ITB. The output of this paper is the design requirements for a HALE UAV ITB for achieving perpetual flight at various flying altitude

Keyword: Sailplane, Performance, CFD Simulation, Spoiler Design, EASA CS-22
Dynamic Obstacle Avoidance System for UAV

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Abstract. This paper presents a method for collision avoidance for moving obstacle based on ellipsoid geometry. Ellipsoid algorithm itself has been implemented in small UAV for static obstacle avoidance. In extending the algorithm to dynamic object, two adjustments have been made, first is to calculate safe heading and selection of head or tail contact point. Using these two adjustments, the algorithm successfully generate safe waypoint for dynamic obstacle avoidance and select which direction to use, whether it is to the head or the tail of obstacle moving direction.

Keywords: collision avoidance, ellipsoid zone, flight guidance
High Altitude Long Endurance UAV ITB Solar Panel Conceptual Design

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Abstract. One of the factors for the long endurance of HALE UAV ITB is the design of battery and solar panel. This paper discusses the method to calculate battery and solar panel requirements for HALE UAV ITB to fly for more than 24 hours at 20,000 feet. Several designs, configuration, and type of solar panels are analysed to fulfil HALE UAV ITB requirements. The variable compared is solar panel area, weight, and types. As a result, the use of Monocrystalline Silicon solar cell was found to be much more efficient than Polycrystalline Silicon, CIGS Thin Film, and Amorphous Silicon Thin Film with power generated per area of 224 Watt/m2 and power per weight of 436 Watt/kg. The minimum area required for a Monocrystalline Silicon type solar cell to generate power is 5.94 m2 with a total cell weight of 5.31 kg.

Keyword: Unmanned Aerial Vehicle, High Altitude Long Endurance, Battery, Solar Panel, HALE UAV ITB
Damage Tolerance Analysis of Aircraft Structure: Case Study of Multiple-Site-Damage on Hercules C-130H Center Wing Box Structure

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Abstract. Damage tolerance analysis ensures that cracks are noticed before the fatal failure occurs. This paper presents the damage tolerance analysis of the Hercules C-130H center wing box structure. The crack propagation was evaluated as a Multiple-Site-Damage case from some rivet holes on the lower skin wing structure. The analyses were divided into three main stages. In the first stage, the operational load received by the center wing box structure was calculated. Next, the center wing box structure's numerical simulation under static load was developed on the second stage. At the last stage, the crack propagation on the structure programming algorithm were obtained using MATLAB. The results show that the center wing box life-cycle is 6.125 flights. After the aircraft has reached 2.244 flight cycles, cracks begin to be detected with standard inspection tools. By scheduling inspections, every 1.294 flight cycle cracks can be reliably detected from scheduled inspections.

Keywords: damage tolerance, fatigue, crack propagation, center wing box structure, numerical simulation
A review on PZT based MEMS Micropumps

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Abstract: From the perspective of biology, medicine, microelectronic cooling to space exploration, microfluidic systems devised via MEMS have gained a major attention in last few decades. The miniaturization of these devices to a dimension of microscale aids in fluid transport, immobilization, biosensing, sample purification and detection. Miniaturization has reached a scale enough to produce a Lab on Chip (LOC) and micro total analyses system (μ-TAS). A major constraint in development and commercialization of MEMS based devices is the unavailability of desired microfluidic component like micropumps and microvalves. Under the scope of this paper a brief review has been provided on MEMS based micropumps and valves, their working mechanism, actuation material and methods, valve type, pumping medium, working fluid, chamber-reservoir design, diaphragm and mode of operation. With essential parameters including actuation voltage, operation frequency, backpressure, flowrate and diaphragm thickness. Studying the progress made in last 30 years and range of applications from biological, cryogenic, chemical to tribology this paper attempts provides a reference and roadmap to researchers in field of microfluidics & converges specifically to PZT based micropumps for space tribological application.

Keywords: total analyses system, microfluidic, lab on chip, valve
Additional Drag Prediction on VTOL System Installation to Hybrid VTOL UAV Based on Computational Fluid Dynamics

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Abstract. This paper proposes an aerodynamics analysis and design of VTOL system on Hybrid Vertical Take-off and Landing (VTOL) UAV to achieve aerodynamically efficient with the additional drag approach using the numerical computational fluid dynamics (CFD) method. The main purpose Hybrid VTOL UAV for delivery purpose is it can carry payload in difficult terrain and can flight longer than multirotor configuration. The hybrid configuration consists two main systems: fixed-wing and VTOL. To achieve specific range requirement, airframe with high aerodynamic efficiency employing maximum CL/CD (lift-to-drag coefficient ratio) must be found. One of the methods to know the CL/CD ratio is by predicting an additional drag effect created by the VTOL system installation on the UAV. Unfortunately, VTOL system gives a contribution to additional parasitic and pressure drag that could affect aerodynamics performance so that reducing range operation. The VTOL system is a pair of pylon boom, two pairs of motor and propeller. The CFD simulations are performed for each component of the VTOL system installation. For the beginning is wing only configuration is simulated. And then pylon booms, VTOL motors, and propellers are added. The drag coefficient additional effect of these installations is assessed. Another design also performed to compare which one the optimal design. The result is the percentage of drag addition generated by the VTOL system from the drag of UAV configuration, comparative design analysis and using this study for creating an aerodynamically efficient VTOL system airframe for future works.

Keywords: aerodynamic efficiency, additional drag, computational fluid dynamics, hybrid VTOL UAV, lift-to-drag ratio
Abstract. Vortex generators are addition surface that can increase heat transfer area and change the fluid flow characteristics of the working fluid to increase heat transfer coefficient. The use of vortex generators produces longitudinal vortices that can increase the heat transfer performance because of the low pressure behind vortex generators. This investigation used delta winglet vortex generator that was combined with rectangular vortex generator to Reynold numbers ranging 6,000 to 10,000. The parameters of Nusselt number, friction factor, velocity vector and temperature distribution will be evaluated.

Keywords: parallelogram winglet vortex generator, heat exchanger, heat transfer performance
Effectiveness Evaluation of Maintenance Tasks for the Landing Wheels of the B737-800 Aircraft

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Abstract. In maintaining the B737-800 aircraft, XYZ airline follows the Continuous Airworthiness Maintenance Program document. However, in its implementation, XYZ Airline experienced many operational disruptions caused by many unscheduled removals due to landing wheel failures. This research uses a reliability calculation method and a failure modes analysis of the landing wheel. The Mean Time Between Removals of each failure mode is expressed by the age of the component using the Weibull distribution. The failure data is used to evaluate the effectiveness of the existing maintenance tasks. The data used were obtained from 26 Pilot Report from January 2017 to September 2018. The components are assumed to have the same Time Since Installed (TSI) and not interchangeable. The landing wheel component has 4 failure modes: deep cut, ply visible, worn out, and bald. The dominant failure mode on the front landing wheel is deep cut and on the main landing wheel it is ply visible. The maintenance task carried out by XYZ airlines to maintain landing wheel is not effective for all failure modes, so it is necessary to revise the maintenance task intervals.

Keywords: maintenance tasks, airworthiness maintenance, operation disruption, failure modes
Flexural Behaviour of Jute, Glass, and Carbon Fibre Reinforced Polyester Hybrid Composites

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Abstract. This study is a part of a project in developing natural fibre reinforced composite for wind turbine blade. The objective of this study is to evaluate the effect of fibre stacking sequence on flexural behaviour of the natural fibre reinforced composite hybridized with synthetic fibre. The flexural behaviour of the composite becomes an important consideration in deciding stacking sequence of the fibres. Material used in this study is polyester resin as the matrix. Jute, glass, and carbon fibres are used as the reinforcement. The composites were fabricated using vacuum bagging method cured at room temperature. The combinations of fibre as the reinforcement is configured by arrange two and three types of fibre. As a natural fibre, jute exists in all kind of combination. Flexural behaviour was observed using 3 point bending test. The specimens were tested in accordance to the fibre stacking sequence. The result shows that stacking sequence of the fibres give significant different flexural behaviour regardless the effect of the fibre strength

Keywords: natural fibre composites, wind turbine, blade, green materials, renewable energy
Developing a Non-routine Maintenance Load Forecasting Procedure in MRO XYZ (Case Study: B737NG)

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Abstract. Turn Around Time (TAT) is one of the most important performance indicators in a Maintenance, Repair, and Overhaul (MRO) company. MRO companies need a high percentage of on-time TAT to compete in the industry. In 2019, there is a 29% difference between the planned and the actual TAT in MRO XYZ. Based on observations in MRO XYZ, there is no planning to perform non-routine maintenance. 54% of the total maintenance loads is a nonroutine maintenance, therefore, it needs to be planned. The first step of the research is to identify routine maintenance tasks that dominate the non-routine maintenance loads based on ATA Chapter and CAMP Number using Pareto Analysis. The next step is to develop a procedure which determines the variables and the mathematical model to estimate the Non-Routine Ratio (NRR) workloads. The last step is to implement the procedure to obtain the NRR estimation model, which is also as the validation of the developed procedure. Several routine maintenance tasks dominate Non-routine maintenance loads and categorized by ATA Chapter, CAMP Number, and task types. Dominant ATA Chapters are ATA 53, 25, and 57. Dominant CAMP numbers are 53-140-00, 53-800-00, and 53-866-00. Dominant task categories are DVI for the system, internal GVI for structure, and external inspection for zonal. The NRR forecasting model for B737NG C-Check is composed of C-Check number, aircraft's age, the ratio of ATA 53, the ratio of ATA 25, and the ratio of ATA 57. The NRR forecast model can be improved by adding some variables, such as Flight Hours (FH), Flight Cycles (FC), and Maintenance Task Type.

Keywords: turn around time, MRO, flight hours, flight cycles
Take off Simulation and Analysis of Aircraft with Twin Floats

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Abstract. Amphibious aircraft is a multi-function aircraft which can be operated on land and water. This type of aircraft helps transportation sector due to its ability to reach remote areas. Indonesia as the largest archipelago in the world has problems in connecting remote areas. Land transportations and conventional aircraft have difficulties to reach remote areas due to lack of facility. Hence, small aircraft capable of operating on land or water with take off and landing distance less than 1000 m are required. This study conducted take off simulation and analysis for DHC-6 Twin Otter Series 400 equipped with twin float. It tries to propose a simpler method to initiate the analysis of take of performance for float planes with limited data constraints. Several programs were used to generate required data, such as DatCom and SolidWorks. Float plane take-off simulation used in this research utilized Gudmundsson’s method. Results showed that the method is suitable and correctly produce take off distance and time similar to those of the real aircraft. Aircraft weight and thrust affect take-off distance and required time, as well as hydrodynamic forces produced. Reduction of weight 10% reduces the distance approximately 17%, while 10% thrust reduction increases take off distance about 15%. In the future this research will be expanded to include other float shapes and sizes, as well as flying boats.

Keywords: take off, twin floats, simulation, DHC-6 Twin Otter
Quality Analysis of Telecommunication Backbone Signaling on High Altitude Platform System (HAPs)

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Abstract. The use of Information and Communication Technology (ICT) for the development of a telecommunication backhaul/backbone system also includes efforts to overcome current limitations, mainly related to the lack of support for telecommunications infrastructure, both due to financing factors and mastery of technology. If efforts to support increased connectivity are carried out through the development of terrestrial telecommunications infrastructure, then the main constraints and challenges lie in the development and integration of infrastructure that is difficult to do in remote areas and islands. As for using a satellite system, the launch and operating costs are the main obstacles faced by the government. Therefore, the development of the Backbone Telecommunication High Altitude Platform System (HAPs) is the best option that can be implemented. Wahana Dirgantara Super or High Altitude Platform (HAPs) is an alternative solution to support telecommunication technology media in the digital era, especially in supporting the implementation of the Independent Secure Network (ISN) backbone. This research will discuss the reliability analysis of telecommunication backbone systems on the High Altitude Platform System (HAPs) as a single repeater with earth stations (Uplink and Downlink) by calculating the quality of the communication line. Analysis of the quality of this communication line is done by calculating the link budget where the indicator parameter of the quality of the transmission line is Carrier to Noise.

Keywords: HAPs, Link Budget Analysis, Angle of Elevation, Radiated Power
Effect on Propeller Slipstream Flow to the RPAS Gull Wing Performance

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Abstract. The propeller of RPAS (Remotely Piloted Aircraft System), the propellers generate swirl flows released from the propeller tips moving downstream as called slipstream. This flow will interact with the surfaces downstream such as wings, horizontal and vertical stabilizers as well as fuselage generating the alteration of aerodynamic forces and moments. This may produce a significant influence on RPAS wing performance that may be dangerous during the RPAS operation. In this study, the investigation of the effects of the propeller on the RPAS wing performance (lift and drag) is being conducted using the Computational Fluid Dynamics method. The flow phenomena of slipstream and its interactions of the wing-RPAS configuration are resulted by solving the governing equations based on Reynolds Averaged Navier Stokes (RANS) on domains discretized using structured meshes. The structured mesh is chosen because of its simplicity and can handle more complex geometry at the analyzed model propeller. The simulation is conducted for various cases of the RPAS on power-on conditions using CFD software.

Keywords: slip stream, wing performance, Computational Fluid Dynamic, propeller.
Sensitivity Study and Structural Optimization of an Aircraft Wing with Maximum-Stress and Flutter Constraints

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Abstract. Optimization process is very important to be done since the preliminary design step, not only for the static load aspect but also dynamic load as well. In the past, aeroelastic behavior aspect is often neglected in this stage and consequently becomes a problem at the later stage of design. This paper contains multi-constraints design sensitivity and optimization which include both maximum stress constraint and damping flutter constraint. Sensitivity study was performed to assist optimization process and makes the process more efficient. Wing structure was modeled as skins, ribs, spar-webs, and spar-caps. Optimization process was done by changing thickness of each component and beam dimension. The methodology used in this paper is a gradient-based optimization developed by MSC Nastran. The final cycle of this optimization has successfully reduced structural weight up to 33% without violating static and flutter constraint.

Keywords: sensitivity study, structural optimization, flutter constraint
Development of Local Lung Ventilator Component for COVID-19 Patient Treatment

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Abstract. Development program of local ventilator component, respiratory flow meter (RFM), respiratory blower fan (RBF), and PEEP Valve is a part of contribution to support medical team during COVID-19 Virus outbreak at the beginning of the year 2020 in Indonesia. In the COVID-19 pandemic era ventilator become necessary thing to treat Covid patient especially for worst cases patient. With increasing in people who infected by COVID-19 around the world and also in Indonesia, caused the demand of the ventilator system also increased significantly. In Indonesia many research institution such as ITB, PINDAD, IAe, developed the emergency ventilator to support the increasing demand. Chroma International initiate to develop the component of the lung ventilator to support other research institution therefore to minimize dependency from impor product which is in the pandemic era the component sucha as flow meter and blower fan is difficult to get caused by stock limitation. Chroma International develop three essential component part of the lung ventilator, Respiratory Flow Meter (RFM), Respiratory Blower Fan (RBF), and PEEP Valve. The development of these components using standard design procedure and helped with CAD and CAE software tools to obtain the optimum design result.

Keywords: Local Ventilator Component, Flow Meter, Blower Fan, PEEP Valve, COVID-19.
V-Tail Flutter Analysis of Wing In Surface Effect (WISE) Aircraft Using MSC Nastran Software

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**Abstract.** Flutter is a dynamic aeroelastic instability that may cause structural failure and limits flight envelope of an aircraft. A passenger aircraft is required to be free from flutter and other aeroelastic instability phenomena, as stated in the regulations such as FAR 25. 33 / FAR 23.33. This paper presents the flutter analyses of the WISE aircraft using MSC Nastran. The analyses were carried out to the V-tail, one of the component where flutter might occur, by assuming rigid fuselage. Results of each analysis, in the form of velocity-damping and velocity-frequency curves, were evaluated to determine the critical flutter speed and frequency. First the analysis were conducted for sea level operation using KE, PK and PKNL methods which predict respectively the flutter speed of 1036 knot, 1037 knot, and 1037 knot. The three methods also consistently predict that the mode shapes involved in the flutter are the 5th mode and the 3rd mode. Then by using the PK-method, the analysis were repeated for air density variation. It is shown that the lower the air density, the higher the flutter speed is. It is concluded that tail flutter does not occur during the operation of the WISE craft with max operating speed of 80 knot.

**Keywords:** flutter, PK, K, PKNL method, V-Tail
Numerical simulation of fluidic thrust vectoring in the TIC nozzle (truncated ideal contour)

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Abstract. In this study, a numerical simulation is carried out in order to analyze and validate the results of a fluidic injection in the diverging part of a supersonic nozzle. It is obvious that this induces several complex phenomena, such as the development of a separation of the boundary layer which induces a shock wave in the primary jet upstream of the fluid interaction zone (primary jet-secondary jet). This shock wave causes the deviation of the main jet, and therefore the thrust vector, relative to the axis of the nozzle. Several parameters are involved in the modelling of such a phenomenon: the Mach numbers of the primary jet and of the injected jet, the ratio of the total pressures, the injection rate, the thickness of the upstream boundary layer, the position of the injector in the diverging part, geometry of the nozzle, etc. knowledge of the physical phenomena of the turbulent boundary layer (the case most frequently encountered in supersonic nozzles), of the calculation of its thicknesses and of the friction forces induced on the walls. The aim of this work is to numerically study the thrust vectoring by secondary injection using the ANSYS-FLUENT simulation software and then analyze the various phenomena involved. The results of the thrust vectoring performance (angle of deviation, efficiency, lateral forces, etc.) obtained will be confronted and compared with those obtained by the experimental.

Keywords: fluidic injection, numerical simulation, supersonic nozzle, thrust performance
Numerical Simulation and Optimization of Thin-Walled Prismatic Columns Subjected to Axial Impact Loading

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Abstract. The present work investigates the influence of gas at high temperature on the design and analysis of two-dimensional plug nozzle. The thermochemical and combustion studies of liquid launchers propellants make it possible to choose the gases to be studied. For example, four cases of bi-propellants engines have been studied. The combinations studied are: H2/O2, RP1/O2, CH4/O2 et MMH/N2O4. The selected gas are: CO2, H2O H2, N2 and CO. Once the profile is generated, an analysis of the thermodynamic-parameters evolution (such as: length, Mach number, mass, thrust coefficient) and aerodynamic performances is conducted. Some results were presented and compared with previous research using air. The comparison shows that the presence of H2O and CO2 gases considerably increases the performance of nozzles. The percentage of gases in the combustion has an influence on these increases. In order to minimize the weight of this nozzle, the truncation of Plug nozzle in order to increase their performances is studied in this research.

Keywords: Rocket propulsion, High temperature, Prandtl-Meyer function, Aerospike nozzle.
Flight Test Evaluation for Tilt Rotor Unmanned Aerial Vehicle Development

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Abstract. Tiltrotor UAV is Unmanned Aerial Vehicle that combine fixed wing (FW) and multirotor (VTOL) configuration in order to be able to perform instant transition from one configuration to another. Tiltrotor UAV has advantage to perform takeoff and landing from limited space such as plantation farm, forest, and residential area. Tiltrotor also can carry various mission since it has 2 configuration such as cargo drone, safer payload dropping, and mapping. In this research tiltrotor UAV designed with ruddervator (V-Tail) configuration with 3 motors in total, 2 motors placed on main wing with tilting capability and 1 motor placed at the end of fuselage as pitch controller in VTOL mode. Test flight will be conducted and evaluated to test UAV capability in hovering and transition from one mode to another.

Keywords: Tiltrotor UAV, Flight Test, VTOL, FW
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