RAJALAKSHMI
ENGINEERING COLLEGE
An AUTONOMOUS Institution
Affiliated to ANNA UNIVERSITY, Chennai

CONFERENCE PROCEEDINGS

NATIONAL CONFERENCE ON PROGRESSES AND CHALLENGES IN AEROSPACE ENGINEERING

NCPCAE - 2024

(Hybrid Mode)

26th and 27th April 2024

Organized by

Department of Aeronautical Engineering

https://rajalakshmi.org/ncpcae2024/

Rajalakshmi Engineering College
(An Autonomous Institution)
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APPROVED BY AICTE | A++ NAAC | ACCREDITED BY NBA | Ranked 86th in nirf INDIA RANKINGS 2023 IN ENGINEERING CATEGORY | CII PLATINUM RATING | HIGHEST 4 STAR RATING INNOVATION & ENTREPRENEURSHIP ACTIVITIES 2020-2021 | OUTSTANDING AAAA+ RANKING CAREERS360

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About the Institution

Rajalakshmi Engineering College, an autonomous institution affiliated to Anna University, Chennai, was established in the year 1997 under the aegis of Rajalakshmi Educational Trust. The College has grown from strength to strength in the last 25 years and progressing towards Excellence in Engineering Education, Research and Development. The College presently offers 19 Undergraduate and 9 Postgraduate programmes including MBA program, with an annual intake of 2070 students. 9 of our departments are recognized as Research Centers of Anna University to conduct Ph.D. and M.S. (By Research) programmes and many scholars have obtained Ph.D. through these research centres. The College is accredited by the National Assessment and Accreditation Council (NAAC) with 'A++' Grade.

In addition to the availability of excellent infrastructure facilities, this rapid growth signifies well qualified and dedicated faculty, staff, well organized HR and administrative systems, highly motivated students and above all, the commitment of the institution for imparting quality engineering education, in the line with its stated vision and mission.

College Vision

To be an institution of excellence in Engineering, Technology and Management Education & Research. To provide competent and ethical professionals with a concern for society.

College Mission

- To impart quality technical education imbibed with proficiency and humane values.
- To provide right ambience and opportunities for the students to develop into creative, talented and globally competent professionals.
- To promote research and development in technology and management for the benefit of the society.

About the Conference

NCPCAE-2024 is dedicated to uniting professionals from Aerospace, Mechanical Engineering, and various branches of engineering pertinent to the Aerospace field. The conference provides a collaborative space for sharing the latest research, practical advancements, and challenges in Aerospace Engineering. It promotes interdisciplinary collaboration, creating a forum for experts to share ideas and knowledge. Attendees will engage with peers, expand their networks, and explore innovations shaping these dynamic engineering sectors. The conference also warmly welcomes contributions from multidisciplinary fields, recognizing the importance of diverse perspectives in driving innovation in Aerospace Engineering.

About the Department of Aeronautical Engineering

The department of Aeronautical Engineering was established in the year 2005, offers 4-year B. E programme with an intake of 60. The Department cherishes the hope that its graduates will be the leaders of tomorrow. The goal of the B. E. program in Aeronautical Engineering is to train the students in a broad-based manner with equal focus on applications in aircraft engineering, rocket and space technology. The curriculum is designed to impart engineering knowledge in topics such as structural mechanics, aerodynamics, propulsion, and space dynamics. Further provision exists to acquire additional engineering knowledge through electives. Besides, the students acquire sufficient knowledge in mathematics, physics and chemistry under the category of basic sciences and in humanities and engineering arts. The importance of computational-skill enhancement through the development of one's own programs as well as the use of advanced software is stressed throughout.

The department is equipped with the best infrastructure and state of the art modern high tech laboratory facilities such as; Aircraft Propulsion Lab., Aerodynamics Lab. (Low Speed Wind Tunnel Facility), Aircraft Structures Lab., Aircraft Simulation Lab. and Design, Modelling and Analysis Lab. (equipped with licensed software viz ANSYS and Catia) catering to B.E. Aeronautical Engineering curriculum as well as to undertake Research activities. The laboratories and workshops, detailed in the curriculum, have been framed to take up the challenges in Industry and focus themselves on research and development.

Graduates in Aeronautical Engineering can seek employment in civil aviation, defence R&D laboratories, space research organizations, and CSIR laboratories. Aerospace graduates are also preferred by software industries engaged in engineering-software developments. In addition to these, graduates can enter general fields like management and civil services. Those having a flair for higher education and research can pursue M. Tech. and Ph.D. Tie-ups with the pioneering organisation like National Aerospace Laboratories (NAL), Indian Space Research Organizations (ISRO) etc., have served as eye-openers on the complexities of real-life problems, both for the students and faculty members. A dedicated project work is taken up by every student for two semesters during final year. The project work is aimed at high quality standards used in current industry practices. Some Project works are also supported by leading MNCs and defence laboratories involved in state of art research and development.

Department Vision

To provide excellent graduate education in Aeronautical Engineering and continuously support the community of aerospace professionals that will spearhead and strengthen the design and development of aerospace related industries and institutions in India.

Department Mission

- To impart quality exposure in theory and practical with proficiency, skill and humane values with the best of teaching and industrial expertise.
- To continuously strengthen the laboratory learning of students in tune with the best industry processes and practices
- To ensure the updated knowledge and skill sets of students in emerging technologies
- To provide the students the right ambience and opportunities to develop into creative, talented and globally competent Aero professionals.
- To promote research and development activities in the sphere of aeronautics for the benefit of the society

The Institution strictly follows OBE. Four levels of OBE are defined for a programme namely:

1. **Programme Outcomes (POs) -** describes what students should know and be able to do at the end of the programme. POs are to be in line with the graduate attributes as specified by the Washington Accord. POs are to be specific, measurable and achievable.
2. **Programme Educational Objectives (PEOs) -** provides a clear understanding of what a program aims to achieve and helps to align all aspects of education, including teaching methods and assessment tools, towards the desired outcomes.
3. **Course Outcomes (COs) -** defined for each course which aligns with the desired outcomes and provides students with the necessary knowledge and expertise to succeed.
4. **Programme Specific Outcomes (PSOs)** - These refers to what the graduates of a specific program will be able to do on completion of the program.

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9. Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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Message From Conference Chair

Dr. S. N. Murugesan
Conference Chair & Principal
Rajalakshmi Engineering College
Mail Id: *principal@rajalakshmi.edu.in*

It gives me great pleasure to extend a warm welcome to all participants of the National Conference on Progresses and Challenges in Aerospace Engineering (NCPCAE'24), organized by our esteemed Department of Aeronautical Engineering.

In today's rapidly evolving global landscape, the aerospace and defence sectors play a pivotal role in shaping the future of nations. As we witness unprecedented technological advancements and paradigm shifts in the aerospace industry, forums like this conference serve as invaluable platforms for knowledge exchange, collaboration, and innovation.

The efforts undertaken by the Indian government, such as the Make in India initiative, Defence Procurement Procedure revisions, and the Strategic Partnership Model, underscore the nation's commitment to bolstering indigenous defence manufacturing capabilities. As an institution dedicated to fostering excellence in engineering education and research, we wholeheartedly support these endeavours and recognize the significance of nurturing talent and expertise in aeronautical engineering.

I commend the Department of Aeronautical Engineering for spearheading this initiative and bringing together experts, researchers, and industry leaders to deliberate on cutting-edge developments, emerging trends, and challenges in the field of aeronautics.

I encourage all participants to actively engage in the discussions, share insights, and forge collaborations that will contribute to the advancement of aeronautical engineering and propel our nation towards self-reliance and technological prowess in the aerospace domain.

Wishing you all a productive and enriching conference experience.

Message From Conference Chair

Dr. S. P. Srinivasan
Conference Chair & Vice Principal
Rajalakshmi Engineering College
Mail Id: *vp@rajalakshmi.edu.in*

Greetings to all attendees of NCPCAE'24., I'm thrilled to welcome you to a cornerstone event that embodies the spirit of innovation in aerospace engineering. Scheduled for April 26th and 27th, 2024, this conference is a crucible for the exchange of ground-breaking ideas and fostering collaborations that shape our industry's future.

Aeronautical engineering is a testament to human ingenuity, constantly pushing the frontiers of exploration and technology. At NCPCAE'24, each session, each presentation, and each discussion is an opportunity to advance our understanding and challenge the boundaries of the possible.

Your role in this endeavour is pivotal. Your insights, questions, and collaborations are the essence of this conference, driving the collective quest for knowledge and innovation. Together, we are more than just participants; we are architects of the future.

I extend my heartfelt thanks to all contributors, the organizing committee, and our sponsors. Your dedication ensures the impact and success of NCPCAE'24.

May our time together at NCPCAE'24 inspire us, challenge us, and contribute to the enduring legacy of aerospace engineering.

Thank you for being an integral part of this National Conference.

Message From Conference Co-chair

Dr. Suresh Chandra Khandai
Conference Co-chair & HOD
Department of Aeronautical Engineering
Rajalakshmi Engineering College
Mail Id: *hod.aero@rajalakshmi.edu.in*

It gives me immense pleasure to extend my greeting and worm welcome to the researchers and the delegates attending the first National Conference on “Progresses and Challenges in Aerospace Engineering”, (NCPCAE’2024) on 26th and 27th April 2024 organized by the Department of Aeronautical Engineering, Rajalakshmi Engineering College, Chennai.

As we convene at the National Conference on "Progresses and Challenges in Aerospace Engineering," it's paramount to acknowledge the pivotal role each researcher plays in shaping the future of this dynamic field. Our gathering represents a nexus of knowledge, experience, and innovation, where experts converge to exchange insights, confront challenges, and chart pathways towards advancements. As we embark on this collaborative journey, let us harness the collective wisdom and determination to propel aerospace engineering to unprecedented heights, surmounting obstacles with resilience and ingenuity. Together, let us pioneer breakthroughs that not only redefine the boundaries of flight but also inspire generations to come.

The conference is the great platform for the researchers, to share their expertise in their domain and for the young engineers to initiate the research work. The theme of the conference is of great significance with the current need for the industry. I wish all the best to the participants.

CONFERENCE CONVENOR

Dr. Surendra Bogadi, Associate Professor, Aero, REC

CONFERENCE SECRETARIAT

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PROGRAM SCHEDULE	Date: 26-04-2024 FRIDAY	
Time	**Event**	**Venue**
08:00 onwards	Registration	Workshop Block
09:00 – 09:05	Invocation Song	Main Seminar Hall
09:05	Welcome address by HOD, Dept. of Aeronautical Engineering, REC	
09:10	Inaugural Address by Principal, REC	
09:15	Falicitation of Delegates	
09:20	Chief Guest invited talk	
09:40	Address by Guest of Honour	
10:10	High Tea	
10:30	Paper Presentation Session 1 – Tracks 1, 2, and 3	T1 - Main Seminar Hall, T2 - Heritage Hall, and T3 - Virtual mode
13:00	Lunch	
13:30 – 16:30	Paper Presentation Session 2 – Tracks 1, 2, and 3	T1 - Main Seminar Hall, T2 - Heritage Hall, and T3 - Virtual mode

PROGRAM SCHEDULE	**Date: 27-04-2024**	**SATURDAY**
Time	**Event**	**Venue**
09:00 – 10:40	Paper Presentation Session 1- Tracks 1, 2, and 3	T1 - Main Seminar Hall, T2, T3 - Virtual mode
10:40- 11:00	High Tea	
11:00 – 13:00	Paper Presentation Session 2- Tracks 1, 2, and 3	T1 - Main Seminar Hall, T2, T3 - Virtual mode
13:00	Lunch	
13:30	Valedictory Function – Welcome Address	Main Seminar Hall
13:40	Technical Talk by Guest of Honour	
14:00	Certificate Presentation	
14:10	Inauguration Ceremony of *CFD Society of REC*	
14:15	Conference Report and Vote of Thanks	
14:25	National Anthem	

SESSION SCHEDULE FOR PAPER PRESENTATIONS

Date	*Time*	*Venue*	*Paper ID*	*Paper Title Authors*
26.04.24	*10.40 AM - 11.00 AM*	*Main seminar hall*	*NCPCAE-2024-13*	*Enhancing Stealth Capabilities through Serpentine Nozzle Technology: A Comprehensive Review* ***Bharath S. and Surendra Bogadi***
	11.00 AM - 11.20 AM		*NCPCAE-2024-14*	*Experimental Study of Shock Formation Over the Blunt Nose Cone with Triangular Aerodisk Using Supersonic Wind Tunnel* ***Reefa L, Lin Susan Sam, Anandh S G, Balaji G, Boopathy G, Santhosh Kumar G, Shabahat Hasnain Qamar, Surendra Bogadi***
	11.20 AM - 11.40 AM		*NCPCAE-2024-23*	*Numerical Investigation of Flow Characteristics in V-Notched Jets* ***B Kathiravan, C Thejeshwarr***
	11.40 AM - 12.00 PM		*NCPCAE-2024-25*	*Comparative Analysis of Drag Reduction In Wing With And Without Feather Winglet* ***Madhivanan, Kishore, Dr Muthusamy***
	12.00 PM - 12.20 PM		*NCPCAE-2024-38*	*Effect of Conical Tabs on Supersonic Jet Characteristics* ***Karen Stephanie I, Anee Prasannal Rajakumari, Vasthadu Vasu Kannah D L, Chandrasekhar P, Surendra Bogadi***
	12.20 PM - 12.40 PM		*NCPCAE-2024-30*	*Effect of Hollow Glass Microsphere on the Density of Ethylene-Propylene Diene Monomer based heat shielding material as a futuristic elastomer for Insulation of Composite Rocket Motor Casing* ***Tejasvi K, and Sundar Singh P***
	12.40 PM - 01.00 PM		*NCPCAE-2024-46*	*Design and Development of Small-Scale Supersonic Wind Tunnel By Using Method Of Characteristics* ***Shree Thulasi R, Harish S, Bhuvan, Prithvi***
	01.00 PM - 01.20 PM		*NCPCAE-2024-31*	*Aerodynamic Performance Evaluation of Grid Fins for Reusable Launch Vehicle* ***Naveen Kumar D, Surendar Kumar V, and Surendra Bogadi***
26.04.24	*10.40 AM - 11.00 AM*	*Heritage Hall*	*NCPCAE-2024-09*	*Practical Experimentation on Dynamic Behaviour of Racing Drone Design* ***Caden Vegas, Siddarth S, Nithiyanantham K K***
	11.00 AM - 11.20 AM		*NCPCAE-2024-29*	*Air-actuated auxiliary sprayer system for Drone-assisted crop spraying* ***Jebi Radshan G, Waahidha S, Nithiyanantham K K***
	11.20 AM - 11.40 AM		*NCPCAE-2024-40*	*Software in Loop Simulation of Autonomous Tandem Wing UAV using Novel PIR Controller* ***Saravanan Elanchezhian, Anitha Ganesan, Jayaram M***

Date	Time	Venue	Paper ID	Paper Title Authors
26.04.24	11.40 AM - 12.00 PM	Heritage Hall	NCPCAE-2024-42	*Development of a Semi-Automated Air Traffic Control System with Electromagnetic Induction for Enhanced Aircraft Safety and Efficiency during CTOL Operations, Night Landings, and Harsh Weather Conditions.* **Vishwas S**
	12.00 PM - 12.20 PM		NCPCAE-2024-50	*Smog Detection and Control Drone By spraying Water mist* **Sriram K S, Vignesh Balaji B, Nithiyanantham K K**
	12.20 PM - 12.40 PM		NCPCAE-2024-53	*Metaheuristic Approach of Utilizing Artificial Intelligence and Machine Learning in Aerospace Applications and Optimizations* **Mayank Roy S, Bharath S**
26.04.24	10.30 AM - 10.50 AM	GOOGLE MEET (https://meet.google.com/nza-qjwz-zue)	NCPCAE-2024-04	*Studies on Mixing Characteristics of Circular Jets in Convergent Nozzle* **Rajamuruqu Natarajan, Rakesh Mulampaka, Shail Ismail Basha, and Solmon Moses Turai**
	10.50 AM - 11.10 AM		NCPCAE-2024-06	*Design and Development of Agricultural Drone* **Manikandan R, Kavya Lakshmi Prasanna B, Lalu J, Karthik T**
	11.10 AM - 11.30 AM		NCPCAE-2024-10	*Conceptual Design of Aerostat-Based Autonomous Docking and Battery Swapping System for Extended Airborne Operation* **Nachiketh Nadig, Prathamesh Minde, Aditya Gautam, Dr.Gurmail Singh Malhi**
	11.30 AM - 11.50 AM		NCPCAE-2024-16	*Conceptual Design of an Adams Pulse Motor Integrated with Arduino Microcontroller for Ease of Performance* **Nachiketh Nadig, Aditya Gautam, Navya Moolrajani, Ajin Branesh Asokan**
	11.50 AM - 12.10 PM		NCPCAE-2024-55	*Numerical Analysis of SCRAMJET Flame Holder* **Thirshaa A, Elayaragavan R, Ashok Kumar K**
	12.10 PM - 12.30 AM		NCPCAE-2024-20	*Analyzing Performance Metrics of Hybrid Rocket Propulsion Systems Employing Dual Fuels through CEA Analysis* **Pandi Siddharth, Snehal More, Pranay Jamjare, Hansika Oswal, Hursh Kshirsagar**
	12.30 PM - 12.50 PM		NCPCAE-2024-21	*CFD Analysis of a Bladeless Propelling Unit for the Drones* **Asmi Raipalli, Prerana Dhawle, Tanaya Joshi, Hansika Oswal, Pandi Siddharth**
	12.50 PM - 01.10 PM		NCPCAE-2024-22	*Review of 3D Printing of Propellant Grains Shapes for Hybrid Rocket Engines* **Nishad Bhavsar, Paarth Saxena, Prasad Sawant, Maitreyee Birajdar, Pandi Siddharth**
	01.10 PM - 01.30 PM		NCPCAE-2024-17	*Modal and Harmonic Analysis of Cantilever Wing to Understanding Flutter Behaviour* **Mansi Gupta, Prabhat Dattakumar Phondekar**

Date	Time	Venue	Paper ID	Paper Title Authors
26.04.24	01.30 PM - 01.50 PM	Heritage Hall	NCPCAE-2024-26	*Numerical investigation of Acrylonitrile Butadiene Styrene protective layer under Compression* **S. M. Satheesh, Farsana Yousef, Shaik Mohamath**
	01.50 PM - 02.10 PM		NCPCAE-2024-57	*Study on Structural Integrity of Turbine Rotor Blade* **Pirithvi Kumaravel, Gautham Velayudhan, Harish Soundararajan**
	02.10 PM - 02.30 PM		NCPCAE-2024-75	*Influence of Ply Orientation on Mode Shapes of Glass Fibre Reinforced Polymer with IoT-enabled real-time monitoring* **Shebaz Ahmed J P, Pooja G, Omkumar Meenakshisundaram, Dhivyadharshini S, Vetrivel M**
	02.30 PM - 02.50 PM		NCPCAE-2024-63	*Morphing of Drag Reduction System Airfoil Actuator using Shape Memory Alloy Printed Using Additive Manufacturing* **M.J Anish and K.Vigneshwaran**
	02.50 PM - 03.10 PM		NCPCAE-2024-71	*Design and Fabrication of Fixed Wing UAV: Vertical Take-Off and Landing (VTOL)* **Kalaimani N, Ramakrishna Madhira, Ravi sankar P, Thamilvarman R**
	03.10 PM - 03.30 PM		NCPCAE-2024-08	*A Review of Deep Learning-based Defect Detection in Aircraft Structures* **Packiyalakshmi S1, Nithiyanatham KK, Suresh Chandra Khandai**
26.04.24	01.30 PM - 01.50 PM	Main seminar hall	NCPCAE-2024-47	*Innovative Design and Development of a Wind Tunnel for Laser Smoke Flow Visualization of Vortices over Nozzles with Varied Geometric Flow Patterns* **Saranya SG, Gopi J Natha, Vishwa, and Dhamodaran K**
	01.50 PM - 02.10 PM		NCPCAE-2024-74	*Advancing Aerospace for Environmental Sustainability* **Vinay Kumar V, Pand Rabhat Dattakumar Phondekar**
	02.10 PM - 02.30 PM		NCPCAE-2024-34	*Numerical Investigation Aerodynamic Performances of over a Sweptback Wing at Subsonic Speed* **Anantharaman S, Balaji G, Boopathy G, and Santhosh Kumar G**
	02.30 PM - 02.50 PM		NCPCAE-2024-87	*Prediction of Vitamin Deficiency In Humans Using Neural Networks* **Abirami Srinivasan, Sindhuja Sridhar, Showmiya Velusamy, Yokesh Selvam, and Sathish Ramajeyam**
	02.50 PM - 03.10 PM		NCPCAE-2024-91	*Potential of Dye-Sensitized Solar Cells for Aircraft Applications* **Vincent Joseph K L, Mary Rosana N T, Jagan K S, Ramya R, and Rufe Adrin Rebecca R**
	03.10 PM - 03.30 PM		NCPCAE-2024-67	*Drone Designs and Constructions that are able to Fly and Walk* **Sureshkumar A, Barani, Madhavan R, Srikanth R, and Jeiya Vidushaa VM**

Date	Time	Venue	Paper ID	Paper Title Authors
26.04.24	03.30 PM - 03.50 PM	Main seminar hall	NCPCAE-2024-78	*Flow behaviour over Flat Plates with Cylindrical Protrusions* **Aswin G S, Maurya Poojary U, Pradesh S, Harish S**
	03.50 PM - 04.10 PM		NCPCAE-2024-44	*Effect of Differential Expansion on Mixing Characteristics of Elliptic Supersonic Jet* **Harish Adishwar A and Surendra Bogadi**
	04.10 PM - 04.20 PM		NCPCAE-2024-35	*Insights into Suborbital Aircraft Design, Aerodynamics, and Propulsion Systems - A comprehensive review* **Avinash moni S, Bharath S, Srinaath KS, and Surendra Bogadi**
26.04.24	01.10 PM - 01.30 PM	GOOGLE MEET (http://meet.google.com/hvx-qbco-bgy)	NCPCAE-2024-64	*Optimization of Cowl Shock Interaction in a RAMJET Engine* **Sureshkumar A, Barani, Madhavan R, Srikanth R, Jeiya Vidushaa VM**
	01.30 PM - 01.50 PM		NCPCAE-2024-81	*Design of Loitering Munition* **Dev Thakkar, Rishi Pawar, Aditya Pandurang Chaudhari, Isaac Yash Gomes, Vijaykumar Gorfad**
	01.50 PM - 02.10 PM		NCPCAE-2024-27	*Design and Analysis of Sounding Rocket* **M Sarthajuddin, and Prabhat Dattakumar Phondekar**
	02.10 PM - 02.30 PM		NCPCAE-2024-45	*Design and Fabrication of Modular Electric Propulsion System* **Skanda Navada P, Riahith Kumar, Karan line, Tharun Surya DJ**
	02.30 PM - 02.50 PM		NCPCAE-2024-49	*Optimising Aircraft Safety: Real-Time Laser Imaging and Python Image Processing for Early Detection and Maintenance of Loose Aircraft Door Plug Bolts* **Pratik Bhowmik, Anuj Kunal Kansara, Raahil Sheikh, Angha Shantaram, Bhade, and Rahul Gupta**
	02.50 PM - 03.10 PM		NCPCAE-2024-18	*Design and Analysis of the ReconBion X-1201 for Military Reconnaissance and Defence Operations* **Raahil Sheikh, Himanshu Dwivedi, Arjun Dabas, Mrudhula Sunder, Netin Kharb**
	03.10 PM - 03.30 PM		NCPCAE-2024-56	*Space-Based Solar Power: Debris Risk & Regulations* **Majal Shiny Subbiah**
	03.30 PM - 03.50 PM		NCPCAE-2024-58	*A Comparative Aerodynamic Analysis using CFD for NACA 4-digit Airfoils used in Unmanned Aerial Vehicles* **Aishwarya Bhinge, Anukruti Dholakia, Shankar Iyer, Dinesh Kumar Bajaj**
	03.50 PM - 04.10 PM		NCPCAE-2024-59	*Finite Element Investigation of Cessna 150 Aircraft Wing* **Moulya, Nikshith U Shettigar, Udaya Ranjan H K, V. Madhanraj**
	04.10 PM - 04.20 PM		NCPCAE-2024-89	*Performance Analysis of Non-Circular Supersonic Jets* **Khaja Patel, Ezhilmaran G, Faisal Ahmed, Veerendra N, Sharath T E**

Date	Time	Venue	Paper ID	Paper Title Authors
27.04.24	04.20 PM - 04.40 PM	Main seminar hall	NCPCAE-2024-19	*A Simulative Approach in Determining the Best Possible Material Selected to Build a Reusable Model Rocket* **Tharun Mario R, Prabhat Dattakumar Phondekar**
	09.00 AM - 09.20 AM		NCPCAE-2024-28	Performance Analysis of A Supersonic Intake **Dhanish Ahamed, Chinni Maadesh, Suresh Chandra Khandai**
	09.20 AM - 09.40 AM		NCPCAE-2024-32	Base Bleed Configuration Optimization for Truncated Aerospike Nozzle **Krishnaraj Ravichandran, and Ilakkiya S**
	09.40 AM - 10.00 AM		NCPCAE-2024-39	Magnetic Field Optimization for Enhanced Ion Thruster Efficiency **Kishore K J, Mythreyan K, and Suresh Chandra Khandai**
	10.00 AM - 10.20 AM		NCPCAE-2024-48	Effect of Bypass Angle on the Aerodynamics Characteristics of Dual Throat Nozzle for military Aircraft Application **Sanjay S, Theebak Thilleeban R, and Surendra Bogadi**
	10.20 AM - 10.40 AM		NCPCAE-2024-51	Investigation of the Effect of Cavity on Shock Train in Isolator in Off-design Condition **Kathiravan B, Prakash R, and Grenville Jonathan**
	10.40 AM - 11.00 AM		NCPCAE-2024-11	Numerical Investigation of Aerodynamics Characteristics of Stepped airfoil of NACA4415 at low Reynolds Number **Sakhshi Nath, Satankshi Kale, Shane A S Giftlin, Balaji G, and Surendra Bogadi**
	11.00 AM - 11.20 AM		NCPCAE-2024-93	Experimental Investigation on The Effect of Solid Slit Tab on Mixing Enrichment of Subsonic Jets **Dhamodaran K, Mohamad Arshath.M, Anusri.S, and Jejin Barnabas Thurai J**
	11.20 AM - 11.40 AM		NCPCAE-2024-94	Mixing Enhancement Investigation on Subsonic Jet Flow Using Triangular Slot Tab **Dhamodaran K, Rasamalla Navya, Sriram S, and Nisha C**
	11.40 AM - 12.00 PM		NCPCAE-2024-12	Supersonic Flow Investigation of Shock Formation over the Ogive Nose Cone Using Aerodisk at different L/D Ratio's **Madhumitha L S, Shawn Varghese S, Balaji G, Boopathy G, Santhosh Kumar G, and Shabahat Hasnain Qamar**
	12.00 PM - 12.20 PM		NCPCAE-2024-43	A Comparative Study on the Impact of Single Ramped and Wedged Profiles on Rocket Exhaust Jet Deflector **Aravind VM , Sarath AS , Vasthadu Vasu Kanah .DL , and Surendra Bogadi**

Date	*Time*	*Venue*	*Paper ID*	*Paper Title Authors*
27.04.24	*09.00 AM - 09.20 AM*	*GOOGLE MEET (http://meet.google.com/suo-sdhw-krm)*	*NCPCAE-2024-65*	Vision Transformer and CNN-based UAV Navigation in an Indoor Environment ***Jayaram Muruqan, Anitha G, and Saravanan Elanchezhian***
	09.20 AM - 09.40 AM		*NCPCAE-2024-69*	Interaction of Gyroscopic Couple, Runway Surface Roughness, Coulomb Friction, and Torsional Free Play on Landing Gear Shimmy Oscillations ***Giridharan V, and Sivakumar S***
	09.40 AM - 10.00 AM		*NCPCAE-2024-70*	Kinetic stabilities of perched landing approach for novel Auxetic landing gear in UAV with the aid of Deep reinforcement learning based IMC PID Control ***Magesh M, Saranya SN, and Raj Jawahar R***
	10.00 AM - 10.20 AM		*NCPCAE-2024-77*	Experimental Study of a Subscale Hybrid Rocket Engine ***Afridi A, Chinmay Kulkarni, Rama Tilekar, Agnel Manoj, and Dinesh Kumar Bajaj***
	10.20 AM - 10.40 AM		*NCPCAE-2024-85*	Design of Door Mechanism for Retractable Landing Gear for UAV ***Amruth M S, Darshan L, Disha I M, Satwik K, and Samuel Vivek Williams***
	10.40 AM - 11.00 AM		*NCPCAE-2024-88*	Trade-off Analysis of Geometric Variations in Cavity-Based Scramjet Combustors ***Vinoth Kumar G, Gourab Koley, Souhardya Banerjee, and Ajin Branesh***
	11.00 AM - 11.20 AM		*NCPCAE-2024-100*	Clearing the Cosmos - Mitigating space debris for Sustainable Space Exploration ***Athulya A, Baraniya P, and Dhamodaran K***
	11.20 AM - 11.40 AM		*NCPCAE-2024-07*	Performance Characterisation of Miniature Turbo Pulse Jet Model ***Kartik Bishnoi, Pinaki Banerjee, Shivani Panwar, Sambhav Verma, and Angom Adison Singh***
	11.40 AM - 12.00 PM		*NCPCAE-2024-82*	Design and Development of Digitalized UAV Propeller Performance Test Rig ***Sundararaj Munisamy, Ramprakash Reddy Ramireddy, Ganesh Pasupuleti, Lakshmi Narayana Reddy Ramireddy, Ramakrishna Madhira***
	12.00 PM - 12.20 PM		*NCPCAE-2024-37*	Noise Reduction in Drone using Toroidal Propeller ***Kayalvizhi S, Vickraman R, and Ganesh Modhilal B***
	12.20 PM - 12.40 PM		*NCPCAE-2024-24*	Numerical study of Jute Vinyl Ester Honeycomb under Compression Testing ***S. M. Satheesh, Basit Nisar Bhat, Mehreena Lone, Mohamed Yousuf***

Date	*Time*	*Venue*	*Paper ID*	*Paper Title Authors*
27.04.24	*09.00 AM - 09.20 AM*	*GOOGLE MEET (http://meet.google.com/fei-sfox-cuv)*	*NCPCAE-2024-101*	Slotted Tabs for Subsonic Jet Flow Control: A Numerical Analysis ***AnuSindhiya K, Vinayagamurthy G, Sathish Kumar K, Arun Prasath R, and Naren Shankar R***
	09.20 AM - 09.40 AM		*NCPCAE-2024-102*	Effect of Velocity Ratios on Coaxial Annular Jets Across Varied Lip Thicknesses ***R. Naren Shankar, S. Irish Angelin, K Sathish Kumar, and Siva G***
	09.40 AM - 10.00 AM		*NCPCAE-2024-60*	Numerical Analysis of Noise Reduction in Supersonic Nozzle ***Tanush G, Silas Nehamiah K, and Venkatesh S***
	10.00 AM - 10.20 AM		*NCPCAE-2024-90*	Design and Development of Solar Power Charging for Pesticide Spraying Drone ***Akshay Naik, Samuel Vivek Willams, and Deeksha R Bhandari***
	10.20 AM - 10.40 AM		*NCPCAE-2024-95*	Application of Friction Stir Welding Process for Joining of 3D Printed Polylactic Acid ***Shiva Kumar B, Singaravel B, Chakradhar B, Divya Ch, and Eswaraiah R***
	10.40 AM - 11.00 AM		*NCPCAE-2024-96*	Design of a Hydraulic Machine and Analysis of Composite Material ***Raj Rohith M, Chakradhar B, Singaravel B, Eswaraiah R, and Divya CH***
	11.00 AM - 11.20 AM		*NCPCAE-2024-97*	Machining of Aerospace Alloy using Textured Cutting Inserts and Solid Lubricants ***Sudheer Reddy M, Divya Ch, Eswaraiah R, Singaravel B and Chakradhar B***
	11.20 AM - 11.40 AM		*NCPCAE-2024-98*	Experimental Analysis of Waveguide Parabolic Antenna Using ANSYS and EDM Process ***Nithish Kumar V, Eswaraiah R, Chakradhar B, Divya Ch, and Singaravel B***
	11.40 AM - 12.00 PM		*NCPCAE-2024-99*	Parametric Analysis Of 3D-Printed Part Using ABS and PLA for Drone Applications ***Atharva Patil, Abhishek Indupally, Lakshmi Deepak J, Niranjan T, and Singaravel B***
	12.00 PM - 12.20 PM		*NCPCAE-2024-79*	Computational Analysis of Chevron-Enhanced Bypass Dual Throat Nozzle for Thrust Vectoring Efficiency ***Karthikeyan P, Shanmugarajan RR and Surendra Bogadi***
	12.20 PM - 12.40 PM		*NCPCAE-2024-72*	Cold Flow Field Analysis of a Ramp-Cavity Duct for Scramjet Applications ***Suresh Chandra Khandai***

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National Conference on Progresses and Challenges
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NCPCAE-2024-04

Studies on Mixing Characteristics of Circular Jets in Convergent Nozzle

Rajamurugu Natarajan[1*], *Rakesh Mulampaka*[2], *Shail Ismail Basha*[3], and *Solmon Moses Turai*[4]

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Abstract

This study aims to investigate the influence of nozzle geometry on potential core length in subsonic jets, focusing on nozzle length and diameter ratio variations. In this research, subsonic jets are examined across a range of nozzle lengths (10, 20, 30, 40, 50, 60, 100 mm, and orifice) for three diameter ratios (2, 3, and 4) at NPRs 1.11, 1.27, 1.52 and 1.89. Potential core length is measured at axial locations X/D 10, 20, 30, and 40. This investigation involves both numerical simulations and experimental data collection to comprehensively assess the effects of nozzle geometry on potential core length. This study identifies clear trends in potential core length based on nozzle length and diameter ratio, it is observed that the potential core length increases from the orifice to 30 mm nozzle length and it does not vary further as the length of the nozzle increases and there is very slight variation when it comes to change in the diameter ratio. Results from the experimental investigation carried out on 10-, 20-, and 30-mm nozzle geometries show that the experimental results and computational results are in good agreement. It was found that there was an increment of 15 %, and 31% in the potential core length for 10, and 20, 30 mm nozzle length of diameter ratio 3 from the orifice.

Keywords- *Nozzle Geometry, Circular Jet, Potential Core Length, Subsonic Jets, Mixing Characteristics*

National Conference on Progresses and Challenges
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NCPCAE-2024-06

Design and Development of Agricultural Drone

Manikandan R[1], Kavya Lakshmi Prasanna B[2], *Lalu J*[3], *Karthik T*[4]

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Abstract

This research examines the intricate interplay between nozzle placement and resulting spray patterns, while considering the influence of propeller-generated air currents. Our aim is to investigate the intricate impact on spray dispersion and angles caused by the sweeping airflow generated by propellers, by systematically altering nozzle positions. Through a comprehensive analysis of spray behavior in various scenarios, our study sheds light on the dynamic interaction between propeller-induced airflow and nozzle placement. The findings of this study not only enhance our understanding of spray dynamics but also provide valuable insights for enhancing industrial and agricultural spray applications that require precise control over spray angles.

Keywords—*Nozzle, Spray pattern, Spray liquid properties, Nozzle placement*

National Conference on Progresses and Challenges
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NCPCAE-2024-07

Performance Characterization of Miniature Turbo Pulse Jet Model

Kartik Bishnoi[1*], *Pinaki Banerjee*[2], *Shivani Panwar*[3], *Sambhav Verma*[4], *and Angom Adison Singh*[5]

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Abstract

The model of a turbo-pulse jet engine took around 40 years to be fabricated and became useful in working models after it was conceptualized. Recent advancements in miniaturization of various parts of an aircraft component have made it easier to be used for several purposes. The unreliable and inefficient usage of such types of engines under the category of pulse detonation engines became a reason for their disappearance from the aerospace sector. The major reasons were found to be regarding detonation initiation and engine noise. The traditional methodologies of usage of spark plugs and solenoids would make it possible to overcome the issue of inefficient detonation initiation. The gun-like, structured nozzle would help the experimental advancements overcome deflagration. Several experimental tests and reviews would be done on the fabricated miniature turbo pulse jet model in terms of various parameters. The curved surface area of the nozzle is considered to be 121.612 cm2 and the volume of the combustion chamber is 9.651cm3. These parameters would revolve around making the component at par with the standards and effectiveness of the best technologies possible. The miniaturization would allow its usage in a variety of small-sized vehicles in the aerospace sector to be operated efficiently.

Keywords- *Pulsejet, Miniaturization, Detonation, Deflagration, Effectiveness, Reliable*

National Conference on Progresses and Challenges
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NCPCAE-2024-08

A Review of Deep Learning-based Defect Detection in Aircraft Structures

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Abstract

Aircraft structural defect detection is critical for ensuring flight safety and preventing failures. With the advancement of Deep learning techniques, the application of digital image analysis in identifying structural defects has gained significant attention. The goal of this review is to present a thorough overview of the use of deep learning techniques for the identification of structural flaws in airplanes. Over time, a wide range of techniques have been developed to identify and assess structural defects in airplanes. The review's conclusions show how deep learning can be used to identify structural flaws and enhance the precision and effectiveness of visual inspection. Further study is necessary to create dependable and strong systems for defect identification as well as to incorporate deep learning models into useful applications. Researchers can utilize this framework as a thorough tool for choosing and assessing pertinent studies for their further research in this field. These findings need to motivate more research into deep learning methodologies, system integration, and defect testing and validation.

Keywords- *Deep learning, Defect Detection, Image Processing.*

National Conference on Progresses and Challenges
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NCPCAE-2024-09

Practical Experimentation on Dynamic Behaviour of Racing Drone Design

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Abstract

The abstract of this project is to achieve the best configuration for straight trajectory and curved trajectory in a race track designed with predetermined dimensions and obstacles. The different configurations in two models with the same lambda distance (A), but different angular distances, were chosen to validate this point. different configuration in the frame SY(symmetric) and ASY(non-symmetric) has been brought into the same single frame(hybrid structure)Two approaches have been made:(i)An analysis of the information collected by a set of speed and time sensors along with GPS is integrated on an indoor racetrack and using a statistical technique to interpret the results.(ii)An analysis of know-how(flight sensations) of a group of racing pilots using a series of technical interviews on the behavior of the drone

Keywords—*Straight trajectory, curved trajectory, symmetric frame, asymmetric frame, hybrid frame*

National Conference on Progresses and Challenges
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NCPCAE-2024-10

Conceptual Design of Aerostat-Based Autonomous Docking and Battery Swapping System for Extended Airborne Operation

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Dr. Gurmail Singh Malhi[4]

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Abstract

In response to the ever-growing global demand for Unmanned Aerial Vehicles, the necessity for efficient battery solutions has become vital. This paper proposes a design and concept of an Autonomous Mid Air Battery Swapping System for Vertical Take-Off and Landing Unmanned Aerial Vehicles. By leveraging the innovative concept of aerostats for battery swapping, the proposed design integrates Aerial Mechatronics, Lighter than Air Systems, and Digital Modelling. This adaptive and effective technology paves the way for the next generation of autonomous Vertical Take-Off and Landing, ensuring a longer flight time and range. Modern-day technologies have empowered Unmanned Aerial Vehicles to operate autonomously and be remotely controlled, expanding their utility across diverse industries.

Keywords— *Autonomous, Battery Swapping, VTOL, Lighter Than Air Systems, Aerial Mechatronics*

National Conference on Progresses and Challenges
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NCPCAE-2024-11

Numerical Investigation of Aerodynamics Characteristics of Stepped airfoil of NACA4415 at low Reynolds Number

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Abstract

This research study represents the numerical analysis of flow development around kline Fogleman NACA4415 airfoil with steps made on lower surface at 50% chord to explore the possibility of enhancing airfoil aerodynamic performance by trapped vortex lift augmentation. To comprehend the potential performance improvements and behavior of the redesigned airfoil relative to the original NACA 4415 design, a thorough analysis of the changes in lift, drag, and other pertinent aerodynamic characteristics will be performed considering variation in Reynolds number, angle of attack (0°-24°) and chord percentages (50%). The Spalart-Allmaras disturbance model is employed to investigate the base airfoil and KF airfoil to explore the aerodynamcis characteristics using ANSYS Fluent commercial software. The simulation is carried out at different AOA varies from 0° to 25° with 5° in positive side and 0° to -25° with 5° in negative side and low Reynolds numer of 3.15 x 105. The results of this study will provide insightful information about the efficacy and practical applications of using the Kline Fogleman modification to improve aerodynamic performance in particular applications. Further, KL airfoil compared with base line arifoil is analysed and ploted.

Keywords— *Stepped Airfoil, CFD, Vortex, Lift force, Drag force, KF Airfoils, NACA4415*

National Conference on Progresses and Challenges
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NCPCAE-2024-12

Supersonic Flow Investigation of Shock Formation Over the Ogive Nose Cone Using Aerodisk at different L/D Ratios

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Abstract

High speeds vehicles generates a bow shock wave ahead of its nose, which is responsible for the high drag called the wave drag and form shock pattern respect to the supersonic speeds.. Efforts to reduce drag on vehicles have focused on altering the flow field ahead of the nose. Among these methods, using spikes and aerodisks with ogive noses has proven highly effective. At Hindustan Institute of Technology and Science tested ogive nose cones with different afterbody shapes (aerospike and aerodisk) at varying lengths and diameters (L/D ratios) in a supersonic wind tunnel. We used Schlieren photography and high-speed cameras to visualize shock waves and measure pressure distribution. This data will help improve nose cone designs for supersonic vehicles like missiles and aircraft.

Keywords— *Nose cone. Blunt, Ogive, Sharp, Supersonic flow, Supersonic tunnel, Schlieren*

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Enhancing Stealth Capabilities through Serpentine Nozzle Technology: A Comprehensive Review

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Abstract

This review article provides an in-depth analysis of serpentine nozzles within the context of stealth aircraft technology, emphasizing their pivotal role in minimizing radar cross section (RCS) and infrared (IR) signatures. It meticulously traces the evolution of stealth technology, highlighting how serpentine nozzles represent a significant advancement in reducing detectability. The document scrutinizes various design methodologies, computational simulations, and the aerodynamic principles underlying these nozzles, presenting a comprehensive overview of their benefits and the complexities involved in integrating them into aircraft systems. It further discusses the aerodynamic penalties associated with serpentine nozzles, such as increased back pressure and potential impacts on engine efficiency. Through a detailed examination of the balance between stealth and performance, the article provides valuable insights into the optimization strategies and future directions for stealth technology development. By covering the technological, aerodynamic, and strategic aspects of serpentine nozzle design and application, this review offers a holistic view of their importance in advancing stealth capabilities in modern combat aircraft, underscoring the ongoing need for innovative solutions to enhance stealth without compromising performance.

Keywords— *Stealth Technology, Serpentine Nozzles, Radar Cross-Section (RCS), Infrared Signatures, Aerodynamic Optimization*

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Experimental Study of Shock Formation over the Blunt Nose Cone with Triangular Aerodisk Using Supersonic Wind Tunnel

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Abstract

A nose cone is the forward projected section used in various high speed vehicles such as rockets, guided missiles and high speed aircraft. High speed vehicles are predominated by the wave shock ahead of the nose cone of the vehicle and leads to forms of high wave drag and shock patterns. Investigated how adding an aerospike with an aerodisk to a blunt nose cone affects aerodynamics at supersonic speeds. Wind tunnel tests with different cone shapes (L/D ratios) at Mach 1.5, 2, and 2.5 visualized shock waves and measured pressure. This data will aid design of high-speed vehicles by balancing heat dissipation and aerodynamic performance.

Keywords— *Aerodisk, Aerospike, Nose cone, Blunt, Ogive, Sharp, Supersonic flow, Supersonic tunnel, Schlieren, Mach number, Schlieren setup*

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Conceptual Design of an Adams Pulse Motor Integrated with Arduino Microcontroller for Ease of Performance

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Abstract

In response to the urgent need to curb carbon emissions and minimize environmental impact, aerospace engineering is increasingly focused on sustainable propulsion and power systems. This paper presents a conceptual design featuring an Adams pulse motor integrated with an Arduino microcontroller, aimed at improving performance to meet aerospace requirements. Based on electromagnetic principles, the motor's stator and rotor configuration generates rotational motion through pulsed electricity, offering simplicity, reliability, and enhanced fuel efficiency ideal for aerospace propulsion systems.

Integration with an Arduino microcontroller enhances control capabilities, allowing real-time adjustment of motor parameters such as speed, torque, and direction. It also facilitates sensor feedback integration for autonomous operation and fault detection, thereby improving system reliability. This study showcases the application of this integrated system in the aerospace industry, aligning with the industry's shift towards sustainable propulsion solutions. The Adams pulse motor integrated with Arduino offers a greener and more efficient option for aircraft propulsion and power systems, with potential applications in flight control surface actuation, landing gear mechanisms, auxiliary power units (APUs), and environmental control systems. As the demand for sustainable propulsion solutions grows, this integrated system emerges as a compelling option for future aircraft propulsion, emphasizing the need for ongoing research and development to fully realize its potential and usher in a new era of eco-friendly aerospace technology.

Keywords— *Adams Pulse Motor, Arduino Microcontroller, Sustainability, Electromagnetism*

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Modal and Harmonic Analysis of Cantilever Wing to Understanding Flutter Behaviour

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Abstract

Flutter is a phenomenon that causes the aircraft's wing to start vibrating or oscillating uncontrollably. It is a highly unstable condition characterized by high frequency and large amplitude. Flutter can lead to catastrophic structural failure and poses a severe risk. The current study presents the flutter analysis of a cantilever wing using modal and harmonic analysis techniques. The Ansys software has been used to conduct the analysis work of the present study. A comprehensive model of the wing is constructed with the structural components and aerodynamic conditions. The static structural analysis is also been studied to evaluate the response under static loads. Modal analysis is used to identify the wing's natural frequency and modal shapes, to gain insights about the flutter mode. The harmonic analysis is carried out to assess the aeroelastic stability of the wing under harmonic conditions. The graphical representations and results are presented to depict frequencies, mode shapes, deformations, and aeroelastic stability of the wing helping in analysis and understanding. The paper emphasizes the importance of flutter analysis creating a deeper understanding of flutter and its role to enhance the safety and reliability of aircraft design. Flutter analysis help in the advancement of preventive measures against structural failure.

Keywords— *flutter, wing analysis, modal analysis, harmonic analysis*

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Design and Analysis of the ReconBion X-1201 for Military Reconnaissance and Defence Operations

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Abstract

The use of UAVs for military purposes started in the 19th century in the Austrian war. These evolved during the World War 2 period when the world started to witness the first powered UAV like the German V-1 flying bomb, a strategic revenge missile. The researchers identified the foremost problem of unmanned vehicles not being capable of flying at high speeds and able to disrupt target visibility and satellite communications. The modern-age weapon/payload adopted for such operations is the Laser Dazzler system, used for disorientation. In military-grade applications, the proposed UAV shall assist in blinding people for tactical purposes and possess various applications like crowd control, anti-piracy operations and sensitive area protection. The system is also proficient in disorienting high-risk suspects and disabling sensors of illegal drones along with the main payload. The UAV is designed with high range and medium endurance, tailored for high-speed operations. The structural frame design is crafted by evaluating its usage and application of the allotted mission profile. Apart from the structural components, the UAV also incorporates a large battery storage resulting in an increased flight time for long paths and reducing the chances of mid-mission failure during prolonged flight missions. The researchers have designed a vehicle with set parameters that can be scaled and utilised in modern-day warfare.

Keywords— *Laser dazzler system, UAV, Military operations.*

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A Simulative Approach in Determining the Best Possible Material Selected to Build a Reusable Model Rocket

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Abstract

"Apogee" is one of the most vital concepts that needs to be comprehended in the field of Aerospace Engineering which refers to the highest point in flight where the velocity of the rocket becomes zero. It is important to send payloads to outer space to reach the destination orbit. The present study tries to focus on identifying and selecting the best possible material that can be used as the structural component to construct this prototype to achieve maximum apogee. "Open-Rocket" software has been employed for the given work to construct a modular single-stage rocket and further proceeded to select the suitable material to optimize the factors affecting apogee. The database of the software accounts for the mass properties and structural integrity of the materials used and gives out important values such as Maximum Velocity, Maximum Acceleration, Centre of Pressure, Centre of Gravity, etc. Reiterating the process with multiple materials and tabulating data we can identify the best possible material which can be used for construction. These results give an understanding of the mass factors of the materials that can produce a rise in new composites with a cost-effective and efficient nature thus paving the way to advancements in Mechanical Engineering and Aerospace Engineering.

Keywords— *Apogee, Open-rocket, model rockets, density, mass, Centre of pressure, Centre of gravity, stability, length, diameter, maximum velocity, maximum acceleration.*

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Analyzing Performance Metrics of Hybrid Rocket Propulsion Systems Employing Dual Fuels through CEA Analysis

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Abstract

Rocket Propulsion is the branch of physics that deals with sending rockets into space. These rockets help us to carry payloads like satellites and space probes. But how do rockets go to space? They produce thrust which is a force generated by chemical reactions which occur between a fuel and an oxidizer in the combustion chamber. The mixture of fuel and oxidizer is called a propellant. In today's times, there are many types of propellants in the field of materials to use in rockets. New technologies are emerging in the field of rocket propulsion; one of them being Hybrid rocket propulsion technology which uses solid fuel & liquid or gaseous oxidizer as propellant, because of its benefits—such as safety features, environmental friendliness, start-restart thrust throttling & low cost—hybrid propulsion is the main area of study for current research. With developments in propulsion technology there has been a breakthrough in the field of propellants, such as the addition of burn rate modifiers, 3D printing of propellants & Dual fuel propellants. These advancements have helped in improving the overall performance characteristics of rocket propulsion technology. Our study focuses on combined research on hybrid rocket propulsion with dual fuel technology. Dual fuels use 2 fuels and a single oxidizer as a propellant. When the execution of experimental evaluations proves to be impractical or cost-inefficient, particularly in the case of emerging and novel propellants like 3D printed ABS, the utilization of NASA's CEA software serves as a viable alternative, as it allows accurate estimation of rocket performance parameters like Specific impulse (Isp) & Characteristic velocity (C*). The present aim of the study is to compare the performance parameters of 2-dual fuel propellants using Chemical Equilibrium with Applications (CEA); taking into consideration different Oxidizer-to-fuel ratios having Hydrogen Peroxide (H2O2) as an Oxidizer with 1st combination of Acrylonitrile Butadiene Styrene (ABS) + Paraffin and the 2nd combination Polylactic Acid (PLA) + Paraffin.

Keywords— *ABS, NASA-CEA, Specific Impulse, PLA*

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CFD Analysis of a Bladeless Propelling Unit for the Drones

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Abstract

Conventionally, unmanned aerial vehicles (UAVs) and autonomous aerial vehicles (AAVs) utilize bladed propellers to produce lift, altitude, and thrust for propulsion. Yet, these blades are susceptible to abrasion when they make contact with external surfaces, resulting in diminished operational efficiency over time. Our ongoing investigation introduces a pioneering approach by integrating bladeless propeller technology, drawing inspiration from Dyson's Bladeless Fan Theory. This study seeks to address the wear-related shortcomings of conventional propeller systems by exploring the feasibility and performance characteristics of bladeless propulsion solutions for UAVs and AAVs. By leveraging advancements in bladeless design principles, our research endeavors to enhance the durability and efficiency of aerial propulsion systems, thereby advancing the capabilities and reliability of unmanned aerial platforms in diverse operational environments [1].

The present study is used to determine how these bladeless propellers function when the size, shape, and taper angles of the 2D airfoil sections are altered. In order to examine how taper angles affected thrust generation and efficiency, initial testing examined taper angles between eight and fourteen degrees. We intend to optimize the design of bladeless propellers for UAVs and AAVs by analyzing these variations. Our goal is to improve the propellers' longevity and performance while requiring less maintenance.

We anticipate that this research will develop unmanned aerial vehicle propulsion systems, opening the door to more robust and effective airborne platforms for a range of uses.

Keywords **-** *Bladeless drones, Bladeless technology, Dyson fan theory, Coanda effect, Air*

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Review of 3D Printing of Propellant Grains Shapes for Hybrid Rocket Engines

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Abstract

Rocket Propulsion specifically Liquid rocket engines (LREs) and solid rocket motors (SRMs) are the two main competitors for rocket propulsion systems, and each has a set of drawbacks. While sturdy, SRMs are less adaptive in dynamic flying situations because they lack the dexterity of throttle control and the ability to make sudden stops and starts. On the other hand, while LREs provide exact control over thrust, they are more difficult to produce, present storage logistics issues, and pose more safety risks because liquid propellants are flammable. Our study focuses on the Hybrid Rocket Propulsion System (HRPS), which combines liquid and solid components for fuel and oxidizer, appears as a workable workaround for these drawbacks. This combination offers several benefits over traditional propulsion techniques. Specifically, liquid component flow is regulated by hybrid rockets, which allows operators more control over thrust levels and easy throttling mechanisms. Furthermore, the intrinsic structure of hybrid systems facilitates the smooth initiation and deactivation of propulsion, augmenting operational adaptability across mission stages. The present study attempts to clarify the complexities of hybrid rocket propulsion by conducting a detailed analysis of propellant grains, including their evolutionary history, underlying theories, intricate design details, performance evaluations, and latest developments. The research tries to put the technological developments that have molded modern hybrid rocket systems into context by exploring the historical development of hybrid propellants. Furthermore, it clarifies the fundamental ideas guiding the hybrid propellants' combustion dynamics, illuminating their distinct features and subtle operating details. By examining design factors, the study outlines the engineering problems and fixes related to the application of hybrid propulsion technology. Furthermore, performance parameters are examined to clarify the effectiveness and efficiency of hybrid rocket systems in different mission scenarios. Lastly, the study summarizes new developments in hybrid propellant technology, providing information about current projects and potential directions for future rocket propulsion research.

Keywords *– 3D Printing, Hybrid Rocket Engines, Gain Geometry, Shapes.*

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Numerical Investigation of Flow Characteristics in V-Notched Jets

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Abstract

A numerical investigation was carried out to analyze the flow characteristics of V-notched jets with varying notch angles. Two specific V-notch configurations, attributed angles of 30° and 45°, were compared with a standard plain jet. Simulations, conducted using the CFX software with the STT Turbulence model, explored subsonic and underexpanded conditions at Mach 0.6 and NPR 5. The study focused on centerline Mach decay and radial Mach profiles, emphasizing distinctions among the different jet types. The results revealed that V-notched jets displayed an elongated centerline Mach number compared to the plain nozzle, resulting in an extended potential core. The introduction of notches on the plain nozzle altered the throat geometry, leading to changes in mass flow rate relative to the plain nozzle. The presence of notches caused the jet flow to disperse, enhancing mixing perpendicular to the centerline compared to the plain nozzle. The V-notch's half-width elongated in both planes. Under expanded conditions, shock cells bifurcated in one direction and quizzed in the other, facilitating effective mixing of the jets. This enhanced mixing holds potential benefits for combustion processes.

Keywords **-** *Centerline & Radial decay, .Potenial core, Jet half-width, Mixing, Underexpansion, Shock cells.*

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Numerical Study of Jute Vinyl Ester Honeycomb under Compression Testing

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Abstract

Sandwich panels have become a flexible option for a wide range of industries, with their strong, lightweight constructions and superior mechanical and thermal qualities. These panels offer durability, strength, and insulation since they are made of a core material sandwiched between two face sheets. Phenolic resin-impregnated aramid paper, often known as Nomex honeycomb, is a commonly utilised core material in aircraft applications, where fire safety and weight reduction are crucial. In Ansys, numerical analyses are performed on the honeycomb Nomex core structure under compression loading. A micromechanical level, highly detailed finite element model has been constructed using the literature's flatwise compressive testing experimental data. Solid elements have been used in the model. The model predictions agreed well with the experimental observations, making it easier to explain the Nomex honeycombs' compressive responses.

Keywords- *Nomex, Compression, Numerical analysis, Mechanical response*

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Comparative Analysis of Drag Reduction in Wing With And Without Feather Winglet

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Abstract

This work describes the aerodynamic characteristics of aircraft wing with and without feather winglet. The airfoil used to construct wing model is NACA 22112 series airfoil. Analysis of feather winglets are implemented for reducing induced drag in low speed aircraft is carried out based on experimental analysis of fabricated wing model at 60 degree inclined winglet for Re =1.66×105 , 2.08×105 , 2.50×105 at different angle of attack about 0,2,4,6,8,10,12 degree in low speed wind tunnel. This work concludes with the estimation of the pressure distribution using pressure taps fixed equal portions in wing model. Calculated C_L and C_D values to compare this result with analytical solutions and also compare feather winglet computational and experimental results with single winglet results. On anticipating the results from the computational analysis, a comparative study is carried between experimentation and CFD for wing and feather winglet.

Keywords- *Low speed wind tunnel, NACA 22112, CFD, winglet, Reynold's number.*

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Numerical investigation of Acrylonitrile Butadiene Styrene Protective Layer under Compression

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Abstract

Millions of motions occur in the knee and elbow over a lifetime, and they frequently experience forces many times greater than their own body weight. The purpose of a knee pad is to offer stability, softness, and resistance against impacts when the knees might be strained or struck. A commercially available protective knee pad has two distinct layers – Acrylonitrile Butadiene Styrene (ABS) protective layer to bear the compression and impact load, and foam layer to provide cushion effect to knees. A numerical study is performed on the load carrying member (Acrylonitrile Butadiene Styrene) subjected to compressive load in order to understand and analyze the behavior of knee pads. A finite element model has been created using the detailed dimensions of Acrylonitrile Butadiene Styrene protective layer detached from the commercially available knee pad, meshed with three dimensional solid elements and simulations are performed. The distribution of stresses and displacement are analyzed. Understanding the structural integrity, deformation properties, and functionality of knee pads be gained from this study.

Keywords- *Knee pad, Acrylonitrile Butadiene Styrene, Compression test, Numerical analysis, Mechanical response*

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Design and Analysis of Sounding Rocket

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Abstract

A sounding rocket is an unmanned rocket designed to carry instruments into the upper atmosphere for scientific measurements. This paper presents a comprehensive approach to the design and analysis of sounding rockets utilizing advanced software tools such as OpenRocket, CATIA and ANSYS. The integration of these software platforms facilitates a systematic and efficient workflow, allowing for precise modelling, simulation, and optimization of rocket components and systems. The initial design phase involves conceptualization and parametric modelling in CATIA enabling rapid iteration and evaluation of different configurations. Similarly, OpenRocket is employed for aerodynamic analysis, stability assessment, performance prediction, providing valuable insights into flight characteristics and trajectory simulations. ANSYS is utilized for structural analysis, thermal management, and vibration studies, ensuring the reliability and safety of the rocket under various operating conditions. In a present study and validation against experimental data, the effectiveness and accuracy of the proposed methodology are demonstrated.

Keywords- *Sounding Rocket,CATIA,ANSYS,OpenRocket, Vibration*

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Performance Analysis of a Supersonic Intake

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Abstract

The design of better performance intake system requires minimum total pressure loss, uniformity of the flow in the system, maximum mass flow ratio. The Project focuses on the design of inlet spike for the intake system for the better pressure recovery across the intake. The Inlet design Mach number of 1.8 with the pressure of 20503 Pa and should give Mach number 0.3 at the exit of the intake system. The inlet spike is designed with the flow deflection angle of 12-degrees, throat height of 13 mm and cowl defection of 10 degrees. The computational Analysis on the intake system is performed for the two different cross sections of the inlet spike. First is the rectangular type cross section at the exit of the inlet spike. Second is the conical type inlet. The CFD analysis carried out for these two geometrical features of the inlet spike helps to determine the most suitable design could be implemented based on the maximum pressure recovery at the exit of the inlet. The shape of the cross section also has the serious effects on shock boundary layer interaction. The expected results from the computational analysis are inlet Total pressure recovery, mass flow ratio, static pressure distribution, velocity at intake exit.

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Keywords- *Intake system, supersonic duct, pressure recovery, mass flow ratio, computational analysis*

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Air-actuated Auxiliary Sprayer system for Drone-assisted Crop Spraying

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Abstract

The integration of an auxiliary sprayer unit with agricultural drones fosters a paradigm shift towards meticulous crop management through targeted agrochemical application. This research investigates the development of an air-actuated auxiliary sprayer system for agricultural drones, augmenting their efficacy in pest control, fertilization, and other precision spraying tasks. The proposed system eschews dependence on external power sources during spraying. It incorporates a readily refillable container using a household hand air pump. The container is pressurized with liquid and compressed air, connected to a servo-actuated nozzle on the drone's undercarriage, where the spraying activity is controlled by varying servo actuation intensity. Using a conventional compressed air system, the container is pressurized to around 70 psi, enabling atomization and propulsion of liquid through the nozzle as a fine mist or spray. A Schrader valve on the container allows for easy refilling and pressurizing with compressed gas using common household equipment. The development process involves designing, fabricating, and testing a prototype of the compressed air sprayer system, integrated into a hexacopter frame made of 6081 aluminum bars. The drone is powered by EMAX 935KV High Torque Brushless Motors, a 4S Lithium Polymer Battery, and controlled using a 12 CH Receiver and 10 CH Transmitter, all operating at 2.4 GHz frequency. This auxiliary sprayer system holds great potential for the agricultural sector, promoting eco-friendly and sustainable farming practices by optimizing chemical usage, reducing environmental impact, and minimizing farmer exposure to chemicals.

Keywords- *Auxiliary sprayer unit , Air-actuated sprayer system, Servo-actuated nozzle, Performance assessments, Ecological farming practices.*

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Aerodynamic Performance Evaluation of Grid Fins for Reusable Launch Vehicle

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Abstract

Grid fins, crucial for the lifting control surfaces in rockets and missiles, outperform traditional planar fins in efficiency. This study introduces an innovative design for octagonal grid fins, tailored through specific geometric considerations, and investigates their aerodynamic performance computationally. The analysis was conducted across Mach numbers 0.4, 0.5, 0.6, and 0.7, considering 14 angles of attack ranging from -5 to 60 degrees for both webbed and octagonal grid fins in isolation. The findings highlight enhanced aerodynamic efficiency with octagonal grid fins exhibiting superior stall characteristics compared to webbed grid fins, delaying stall by 5 degrees (14.29% improvement). Additionally, at increasing angles of attack, the octagonal grid fins demonstrated a lift coefficient marginally higher (5.64%) than that of the webbed grid fins. Through computational simulations, the study effectively predicts the flow dynamics around the grid fins in subsonic conditions, confirming their augmented control efficacy and aerodynamic attributes. Thus, octagonal grid fins are identified as more advantageous for use as drag brakes, optimizing stabilization and deceleration of reusable launch vehicles during Earth re-entry.

KeyWords: *Octagonal grid fins, Aerodynamic efficiency, Computational fluid dynamics (CFD), Angle of attack (AOA), Reusable launch vehicles*

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Base Bleed Configuration Optimization for Truncated Aerospike Nozzle

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Abstract

Contemporary rocket engines, exemplified by SpaceX Raptor, employ full flow staged combustion cycle engines to enhance the performance of existing satellite launch vehicles (SLVs). Despite this, innovative nozzle designs like the Aerospike (Plug) have yet to find application on launch platforms. The Aerospike nozzle stands out for its superior performance achieved through the manipulation of the outer jet boundary, distinguishing it from the traditional bell nozzle. Specifically designed for NPR 20, efforts are made to optimize the aerospike nozzle's performance by adjusting key design parameters, with a focus on cold flow conditions. The optimization process involves creating a model of the aerospike nozzle for specific parameters, followed by adjustments for both a truncated model and a base bleed model. The flow domain is meticulously crafted using CATIA v5 and ANSYS Workbench, while Computational Fluid Dynamics (CFD) software, FLUENT, is employed to scrutinize flow behavior. Notably, the base bleed model yields a noteworthy 12% increase in thrust compared to a full spike. Furthermore, truncation results in a significant 30% reduction in nozzle weight, thereby enhancing the nozzle's thrust-to-weight ratio. This research underscores the potential advancements in rocket propulsion technology and the efficiency of satellite launch vehicles achievable through the strategic optimization of aerospike nozzle designs.

Keywords- *Aerospike Nozzle,Base bleed,Altitude Compensation,Sound Pressure Level,Annular nozzle*

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Effect of Hollow Glass Microsphere on the density of Ethylene-Propylene Diene Monomer based heat shielding material as a futuristic elastomer for Insulation of Composite Rocket Motor Casing

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Abstract

The present study aims at developing a new rocket motor insulator containing lightweight filler. Efforts have been made to quantify the effect of lightweight filler loading on the thermal and mechanical behaviours of EPDM based thermal insulation. iM16K Hollow glass microsphere(HGMs) are a kind of hollow particulate material, made of SiO2, B2O3, CaO, MgO etc. thin walled, filled with gases like CO2 and N2 (traces CO, O2 and H2O), having a density of 0.46 g/cc, with an average diameter 15 to 16 µm is used in the material formulation for our research. However, the open literature on EPDM based Elastomeric Heat Shielding Material (EHSM) combined with this density reducer is little. This addresses a comparison, among nitrile rubber (NBR) and ethylene-propylene-diene monomer rubber (EPDM) elastomeric heat shielding materials. Currently, these are utilized for the insulation of composite rocket motor casings to prevent catastrophic breakdown if combustion gases from propellant reaches the motor case. From this work, Low Density EPDM emerged as an alternative to EPDM because of their easier processability and compatibility with composite propellant. With the appropriate reinforcement and concentration in the rubber, they could replace EPDM in applications such as rocket motors filled with composite propellant. The thermal properties, mechanical and erosion properties and heat of ablation of the produced materials were studied and reported.

Keywords- *Composite Rocket Motor casings, Elastomeric Heat Shielding Materials, EPDM, Composite Propellant*

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Numerical Investigation Aerodynamic Performances of over a Sweptback Wing at Subsonic Speed

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Abstract

This study delves into exploring the intricate relationship between vortices and aerodynamic parameters with three different configurations of semi-span swept-back wing of aircraft utilizing computational fluid dynamics (CFD) analysis. The primary aim is to delve into how vortices impact the aerodynamic performance of the wing across various airflow conditions. The approach involves creating a 3D computational model with different semi-span swept-back wing of NACA0015 airfoil and also varying he sweep angle of wing such as 10° to 40° with step of 10° and simulating airflow using CFD techniques. The investigation utilized Standard k-ε turbulence models to analyze vortex generation and behavior near wing surfaces and their impact on aerodynamic parameters. The study aims to understand how vortex interaction affects key aerodynamic metrics such as lift-to-drag ratio and flow separation through systematic analysis. By varying flow velocities from 15 m/s to 25 m/s and angle of attack from 0° to 25°, the study comprehensively assesses the influence of vortices on wing performance. The wing design was created using Solid Works, with FLUENT serving as the solver and ANSYS used for meshing and domain construction. The research provides insights into the complex aerodynamic phenomena associated with swept-back wing configurations and their interactions with vortices. Such comprehension is pivotal for refining wing designs to bolster aircraft performance, stability, and efficiency across diverse flight regimes.

Keywords- *Sweptback wing, NACA0015, Lift, Drag, Aerodynamics Performance*

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Insights into Suborbital Aircraft Design, Aerodynamics, and Propulsion Systems - A comprehensive review

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Abstract

This review paper provides a detailed and thorough analysis of the multifaceted design process associated with suborbital aircraft, taking into account various critical factors such as thrust requirements, aerodynamic heating considerations, and strategies for drag reduction. By delving into the complexities of suborbital aircraft design, this article sheds light on the numerous challenges encountered in developing such vehicles. Furthermore, it explores a range of propulsion system options aimed at achieving hypersonic travel to Earth's sub- orbit, considering their respective advantages and limitations. Moreover, this paper offers valuable insights into innovative design approaches for suborbital vehicles, encompassing a wide array of topics including aerodynamics, propulsion mechanisms, space mechanics, and technological advancements. Through a comprehensive examination of these aspects, the article presents novel and enhanced design concepts that can potentially enhance the performance and capabilities of suborbital aircraft. Additionally, this article underscores the significance of suborbital flight in advancing space research endeavors and paving the way for the burgeoning field of space tourism. By providing a holistic perspective on the importance and applications of suborbital flight, this review paper contributes to the ongoing discourse surrounding the exploration and utilization of space for both scientific and commercial purposes. Keywords: Suborbital aircraft design, Hypersonic propulsion systems, Aerodynamics, Space tourism, Innovative design concepts

Keywords- *Suborbital aircraft design, Hypersonic propulsion systems, Aerodynamics, Space tourism, Innovative design concepts*

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Noise Reduction in Drone Using Toroidal Propeller

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Abstract

An unmanned aerial vehicle (UAV), commonly known as drone, is an aircraft without any human pilot, crew, or passengers on board. UAVs were originally developed through the twentieth century for military missions, and by the twenty-first century, they had become essential assets to most militaries. As control technologies improved, their applications also expanded to many non-military applications. The main component which makes the drone to fly is propeller. Usually, the drone propeller produces greater noise which is sensitive to human's ears. Our project mainly aims to design and analyse a toroidal shaped propeller by distributing the vortices that are being generated by the propeller across the whole shape of it, instead of just at the tip. This results in increasing thrust, power draw and reducing noise without adding weight. The toroidal propellers introduce a game-changing design. The twisted and looped propellers, aiming to minimize the vortex effect, ensure high and low-pressure air remain apart, thus reducing noise and improving efficiency. A model of toroidal shaped propeller is designed using CAD FUSION 360, meshing and flow analysis using ANSYS 19.2. To evaluate the performance produced by the toroidal shaped propeller we compared the results with other conventional propellers by 3D printing the models. This project focus on reducing noise and improving efficiency of the propeller.

Keywords- *drone, aircraft, propeller, greater noise, distributing noise, toroidal shaped, twisted and looped propellers, CAD FUSION 360, ANSYS19.2, 3D Printing*

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Effect of Conical Tabs on Supersonic Jet Characteristics

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Abstract

The study investigates the influence of conical tabs on the characteristics of a Mach 1.8 supersonic jet using Computational Fluid Dynamics (CFD) simulations. Among the various tab geometries tested, the triangular geometry emerges as the most effective for jet control. Furthermore, even minor variations introduced in the triangular tab design can have a significant impact on the aerodynamic mixing characteristics of the jets. Conical tabs, small protrusions placed at the nozzle exit, generate counter-rotating vortices. These vortices are expected to disrupt the jet's core flow, facilitating faster mixing with the surrounding air, potentially leading to reduced noise emission. The performed analysis involves controlling a Mach 1.8 supersonic jet with two identical conical tabs at diametrically opposite locations, positioned at the nozzle exit. The research employs a comparative approach, evaluating the jet behaviour with and without conical tabs under various pressure conditions, including 3.5 bar, 6 bar, and 7 bar. Pressure and Mach number contours are obtained to analyse flow characteristics. The diminished cross-sectional area at the nozzle exit will lead to a reduction in the Mach number that would be achieved by the nozzle in the absence of tabs, assuming a clean exit. The results indicate that the convergent-divergent nozzle with conical tabs exhibited a reduction in the length of the supersonic jet core, suggesting enhanced mixing.

Keywords- *Supersonic Jet, Conical Tabs, Computational Fluid Dynamics (CFD), Aerodynamic Mixing,*

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Magnetic Field Optimization for Enhanced Ion Thruster Efficiency

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Abstract

This study aims to refine ion thruster efficiency by optimizing the plasma sheath within the reaction chamber. In ion thrusters, magnets are strategically manipulated to shape and control plasma dynamics essential for propulsion. By ionizing gases like argon, positively charged ions are generated and utilized for thrust through an electric field. Magnets establish a magnetic field in the reaction chamber, governing the trajectories of charged particles and facilitating precise control over plasma behaviour to enhance thruster efficiency. The proposed methodology involves modifying magnetic field configurations with magnets of sizes 5mm, 10mm, and 15mm, equally spaced, to induce converging magnetic field lines. Through theoretical modeling and computational simulations using tools like COMSOL Multiphysics, the study aims to trace charged particles and simulate magnetic flux dynamics, thereby unlocking pathways for heightened thruster performance. Operational parameters include a reliance on a 220-volt power supply with a power rating of 990 watts, a mass flow rate of argon propellant at 4.4 milligrams per second under 1 bar pressure. Anticipated outcomes aim for a thrust exceeding 0.058 Newton, a velocity of 13.2 kilometres per second, and a specific impulse (ISP) of 13181 seconds. This multidisciplinary approach endeavours to propel the frontiers of space exploration and technology.

Keywords- *ion thrusters, magnetic field, plasma sheath, charged particles, COMSOL Multiphysics, reaction chamber*

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Software in Loop Simulation of Autonomous Tandem Wing UAV using Novel PIR Controller

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Abstract

Guidance and control design for autonomous flight configurations is one of the crucial processes in the field of aviation. This paper is about software in loop simulation of tandem wing UAV for autonomous flight using novel PIR controller. A modified PID control algorithm is proposed as PIR controller and the same is implemented in MATLAB-Simulink to control the aircraft in the X-Plane environment. The proposed PIR controller is compared with the conventional PID. Software in loop simulation and testing of the proposed PIR controller are performed using MATLAB and X-Plane. The tandem wing aircraft of consideration is designed using Plane Maker and the same is loaded in the X-Plane environment. The control loop is closed by sending the aircraft state parameters from X-Plane to MATLAB. A Universal Datagram Protocol (UDP) communication is established for exchange of data between MATLAB and X-Plane. A methodology for implementing autonomous flight using waypoint navigation is proposed and the same is tested in the simulation environment. The simulation is performed with and without atmospheric disturbance to test the performance of the designed controller and the control scheme.

Keywords- *Nozzle Geometry, Circular Jet, Potential Core Length, Subsonic Jets, Mixing Characteristics*

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Development of a Semi-Automated Air Traffic Control System with Electromagnetic Induction for Enhanced Aircraft Safety and Efficiency during CTOL Operations, Night Landings, and Harsh Weather Conditions.

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Abstract

This project aims to develop a semi-automated Air Traffic Control (ATC) system that leverages electromagnetic induction and incorporates the use of metallic coating on aircraft, EMF beds at specific locations, and a magnetic beam emitter for enhanced safety and efficiency. The project aims to boost aircraft safety during Controlled Takeoff and Landing (CTOL) operations, particularly in adverse weather and night conditions. This is achieved by applying a metallic coating to the aircraft, making it magnetically receptive for precise landings. Strategically positioned EMF beds along the runway interact with the aircraft's coating, ensuring stable alignment upon landing. Magnetic beam emitters guide night landings by directing aircraft at specific angles. Additionally, an advanced device prioritizes aircraft emitting designated frequencies, optimizing takeoff sequencing. By integrating these technologies into the semi-automated ATC system, the project aims to enhance safety, operational efficiency, and performance during CTOL operations, night landings, and adverse weather conditions. The system's successful implementation involves design, testing, validation, protocol development, and integration with existing ATC infrastructure.

Keywords- *Air Traffic Control (ATC), Electromagnetic Induction, Metallic Coating, EMF Beds, Magnetic Beam Emitter, Controlled Takeoff and Landing (CTOL), Adverse Weather Conditions, Night Landings, Aircraft Safety, Operational Efficiency*

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A Comparative Study on the Impact of Single Ramped and Wedged Profiles on Rocket Exhaust Jet Deflector

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Abstract

In this study, the aerodynamic effects of rocket exhaust jets on two distinct deflector profiles: Single Ramped and Wedged was explored. Utilizing advanced Computational Fluid Dynamics (CFD) simulations through ANSYS software, our research evaluates the flow characteristics and behaviour as high-pressure supersonic jets interact with these deflector designs. By designing a conical nozzle with an exit Mach number of 2 to generate the exhaust flow, the nozzle design was validated through simulations to ensure accurate representation of the exhaust characteristics. Subsequent simulations extend to the jet deflectors, focusing on analyzing and comparing the pressure and mach number distributions along the surfaces of the deflectors at various positions. This paper presents a detailed comparison between the single ramped and wedged profiles, highlighting their respective influences on flow redirection and overall efficiency in mitigating adverse effects on the rocket and its launch infrastructure. This research offers critical insights for aerospace engineering, particularly in enhancing the safety and performance of rocket launch systems by mitigating adverse aerodynamic effects.

Keywords- *deflectors, wedge, ramp, flow dynamics, mach number, pressure, surface distribution*

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NCPCAE-2024-44

Effect of Differential Expansion on Mixing Characteristics of Elliptic Supersonic Jet

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Abstract

This study addresses the critical need for enhancing the mixing of supersonic jet flows to mitigate noise levels in industrial applications such as injector and exhaust nozzles of jet engines. The investigation focuses on the effect of expansion ramps placed at the exit of an elliptic supersonic nozzle. These ramps, situated on diagonally opposing corners, extend inward along the diverging section of the nozzle, generating pressure gradients that induce additional swirl at the nozzle exit. This swirl enhances the entrainment of ambient fluid, particularly at supersonic speeds, where Prandtl-Meyer waves further amplify pressure gradients. Through experimental analysis, this research evaluates the impact of these expansion ramps on mixing level enhancements and noise reductions of a supersonic Mach 1.8 jet. The findings of this study demonstrate significant promise for reducing flow-generated noise levels in industrial settings, thus highlighting the potential of the proposed design for practical applications.

Keywords- *Supersonic jet flow, Expansion ramps, Mixing enhancement, Noise reduction*

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Design and Fabrication of Modular Electric Propulsion System

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Abstract

The rapid evolution of Unmanned Aerial Vehicles (UAVs) has led to an increasing demand for efficient and versatile electric propulsion systems. This paper presents the design and fabrication of a modular electric propulsion system tailored specifically for UAVs. The proposed system integrates cutting-edge technologies to enhance performance, reliability, and adaptability. The modular design allows for easy customization and scalability, accommodating various UAV sizes and mission requirements. The propulsion system incorporates advanced electric motors, power electronics, and energy storage solutions to optimize efficiency and extend flight endurance. Additionally, the system integrates intelligent control algorithms for precise maneuvering and autonomous flight capabilities.

Keywords- *Unmanned Aerial Vehicles, mission requirements, maneuvering*

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Design and Development of Small Scale Supersonic Wind Tunnel using Method of Chracteristics (MOC)

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Abstract

Supersonic wind tunnels are important tool to study and investigate the supersonic external and internal flows such as intake, nozzle, supersonic combustion, etc. A simple conical convergent divergent (CD) nozzle can generate a supersonic but getting a uniform and shock free in the test section is difficult using simple conical CD nozzle. The objective of this present study is to develop a python program to design and verify shock free supersonic convergent divergent nozzle using method of characteristics. The contour of convergent section of the nozzle was designed with requirement of linear variation in Mach number from intel to the throat. A circular arc throat of radius 150 mm was used to connect the convergent section to the straightening section of the supersonic. The contour for straightening section was generated using method of characteristics to generate shock free supersonic. The designed nozzle has throat and test section area of 32 X 10 mm2 and 42.5 X 10 mm2 respectively with test section Mach number of 1.69. Numerical analysis was carried in ANSYS CFX. The flow properties along the center line of the nozzle from numerical analysis was compared to the experimental wall pressure measurement to verify shock free supersonic flow. Further schlieren flow visualization available at Rajalakshmi engineering college was used to compare and verify the shock free supersonic flow.

Keywords- *Supersonic wind tunnel, Method of characteristics, Numerical analysis, ANSYS CFX, Supersonic flow, Center line Mach number.*

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Innovative Design and Development of a Wind Tunnel for Laser Smoke Flow Visualization of Vortices over Nozzles with Varied Geometric Flow Patterns

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Abstract

This paper presents the design and development of a novel wind tunnel system equipped with laser smoke flow visualization techniques to study vortices over nozzles featuring diverse geometric flow patterns, such as square, pentagon, and triangle configurations. The experimental setup aims to investigate the influence of different flow patterns on vortex formation and behaviour. The integration of advanced visualization tools provides valuable insights into the aerodynamic characteristics and flow dynamics, contributing to a deeper understanding of nozzle performance in varied geometric scenarios. The findings from this study can inform future advancements in nozzle design for enhanced aerodynamic efficiency across multiple applications, from industrial processes to aerospace engineering.

Keywords- *wind tunnel, geometric flow, flow dynamics*

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Effect of Bypass Angle on the Aerodynamics Characteristics of Dual Throat Nozzle for military Aircraft Application

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Abstract

Dual throat nozzles play a crucial role in enhancing the aerodynamic performance of military aircraft, particularly in terms of thrust vectoring and maneuverability. This research delves into the aerodynamic characteristics of bypass dual throat nozzles, focusing on three distinct bypass angles of 90º, 105º, 110º, 115º, 120º, 125º and 130º. The study encompasses a comprehensive analysis across multiple inlet pressure conditions ranging from 3.6 to 5 bar (absolute). Through computational simulations and experimental validations, the investigation uncovers substantial variations in the shock wave structure, mixing enhancement, and notably, the thrust vectoring behaviour associated with different bypass angles. The results offer valuable insights into the intricate interplay between bypass angle configurations and aerodynamic performance, crucial for optimizing nozzle designs for military aircraft applications. The findings of this study not only deepen our understanding of dual throat nozzle dynamics but also underscore the significance of tailored nozzle configurations in advancing the maneuverability and performance capabilities of next-generation military aircraft.

Keywords- *Dual throat nozzles, Bypass angle, Aerodynamic performance, Shock wave structure, Thrust vectoring*

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Optimizing Aircraft Safety: Real-Time Laser Imaging and Python Image Processing for Early Detection and Maintenance of Loose Aircraft Door Plug Bolts

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Abstract

Aircraft safety remains paramount in the aviation industry due to the potential for catastrophic failures and associated high costs from structural damage. However, current inspection and maintenance methods often lack effectiveness, cost-efficiency, and cause disruption. Recent attention has focused on loose door-plugs following the January 5, 2024 Boeing 737-Max-9 Emergency Door blowout event, revealing vulnerabilities in maintenance practices. This paper proposes an innovative approach using real-time laser imaging and Python image processing to detect loose or misplaced Door Plug Bolts, aiming to prevent mid-air door plug blowouts and reduce maintenance costs and time. By proactively addressing structural issues, it aims to extend aircraft operational lifespan and ensure reliability. The paper details the design and implementation of a Laser Imaging system and Python image processing algorithm, integrating data from OEM blueprints with real-time laser images for analysis after each landing. Additionally, it presents a proactive failure identification method and decision support system for optimal repair actions. The results showcase the efficacy of this approach in detecting and locating loose Door Plugs, contributing significantly to aircraft safety and MRO practices with a practical and innovative solution.

Keywords- *Aircraft safety, Aircraft Door Plug, Laser Imaging System*

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Smog Detection and Control Drone By spraying Water mist

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Abstract

In this evolving world, one of the most concerning problems is the increase in pollution, that too by means of air. Smog is one type of pollution, which reduces the visibility and also contains hazardous particles. Smog is a mixture of both smoke and fog. This smog can arise in areas where the air is denser, like industrial areas and agricultural lands. The Air Quality index is very poor in those areas. As per the recent study, the cities like Delhi, Kolkata and Mumbai are having poor AQI, which is way more than a healthy person should have. So, the reduction of smog is very much needed. Generally, the smog is cleared by spraying water via huge tankers, which obviously results in more water wastage. So, we aimed to reduce this disadvantage by fitting a sprayer setup in a drone which consumes less space, does not want human power compared to traditional ways with autonomous flying conditions and various other features. This study introduces an innovative approach to combat the urban smog through the deployment of a specialized drone designed for atmospheric smog reduction. The drone, equipped with a water mist spraying system, seeks to mitigate smog pollution by spraying water or liquid substance and neutralizing particulate smoke matter. Here, we are using MQ-2 sensor to sense the smog, which is widely used in monitoring the air quality index and gas leakage. This paper highlights the possible technologies used to minimize human efforts in smog control using quadcopters.

Keywords- *Smog, water mist, MQ-2 Sensor, quadcopters.*

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Investigation of the Effect of Cavity on the Shock Train in Isolator in Off-Design Condition

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Abstract

The Isolator is typically a constant area duct placed between the inlet and combustor of a scramjet engine to prevent the backpressure from instabilities in the combustor from reaching the inlet and causing an engine unstart from taking place. The isolator also works as a duct containing the shock train, an aerodynamic device consisting of a series of shocks to increase the static pressure and reduce the velocity of the air going to the combustor from the inlet. This is done to conserve the flame in the supersonic combustion ramjet engine's combustor. This paper analyses the effects of placing a wall cavity angled at 15 degrees upstream on the static pressure and velocity of the flow field. Simulations were done using ANSYS steady state analysis [2] for the inlet pressure at 5BAR and the Mach number readings, static pressure readings and wall static pressure readings were taken and plotted against the length of the designed isolator. Then the cavity was dimensionally modified in two ways as two separate test cases, one with double height (DH) and one with double length (DL). Analysis of the static pressure plot showed the highest spike in static pressure occurs in double height (DH) cavity case. But at the same time, the Mach number plot showed the highest flow velocities also occurred when the cavity was doubled in height.. However, the Mach number along the centerline was maximum when the cavity was doubled in length (DL). The shock trains occurring for each of the four cases are elucidated upon using the density gradient analysis.

Keywords- Isolator, Mach number, double height, ANSYS

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Metaheuristic Approach of Utilizing Artificial Intelligence and Machine Learning in Aerospace Applications and Optimizations

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Abstract

Artificial Intelligence (AI) and Machine Learning (ML) represent groundbreaking fields set to revolutionize global systems. With the advent of the Internet in the early 1990s, the ability to transmit vast amounts of data worldwide has facilitated the utilization and advancement of AI tools developed since the 1950s. AI has made significant strides across various sectors like communications, finance, retail, automation, and robotics, including Aerospace Engineering. In Aerospace, AI&ML applications span system optimization, predictive maintenance, automation, aircraft design, and simulation. This paper aims to explore the application of metaheuristic AI&ML concepts in Aerospace, covering topics such as telemetry data analysis of artificial satellites, anomaly detection, turbojet engine control, system monitoring, air traffic optimization, and UAV guidance. It also discusses the future trajectory of AI, particularly the impact of Artificial Narrow Intelligence (ANI) and the anticipated advancements with Artificial General Intelligence (AGI), which could lead to fully autonomous commercial aircraft and aerial vehicles.

Keywords- *Artificial Intelligence, Machine Learning, System Maintenance, System Optimization, Telemetry Data Analysis, Engine Control, Artificial Narrow Intelligence, Artificial General Intelligence*

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Numerical Analysis of Scramjet Flame Holder

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Abstract

In the realm of scramjet propulsion, where the quest for optimal combustion within mere fractions of a second reigns paramount, the challenge is nothing short of formidable. To meet this challenge head-on, a meticulous investigation into flame holder dynamics becomes imperative. This project, at its forefront, harnesses the power of Computational Fluid Dynamics (CFD) to dissect and scrutinize a myriad of strut geometries, with a laser focus on bolstering turbulence, harnessing shock waves, and sustaining a robust recirculation region to foster efficient combustion. Delving deeper, this study meticulously compares and contrasts two flame holder cavities outfitted with wedge struts, meticulously evaluating their prowess in air mixing capabilities. Through rigorous experimentation and analysis, the superior design is isolated and propelled into the spotlight for an in-depth examination across a spectrum of geometrical variations. It is within this crucible of analysis that the optimal flame holder cavity emerges, honed to precision through the crucible of iterative refinement. At its core, the objectives of this project orbit around the dual imperatives of fluid mixing efficiency and the establishment of a resilient recirculation region, both critical components in elevating combustion efficacy within the confines of brief residence times characteristic of scramjet combustors. By pushing the boundaries of knowledge and engineering ingenuity, this research endeavours to carve new pathways toward unlocking the full potential of scramjet propulsion systems, propelling us ever closer to the realms of high-speed travel and exploration.

Keywords-*scramjet propulsion, computational fluid dynamics, turbulence*

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Space-Based Solar Power: Debris Risk & Regulations

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Abstract

With increasing global energy demands, it's the ideal time for the space sector across the world to work towards Space-Based Solar Power (SBSP) initiatives. Many space-based solar power initiatives are in the near future pipeline of most space-faring nations. Solar Power Satellites (SPSs) are the primary means of space-based solar power. These solar power satellites are comparatively huge in terms of size and weight compared to other satellites. In order to attain space-based solar power, a constellation of solar power satellites will be launched into geostationary orbit to harness the solar energy and beam it back to the ground stations on Earth via wireless power transmission. Though orbital debris risk in geostationary orbit (GEO) is not as high as in lower earth orbits (LEO), it's still at a hazardous level. Hence, the launch of a constellation of huge solar power satellites into geostationary orbit will have an even more severe negative impact on the existing orbital traffic conditions. Debates concerning the laws and ethics of the commercialization of space aside, in this paper I intend to highlight a new outlook on how to regulate space-based solar power activities in terms of orbital traffic management. To solely focus on the same, I also assume that humanity is currently technologically advanced enough to proceed with space-based solar power initiatives.

Keywords- *Space-based solar power (SBSP), Solar power satellite (SPS), orbital debris, geostationary orbit (GEO), lower earth orbits (LEO)*

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Study on Structural Integrity of Turbine Rotor Blade

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Abstract

The turbine rotor blade plays an important role in gas turbine engines. In this analysis, the turbine blades are cleverly arranged on a disc rather than being treated separately, creating a single unit known as a Blisk (Bladed Disc). Every modern aircraft is powered by a gas turbine. To create the necessary thrust for the aircraft's propulsion, the turbine blisk in a gas turbine expands the hot gases that exit the combustion chamber. The most important component of a gas turbine engine is hence the turbine blisk. The power needed to run the compressor and other accessories is also developed by it. This method makes it possible to thoroughly analyze the assembly's overall structural behavior of the model. This paper describes the static structural analysis in the turbine rotor blade using ANSYS Workbench Three different materials Stainless Steel 316, Nimonic 90, and Inconel 718 are used to determine the structural integrity properties. Boundary conditions have been applied to conduct stress analysis. To optimize turbine blade performance in challenging operating situations, the study's goal is to provide subtle insights into material selection by comparing diverse materials.

Keywords- *Blisk, Turbine, FEA, Materials.*

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A comparative aerodynamic analysis using CFD for NACA 4-digit airfoils used in Unmanned Aerial Vehicles

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Abstract

Aerodynamic performance is crucial in various engineering applications and is used to improve wind turbine efficiency, build more efficient propeller blades, optimize aircraft wing designs, and improve race car performance. This study presents a comparative analysis of three commonly used NACA airfoil profiles: NACA 0008, NACA 0012, and NACA 2412. Given that each type of airfoil has a unique geometric shape that produces variations in lift and drag, the airfoil chosen has a direct effect on the aircraft's flying performance. Computational Fluid Dynamics (CFD) simulations are employed to investigate the aerodynamic characteristics of these airfoils, including lift, drag, and stall behavior. The study begins with a comprehensive overview of each airfoil's geometric properties and their respective aerodynamic implications. Subsequently, numerical simulations are conducted using a validated CFD model to analyze the flow behavior over the airfoils at various angles of attack. The lift-to-drag ratio, lift coefficient, and stall characteristics are compared to evaluate the performance of each airfoil under different operating conditions.This research helps in choosing the optimal airfoil profile for UAV at a wider range of angles of attack where NACA 0012 has shown the balance of lift and drag generation compared to the NACA 0008 and NACA 2412.

Keywords- *NACA, coefficient of lift, coefficient of drag.*

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Finite Element Investigation of Cessna 150 Aircraft Wing

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Abstract

Aircraft wings are subjected to various loads due to the difference in pressure between the upper and lower surfaces of the wings or the weight of the wing structure. This load causes deformation and stress. The stress and strain of different wing materials are used to compare the appropriate combination of materials that can be used for aircraft wings. The finite element method (FEM) is used to model the wing structure, including detailed geometric features and material properties. Structural analysis is carried out to estimate important parameters such as stress distribution, deformation and safety factor. The researchers considered typical flight behaviour such as take-off, take-off, landing and dynamic loading to provide a comprehensive assessment of wing behaviour. The results of this study provide valuable insight into the structural behaviour of the Cessna 150 aircraft wing and serve as a basis for future optimization efforts and structural improvements. Using advanced numerical methods, this study contributes to ongoing efforts to ensure the continued airworthiness and safety of the Cessna 150 fleet, thereby supporting the continued operation of this aircraft in the general aviation industry.

Keywords- *finite element method, Structural analysis, wing structure*

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Numerical Analysis of Noise Reduction In Supersonic Nozzle

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Abstract

Nozzle is a device in which pressure energy is converted in to kinetic energy and this supersonic nozzle can be used for different application includes aerospace, materials science, automobile many more. Present study involves study of flow parameter of a supersonic nozzle for different exhaust geometry. Length of the supersonic nozzle is assumed to be a constant but the exhaust section is changing with the reference of active noise control technique like chevrons . Flow parameter is observed for different designs of exhaust geometries like curve, curve-spike etc.., for two different pressure's of 13.24 atm and 15.24 atm. Subsequently, the geometries had been carried out with CATIA V5 software. The study has been demonstrated that a validated CFD methodology can be used to accurately predict the performance and in this work, the commercial Ansys CFX solver is used to evaluate the velocity and mach number contour which mainly explains noise production precisely. Compressible-Transient state analysis are conducted in three-dimensional domain discretized with ICEM CFD. The objective is to optimize the nozzle's exhaust configuration to achieve significant noise reduction while maintaining aerodynamic efficiency and performance standards, ensuring compliance with environmental regulations and enhancing operational safety.

Keywords- *Supersonic nozzle, Exhaust geometry, Active noise control, CFD, domain discretized, Compressible – Transient state analysis, efficiency.*

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Morphing of Drag Reduction System Airfoil Actuator using Shape Memory Alloy Printed using Additive Manufacturing

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Abstract

In F1 cars weight reduction and time is one of the important factors in the race. In the rear wing of the car there are two main parts spoiler and flap. These two controls the air flow in the rear part. They are responsible for the amount of drag, drag coefficient and downforce of the car. During cornering down force is an important factor which gives an additional grip to the wheels to the road surface this makes the car more stable. Spoiler is a fixed part and the flap is a movable part, during the DRS zone the flap will be opened this reduces the down force and increases the speed upto 15 km/h to 20 km/h. These DRS zone are strait roads of the track. The opening and closing of flap is carried out by a hydraulic actuator. This hydraulic actuator occupies more space and the hydraulic lines must be taken care. This work deals with the replacement of hydraulic actuator into a shape memory alloy (NITINOL). Smart is a material where it can able to return to its original position when a heat or a electricity is applied, for this project nitinol is selected as a smart material.

Keywords- *Smart material, Carbon fiber, Fusion deposition modeling, Ansys.*

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Optimization of Cowl Shock Interaction in a RAMJET Engine

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Abstract

This study aims to enhance the thrust of Ramjet engines by incorporating supersonic inlet cowls, organized into primary and secondary pathways within the inlet. The primary goal is to increase the pressure ahead of the combustion chamber, thus improving combustion efficiency and overall thrust output. Additionally, the research introduces two additional components, the deflector and a slit, to further optimize performance. Computational Fluid Dynamics (CFD) analysis is employed with an inlet Mach number of 3, exploring three different configurations with deflector angles set at 20°, 25°, and 30°, each paired with corresponding slit lengths of 20mm, 25mm, and 30mm respectively. Results indicate that the most substantial thrust enhancement and performance improvement occur at a deflector angle of 25°, particularly when combined with the secondary cowl inlet.

Keywords- *Ramjet, Cowl shockwave, Pressure, Boundary layer, Computational Fluid Dynamics (CFD).*

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Vision transformer and CNN-based UAV navigation in an indoor environment

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Abstract

Autonomous indoor navigation of micro aerial vehicles (MAV) possesses many challenges, like limited GPS precision in an indoor environment and high power-consuming sensors. Since scene classification is the first step in MAV indoor navigation, deep learning techniques are used to make the process faster and more efficient because they can learn from trained examples without explicit programming. The Convolutional Neural Network (CNN) and Vision Transformer (ViT) are renowned algorithms in deep learning, particularly recognized for their image processing and object detection capabilities. CNN and ViT prove to be fast and efficient algorithms for indoor scene classification, learning crucial features from trained models. In a comparative study between CNN and ViT for indoor scene classification, ViT-based models consistently outperform CNN-based models in similar epochs, attributed to ViT's inherent self-attention mechanism effectively capturing long-range data dependencies. However, ViT requires a lengthier training period and higher computational resources compared to CNN. The MIT Indoor Scene Recognition dataset is utilized, achieving a maximum accuracy of 96% for corridors, 92% for staircases, and an overall model accuracy of 98% with a maximum speed of 16 frames per second. Following the analysis, a control scheme is developed using a single camera atop a baseline model, enabling a quadcopter to autonomously locate and navigate through corridors and staircases in various ROS gazebo simulation environments.

Keywords- *Micro aerial vehicle (MAV), Convolution neural network (CNN), Vision Transformers (ViT), Residual network (Res Net), Robot.*

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Drone Designs and Constructions that are able to Fly and Walk

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Abstract

The project seeks to elevate drone functionalities through the incorporation of a walking robot attachment. Positioned beneath the drone, this walking robot augments its capabilities by enabling ground-based movement post-landing. Operating independently, the robot executes a range of maneuvers including forward and backward motion, as well as anti-clockwise rotation. This autonomous operation enhances versatility and efficiency across diverse scenarios. By seamlessly transitioning from aerial to terrestrial locomotion, the integrated system expands the drone's utility beyond traditional flight capabilities. This innovation promises to revolutionize applications in fields such as surveillance, search and rescue, and logistics, where access to both aerial and ground environments is paramount. The symbiotic relationship between the drone and walking robot amplifies their collective potential, unlocking new possibilities for unmanned systems in complex and dynamic environments. This integration represents a significant step towards realizing a more adaptable and robust generation of drones capable of addressing a myriad of challenges with unprecedented agility and effectiveness.

Keywords- *Ramjet, Cowl shockwave, Pressure, Boundary layer, Computational Fluid Dynamics (CFD).*

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Interaction of Gyroscopic Couple, Runway Surface Roughness, Coulomb Friction, and Torsional Free Play On Landing Gear Shimmy Oscillations

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Abstract

Aircraft stability during ground maneuvers depends on landing gear dynamics, especially shimmy. Shimmy is a self-excited oscillation that is governed by the dynamic behavior of the tire and strut. So, the study of landing gear dynamics is a significant part of the design process of aircraft. Suitable mathematical models are required to make a reliable prediction of the shimmy oscillation and stability of the system. This work deals with the development of a non-linear mathematical model for representing nose wheel landing gear to study the effect of real-world scenarios such as gyroscopic couple, runway irregularities, sprung mass, friction and torsional free play on shimmy oscillation. The numerical model has five degrees of freedom (DOF), which includes tire lateral deformation, strut torsional angle, strut lateral bending angle, and vertical displacement of sprung mass and unsprung mass. Simulation results reveal interesting features of shimmy oscillations and their dependence on various factors. The proposed model has proved to be an effective computational tool for enhancing the performance, safety, and durability of the landing gear systems.

Keywords- *nonlinear parameters, friction, free play, runway irregularities, shimmy.*

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Kinetic Stabilities of Perched Landing Approach for Novel Auxetic Landing Gear in UAV with the Aid of Deep Reinforcement Larning based IMC PID Control

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Abstract

Drone stability and control is a difficult task to solve. The drone requires a more responsive and reliable control that will allow it to directly adapt to its uncharted surroundings. The current generation of flying perching robots is not particularly flexible or strong under a load. Inspired by the structure and movements of birds' feet, this research presents a deformable UAV perching mechanism with strong adaptability and high loading capacity, which can alleviate these issues. A novel hexachiral auxetic landing gear was designed and implemented. This research proposes a reinforcement learning framework for regulating oscillations caused by landing gear impact on an unlevel surface. Using Reinforcement learning and the DLMC, the PID gain values are optimized. Q-learning of Reinforcement Learning is used to train the drone in a simulated setting. The prepared model is sent to use-world testing. The MATLAB program was used to model the IMC-PID control mechanism. After that, we compare the IMC-PID control strategy to the DLMC IMC-PID strategy.

Key Words: Quadcopter, Q-Learning, IMC-PID, Model Based Control, Reinforcement Learning

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Design and Fabrication of Fixed Wing UAV: Vertical Take-Off and Landing (VTOL)

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Abstract

The objective of this work is to explain the steps involved in the design and manufacturing of a fixed wing vertical take-off and landing UAV with IC engine. Drones are commonly used in military surveillance, search and rescue missions, aerial combat strike and etc. This drone is designed for medium altitude Surveillance operations. Size of the wing and Airfoil are selected based on the coefficient of lift required are also demonstrated. Static stability is fulfilled by calculating the center of gravity location with respect to neutral point. Engine is selected based on the power requirements and energy consumptions for take- off, climbing, cruise and landing conditions. The final aircraft was designed with an empty weight and maximum take-off weight of 10 kg and 13kg respectively while the wingspan, cruising speed and maximum speed were 2.5m, 20.1 m/s and 26.1 m/s respectively with a total take-off distance of 1km. The design of the drone is done by the use of CAD software Fusion 360 and CATIA, and for the drag and lift analysis it is then tested in the ANSYS software. The results and the limitations of the drone manufacturing are also discussed along with the future scope of the project.

Keywords *- Fixed-wing VTOL UAV, IC engine, medium altitude surveillance, CAD design*

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Cold Flow Field Analysis of a Ramp-Cavity Duct for Scramjet Applications

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Abstract

The scramjet engine is a high-speed propulsive system for hypersonic air-breathing vehicles. This paper presents the computationally obtained flow characteristics of scramjet combustor with a ramp immediately followed by a rectangular cavity.The ramp-cavity is located on the bottom wall of the combustor. Three secondary jet injection pressures, namely 600 kPa, 800 kPa, and 1000 kPa were studied in present investigation. The inlet Mach number of the duct was considered as 2.0, and the secondary jet was injected at Mach 1.5 from the ramp-cavity. The duct consisted of a C-D nozzle, an isolator, and a diverging area combustor. A grid independence analysis was carried out to choose optimal mesh resolution. The flow field is modelled using Reynolds Average Navier-Stokes equations, and the k- SST 2-equation turbulence model. The flow field properties were analyzed by identifying ramp leading edge shock, expansion fans, Mach reflection, bow shock, and compression waves. Additional shock waves are from the tip of the ramp and edge of cavity. Also quantitative wall static pressure distributions over the top and bottom walls of combustor are presented.

Keywords: *Ramp-Cavity; Ramp injection; Scramjet; Supersonic combustion*

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Advancing Aerospace for Environmental Sustainability

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Abstract

Aerospace fuel plays a central role in the pursuit of environmental sustainability within the aviation industry. As concerns over climate change and air quality intensify, there is mounting pressure to reduce greenhouse gas emissions and mitigate the environmental impact of air travel. One critical focus is reducing emissions, particularly carbon dioxide (CO2) and nitrogen oxides (NOx), which contribute to climate change and air quality degradation. Traditional aviation fuels, primarily derived from fossil sources, emit significant amounts of carbon dioxide and other pollutants during combustion, contributing to global warming and air pollution.The present study explores the new aircraft design space created by revolutionary aerospace technologies, such as electrified and hydrogen propulsion, to maximize the environmental and operational benefits through the use of physics-based and reduced order modeling, probabilistic design methods, and systems engineering principles.This paper provides a comprehensive review of the current state of aerospace fuel and its impact on environmental sustainability. Additionally, research into synthetic fuels produced via sustainable processes, such as power-to-liquid technologies, holds further promise for decarbonizing aviation. These sustainable alternatives have the potential to significantly lower CO2 emissions compared to conventional jet fuels, while also mitigating other harmful pollutants. Efforts to develop alternative fuels, such as hydrogen, aim to minimize reliance on fossil fuels and decrease greenhouse gas emissions.

Keywords- *Hydrogen, Combustion, Propulsion, Fuel-ratio, Enthalpy, Emission, Sustainability.*

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Influence of Ply Orientation on Mode Shapes of Glass Fibre Reinforced Polymer With IOT Enabled Real-Time Monitoring

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Abstract

Advanced lightweight materials like composites have become favoured alternatives due to their exceptional properties and relatively more cost-effective manufacturing and maintenance processes. However, ensuring the integrity of these composite structures is crucial due to the significant investments involved. This paper investigates the dynamic behavior of GFRP laminates with different ply orientations (unidirectional, cross-ply, and quasi-iso) using ANSYS software. Analytical, experimental, and numerical methods are employed to assess flexural modulus, natural frequency, and mode shapes. The study proposes an innovative IoT-based approach for monitoring the health of impacted composite structures, integrating vibration-based condition monitoring with accelerometer, Arduino Uno board, and Wi-Fi module for Cloud transmission. Real-time wireless monitoring, coupled with an alert system, enhances malfunction detection efficiency. Experimental validation using GFRP samples achieves an 80% accuracy rate, highlighting the economic and operational benefits of vibration-based condition monitoring, applicable across aviation, aerospace, wind energy, and infrastructure sectors, specific GFRP orientations analysed.

Keywords- *Glass fibre reinforced polymer, ply orientations, natural frequency, Modal analysis, Internet of Things.*

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Experimental Study of a Subscale Hybrid Rocket Engine

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Abstract

Performing experimental tests on a subscale model is essential for acquiring foundational insights and comprehending the implications of combustion efficiency within practical propulsion technologies. The study seeks to maximize the benefits of optimization and stop/restart capabilities of a hybrid rocket motor engine. Utilizing NASA CEA software, the theoretical study offers insights into combustion efficiency and contributes to building a solid foundation for the experimental phase. Actual fire trials are used in experimental testing, and data is carefully gathered and examined to comprehend the complex details of combustion efficiency. The word "regression rate" is emphasized in particular in the article as a critical performance metric, and its relationship to the propellant grain geometry is examined. The inquiry also dives into the influence of additives on combustion efficiency, comparing propellant grains made with and without additions that sheds light on how additives affect the combustion efficiency. The objective is to clarify how these additives affect combustion in order to provide important information for the development of hybrid rocket engines in the future. Understanding combustion efficiency in subscale hybrid rocket engines is made easier by the results of both theoretical and experimental methods. This research offers a useful advice on how to maximize combustion efficiency, which could have ramifications for the development of rocket engine technology.

Keywords- *Hybrid Propulsion systems, NASA CEA, Combustion efficiency, Regression rate.*

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Flow behaviour over Flat Plates with Cylindrical Protrusions

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Abstract

The effect of cylindrical protrusion on a supersonic flow field over a flat plate and its influence on the surface forces is studied at two different freestream Mach numbers (M∞). The investigation is conducted across two distinct freestream Mach numbers (M∞), providing a comprehensive understanding of how these protrusions interact with the flow field. Various cylindrical protrusions, each with different height ratios (h/D), are examined at a fixed distance from the leading edge (XLE) of the flat plate. To conduct this analysis, advanced numerical simulations are employed, utilizing the ANSYS CFX solver along with structured mesh generated from ICEM-CFD. The findings of the study unveil significant insights into the behavior of the flow field and surface forces. Specifically, it is observed that certain height ratios of cylindrical protrusions lead to notable increases (ranging from 7% to 10%) in the forces exerted on the plate. Moreover, as the Mach number increases, there is a distinct pattern of increased pressure drop behind the cylinder, coupled with a decrease in separation length (ranging from 9% to 15%). These discoveries shed light on the intricate relationship between cylindrical protrusions, supersonic flow, and surface forces, offering valuable insights for the design and optimization of structures in supersonic environments.

Keywords- *Passive Flow control, Computational Fluid Dynamic*

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Computational Analysis of Chevron-Enhanced Bypass Dual Throat Nozzle for Thrust Vectoring Efficiency

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Abstract

This study explores the efficacy of Fluidic Thrust Vectoring (FTV) techniques for directing engine thrust to manage the attitude or angular velocity of an aerospace vehicle, focusing specifically on the application of Fluidic Throat Skewing. A novel approach is employed utilizing a Bypass Dual Throat Nozzle (BDTN) augmented with chevrons to achieve FTV under varying expansion scenarios, assessed through computational analysis. The study limits bypass mass injection to 3% of the total. Computational Fluid Dynamics (CFD) simulations were executed using ANSYS CFX, employing Navier-Stokes equations to evaluate thrust vectoring performance. The findings reveal that the BDTN configuration achieves a maximum vectoring angle of 16.66 degrees and a thrust coefficient of 0.839 at a Nozzle Pressure Ratio (NPR) of 8, marking a 7% reduction in thrust coefficient compared to a conventional Dual Throat Nozzle (DTN). Notably, the Chevron-integrated BDTN model (BDTN-C) demonstrated a superior vectoring angle of 21.47 degrees—a 28.99% improvement—with a thrust coefficient of 0.631 (a 24.79% reduction) at a lower NPR of 7. The study concludes that the chevron-augmented BDTN model significantly enhances vectoring angles at reduced NPR levels compared to the standard BDTN setup, offering insights into the potential for optimizing thrust vectoring mechanisms in aerospace applications.

Keywords- *Fluidic Thrust Vectoring, Computational Fluid Dynamics, Chevron-Enhanced Bypass Dual Throat Nozzle, Nozzle Pressure Ratio*

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Design of Loitering Munition

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Abstract

This paper aims to present the design of a Loitering Munition capable of passive surveillance and self-sufficient actions. The objective of Loitering Munitions is to navigate, detect, and execute precision strikes autonomously. They are typically equipped with a warhead and a launching that can be used to attack ground targets, ships, or other UAVs even beyond line of sight. The major factors considered while designing are lightweight and compact size, convoluted aerodynamics, a precise guidance system, an efficient propulsion system, ingenious payload-carrying capabilities, and a suitable launch mechanism considering the mission requirements. The method involves configuration selection as per the mission requirements, sizing and the detailed design of the particular components and validating the performance through computational analysis.

Keywords- *Loitering Munitions, UAVs, Loiter, Autonomous, Warhead.*

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Design And Development of Digitalized UAV Propeller Performance Test Rig

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Abstract

Unmanned aerial vehicles, or UAVs, are becoming increasingly common in a variety of applications, from aerial photography to surveillance. The effectiveness of the propellers on a UAV is one important component of its performance. This study introduces a digitalized test rig designed to evaluate UAV propeller performance under controlled conditions. The rig incorporates advanced sensors and data acquisition systems to accurately measure thrust, RPM, and power consumption. Utilizing contemporary digitalization techniques, the rig offers real-time monitoring and analysis capabilities, providing valuable insights into propeller performance across different operating conditions. Key components include a stand, adjustable mounting system, high-precision load cells, Watt meter, and data acquisition unit. Emphasizing portability and ease of setup, the design enables testing in both field and laboratory environments. Overall, the developed test rig offers a comprehensive solution for assessing UAV propeller performance, contributing to the advancement of unmanned aerial systems technology. Its digitalization, portability, and intuitive interface make it an invaluable resource for UAV propulsion system research, development, and optimization.

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Design of Door Mechanism for Retractable Landing Gear for UAV

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Abstract

The primary goal of this project was to create a specialized sliding door mechanism tailored for the landing gear door of a Medium Altitude Long Endurance (MALE) Unmanned Aerial Vehicle (UAV). This mechanism needed to function seamlessly during critical phases of flight, particularly during take-off and landing, when the UAV operates at varying speeds. To ensure the effectiveness of the design, a comprehensive examination was undertaken. This assessment encompassed three key areas: structural integrity, to guarantee the door mechanism could withstand the stresses and forces experienced during flight operations; aerodynamic efficiency, to optimize the airflow around the door to minimize drag and enhance overall performance; and operational reliability, to ensure the mechanism could be deployed consistently and without fail, even in challenging conditions. By thoroughly analyzing these aspects, the project aimed to deliver a sliding door system that not only met the functional requirements of the UAV but also contributed to its overall efficiency and safety.

Keywords- *UAV, Integrity, Efficiency*

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Prediction of Vitamin Deficiency in Humans using Neural Networks

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Abstract

A vital component of our meals is vitamins. Vitamins must therefore be a part of our meals. If the recommended number of vitamins is not taken, a deficiency will occur. A branch of computer science and artificial intelligence (AI) called "machine learning" uses data and algorithms to mimic human learning and gradually improve the accuracy of the model. Convolutional neural networks (CNNs) are a particularly good deep learning method for problems involving image recognition and processing. Its layers consist of convolutional, pooling, and fully linked layers, among others. Blood samples are not needed in the present method to determine vitamin deficiency. However, the system requires images of the user's lips, tongue, eyes, and nails.It can be used for various applications such as aerospace, medialect...

Keywords- *Machine Learning, Artificial Intelligence, Convolutional Neura Networks, Deep Learning, Blood Samples, Pooling.*

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Trade-off Analysis of Geometric Variations in Cavity-Based Scramjet Combustors

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Abstract

A major focus of current research has been the study of scramjet combustor cavity designs as primary flame holding devices and combustion stabilizers. A computational fluid dynamics analysis of scramjet combustors is performed to discuss limitations of extending the aft-cavity axial length. Considering the variation in chamber length, an extensive parametric study has been conducted with scramjet combustors equipped with the wall cavity. The axial length of the combustor has been primarily limited by the combustor's weight and exit Mach number and are considered limiting factors. In a series of iterations, the ratio between length, weight and exit Mach number was compared to obtain the optimum expandable length magnitude. The research was carried out computationally with the aid of combustion and turbulence modelling. An eddy dissipation combustion model and the K-epsilon turbulence model are used to predict turbulent reactive flow behavior along with characteristic fluid properties in three dimensions. A three-wall cavity-based scramjet combustor is used as reference for geometry modelling and analysis. Additionally, this paper reviews potential material choices for manufacturing scramjet combustors.

Keywords- *scramjet combustor, cavity-based, k-epsilon, turbulence, eddy dissipation concept, composite materials.*

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Performance Analysis of Non-Circular Supersonic Jets

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Abstract

Numerical simulations were performed for all three C-D nozzles with different exit geometry (circular, pentagon, and octagon). The equivalent diameter of the circular exit diameter was maintained for all three nozzles. In the literature, jet characteristic investigations have been performed for various exit geometry (hexagon, elliptical, triangle, circular, rectangular, etc.). However, there is little research on pentagon or octagon shaped exits. The simulations are performed for the exit Mach number (1.2) for all nozzles in this paper. The present results from the simulations as well as the experimental data prove that the present results are in line with what was reported in the literature. Pentagon-shaped exits are 25% better than octagon-shaped exits. This improvement in spreading characteristics is due to the octagon having more sides than circular or pentagon. Pentagon-shaped exits shed 15-17 % more vortices compared to circular or pentagon-shaped exits.

Keywords- *Supersonic jets, Shock waves, non-circular shapes, Turbulence, Hydraulic diameter*

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Design and Development of Solar Power Charging for Pesticide Spraying Drone

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Abstract

Manual pesticide spraying causes many harmful side effects to the personnel involved in the spraying process. To overcome this problem we can use modern technology i.e. pesticide spraying mechanism mounted on the drone. The goal of this study is to design and develop a solar power charging system or an agricultural drone. An agricultural drone with the capability to spray an area was built and the components with spraying nozzle were sized accordingly. Based on the requirements for charging the drone, a COTS solar panel charging system which had four solar panels with dimensions 7cmx15cmmx3mm and a current output of 200mA, with a charging circuit of 800mAh per cell was implemented. The effectiveness of this system was analyzed to determine if it was adequate for the needs of current drones used for agricultural spraying.

Keywords- *drone, agriculture, solar panels, pesticide spray, pump*

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Potential of Dye-Sensitized Solar Cells for Aircraft Applications

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Abstract

Dye-sensitized solar cells (DSSCs) represent a promising photovoltaic technology with significant potential for space applications. Their unique characteristics, including lightweight and flexible form factors, low-light performance, and potential for low-cost manufacturing, make them attractive candidates for power generation in space missions. This paper explores the suitability of DSSCs for space applications, considering their advantages, challenges, and ongoing research efforts. We discuss the key attributes of DSSCs that make them well-suited for aircraft applications, such as their ability to perform under varying illumination levels and their potential for integration into flexible and deployable structures. Furthermore, we address the challenges associated with DSSCs in the space environment, including radiation tolerance, durability, and integration complexity. Research efforts aimed at enhancing the efficiency, durability, and reliability of DSSCs for aircraft applications, such as harnessing and supplying power from DSSCs to flight cabin lighting and other amenities, are highlighted. Overall, this paper provides an overview of the potential of DSSCs as a viable option for power generation in flight missions and identifies areas for further investigation and development to realize their full potential in aircraft applications.

Keywords- *hotovoltaics, aircraft, energy harvesting, Dyesensitized solar cells, weight and space constraints, adaptability*

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Experimental Investigation on the Effect of Solid Slit Tab on Mixing Enrichment of Subsonic Jets

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Abstract

An experimental investigation into the impact of a solid slit tab on the mixture enhancement of subsonic jets is detailed in the present study. In many different technical applications, including combustion, propulsion, and heat transmission, jets are commonly employed. The performance of these jets may be greatly increased by optimizing the mixing of the surrounding fluid. The purpose of this research is to examine the impact of introducing a solid slit tab on the jet's mixing properties. Pressure readings taken both radially and along the jet's centreline are used to assess the mixing enhancement. A comparison is made between the axial and radial jet spread for nozzle exit Mach values of 0.4, 0.6, and 0.8. The findings show that by creating streamwise vortices and raising the turbulence strength in the jet's near-field area, the solid slit tab may enhance the jet's mixing.The implications of the study's results for the design and optimization of jet-based systems are considerable.

Keywords- *Mach No, Tab, Propulsion, Combustion, Subsonic jet, thrust loss, Mixing of jets.*

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Mixing Enhancement Investigation On Subsonic Jet Flow Using Triangular Slot Tab

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Abstract

This experiment examines how triangular slot tabs in subsonic convergent nozzles improve mixing efficiency and minimize jet stream noise. Tab configurations influence ambient air mixing into the jet flow at Mach numbers 0.4, 0.6, and 0.8, according to physical experiments. The research explores ideal jet engine and fluid system noise abatement options. The research should reveal ways to improve jet performance and reduce noise pollution. Pressure measurements at the jet's centerline and radially determine mixing enhancement. Axial and radial jet spreads are compared for nozzle exit Mach values of 0.4, 0.6, and 0.8. The experimental findings will be extensively analyzed and compared to free jets to establish the best jet control for mixing. Triangular slot tabs at the nozzle exit interrupt large-scale vortices that generate jet noise, enabling smoother flow and lowering turbulence. This makes nozzle operation quieter and more precise for jet-based applications.

Keywords- *Experimental analysis, aerospace vehicle, propulsion, combustion, triangular slot tab, subsonic jet, mixing of jets, thrust loss.*

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Application of friction stir welding process for joining of 3D printed Polylactic Acid

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Abstract

Additive manufacturing technologies are used to produce three-dimensional object. Fused Deposition Modeling (FDM) is one of the 3D printing processes. The notable advantage of 3D printing is to develop actual parts directly. But it has a limitation for printing long parts due to the bed size. It can be overcome apply secondary using joining of polymers. Friction Stir Welding (FSW) is classified as solid-state welding widely preferred in automobiles and aerospace products. It has significant advantages of no melting, reduced heat affected zone and environmentally friendly aspect. In this work, 3D printed polymer specimen is joined using FSW process. Polylactic Acid (PLA) is used as work piece material. Process parameters considered are tool pin profile (circular, hexagonal and square), tool rotational speed and tool feed. Response parameters considered are tensile strength and bending strength. The result of the experiment is understood that better combination of process parameters such as tool low level value of rotational speed and medium level of tool travel speed with hexagon pin profile are significantly influenced the performance in terms of tensile strength and bending strength.

Keywords- *FSW, 3D Printing, Tool pin profile*

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Design of a Hydraulic Machine and Analysis of Composite Material

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Abstract

In order to optimize for the design, performance and efficiency of hydraulic machines, the importance of understanding fluid mechanics, kinematics, and control systems is essential. Through a combination of simulation and experimental validation, key parameters such as pump capacity, pressure control mechanisms, and hydraulic fluid characteristics is to be identified and optimized. Then the resultant hydraulic system exhibits improved load control, reduced energy consumption, and enhanced reliability during operation. Sensor integration emerges as a prominent theme in hydraulic machine research, as evidenced by studies focused on real-time monitoring and feedback systems. Advanced sensors, including strain gauges, accelerometers, and pressure transducers, to be strategically incorporated into machine designs to capture crucial data such as strain, deformation, and failure modes. This integration enhances the accurate understanding of material behavior under diverse loading conditions, facilitating informed decision-making in material selection and design optimization. The study introduces a hydraulic testing machine tailored for assessing the mechanical properties of composite materials. The machine boasts a sturdy frame capable of withstanding high loads and precise hydraulic actuators for controlled force application. Design considerations include accommodating various specimen geometries and loading configurations to meet different testing needs. This paper focuses on improving the hydraulic system's performance and efficiency in the testing machine's design. It is observed that specimen failure occurs at the hole junction. Drawing insights from previous research, this paper aims to inspire further innovation in hydraulic machine technology, fostering progress in the field.

Keywords- *Design, Analysis, Hydraulic Machine, Composite material*

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Machining of Aerospace Alloy using Textured Cutting Inserts and Solid Lubricants

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Abstract

Machining of Inconel 718, an aerospace alloy with conventional methods is difficult. During machining operation emits heat that has to be minimized with the use of cutting fluid. Cutting fluid containing hydrocarbons is generally employed, this leads to environmental pollution and affects the operators' health.Textured cutting inserts with solid lubricants is one of the alternative. In this study, turning is carried out on Inconel 718, a nickel based super alloy using a micro-hole textured cutting insert that is loaded with various solid lubricants. Solid lubricants as lubricant materials, is fundamentally solid but soften at the point of contact due to frictional heat. Micro-hole pattern texture with two different types of solid lubricants is attempted namely Molybdenum disulfide and graphite. The cutting speed, feed rate and depth of cut are the process parameters and surface roughness is the output measured. Experiments are performed as per L9 orthogonal array and the effect of each process parameter is determined through the Analysis of Variance (ANOVA). The results revealed that micro hole textured cutting insert is performed better with graphite as solid lubricant. Micro hole textured cutting inserts acts as lubricant storage, and also as a micro pool. It is direction independent, reduced the contact length of textured tool insert and chip and hence reduces the transformation of heat to the cutting insert.

Keywords- *Turning, aerospace alloy, solid lubricant, environmental nachining*

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Experimental Analysis of Waveguide Parabolic Antenna Using ANSYS and EDM Process

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Abstract

Wireless technology is playing a significant role in aerospace industries. The main use of this technology is used to communicate and operate waveguide in parabolic antenna. Waveguide is an important electromagnetic wave transmission Component of parabolic antenna. It has potential benefits of parabolic antenna does not involve cable to transmit signals. In this work, an attempt towards to design, analysis using ANSYS and manufacture the waveguide using electric Discharge Machining (EDM) by varying cross-section with the help of CREO software. Creo Elements and Creo Parametric compete directly with CATIA, Siemens NX/Solid Edge, and SolidWorks. Manufacturing of waveguide Carried out by milling, the inner pocket of waveguide was machined by Electrical discharge machining process. The result of the experiment indicated that accurate surface and suitable for travelling of electromagnetic wave without any disturbance. The material which had chosen was ALUMINUM 6061 T6 alloy, has good strength to its weight ratio which suitable for manufacturing of wave guide.

Keywords- *Wireless technology- parabolic antenna-CREO Software-ANSYS-EDM*

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Parametric Analysis of 3D-Printed Part using ABS and PLA for Drone Applications

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Abstract

The process of building a three-dimensional object from a CAD model or digital 3D model is known as additive manufacturing, or 3D printing. It can be carried out via a variety of techniques in which material is brought together, often layer by layer, and then deposition, joining, or solidification are all controlled by computers. Numerous factors influence the various aspects of the 3D printing process, which in turn influence the mechanical and thermal qualities such as wear characteristics, Impact test, tensile strength, and surface roughness of the final result. When it comes to structural components that must support a range of loads, this needs to be studied in particular. Unmanned Aerial Vehicle (UAV), also known as Drone is an aircraft without any human pilot, passenger or crew, are used tremendously because of their multiple applications in remote locations. The objective of this paper is to take a look at a number of these variables and perform a parametric study of the various 3D printing process variables utilizing ABS and PLA material. The input factors taken into account are printing layer thickness, infill pattern, printing speed, and component material. The tensile strength of the 3D printed object is the output parameter being taken into account. The results will then be used in the application of design and analysis of Drone components for lightweight polymer manufacturing

Keywords- *ABS and PLA, Process variables, Tensile strength, Taguchi*

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CLEARING THE COSMOS: Mitigating Space Debris for Sustainable Space Exploration

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Abstract

Space debris, comprised of defunct satellites, spent rocket stages, and fragments from previous collisions, poses a significant threat to the sustainability and safety of space activities. As the volume of debris in orbit continues to escalate, the risk of catastrophic collisions with operational spacecraft intensifies. “The "Clearing the Cosmos" project focuses on developing advanced techniques and technologies for mitigating space debris proliferation. Leveraging state-of-the-art sensors, machine learning algorithms, advancement in satellite tracking, propulsion technologies and robotic systems, our approach emphasizes early detection, precise tracking, and targeted removal of debris objects. Through a combination of ground-based observation networks and satellite-based monitoring systems, we aim to create a comprehensive orbital situational awareness framework. Additionally, we explore novel strategies such as autonomous debris removal spacecraft and on-orbit servicing missions to actively deorbit defunct satellites and other debris sources. Ultimately, our project seeks to preserve the long-term sustainability of space activities and ensure safe access to orbital environments for future generations.

Keywords- *Space Debris, Collisions, Satellite, Spacecraft*

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Slotted Tabs for Subsonic Jet Flow Control: A Numerical Analysis

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Abstract

The success of using rectangular slotted tabs with three distinct slot profiles - slant, L-bent, and arc, to numerically control the Mach 0.6 jet is discussed in this paper. In the outflow plane of a 13 mm diameter convergent nozzle, a perforation, slot, or aperture is made on the adjacent faces of two rectangular tabs spaced 180 degrees apart. For a flow blockage ratio of about 7.3%, the tabbed jet's jet spread and flow development properties are examined. Due to significant levels of turbulence caused by the flow from the slots interacting and impinging into the mainstream flow perpendicularly, it is discovered that the slots encourage mixing. Comparing this behavior to the free jet also results in jet instability. It is discovered that slotted tabs perform better as mixing promoters than free jet. Therefore, a significant amount of potential core decay will be seen in the regulated jet. For the tabs with slanted, L- bent, and arc slotted surfaces, a reduction in potential core length of approximately 78.5, 85.71, and 87.5 percent, respectively, is obtained in comparison to the uncontrolled jet.

Keywords- *tabs, instability, arc, mixing*

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Effect of Velocity Ratios on Coaxial Annular Jets Across Varied Lip Thicknesses

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Abstract

The effect of velocity ratio on a coaxial annular jet decay at different lip thicknesses have been studied numerically. Annular jets from coaxial nozzles of the same primary nozzle exit diameter with varying lip thickness of 0.7 to 10.7mm in steps of 2 have also been studied. A single jet from a coaxial nozzle with a primary nozzle exit diameter equal to that annular nozzle was also studied for comparison. Jet centerline total pressure decay, static pressure contours, turbulence contours, and velocity streamlines showing the vortex present in the near-field of the jet were analyzed. The results show that the mixing of an annular jet is superior to the coaxial jet at velocity ratio 100 of the present study. Also, low velocity ratio experiences a significantly higher mixing than the annular jet. For high lip thickness the recirculation zone at high velocity ratio's becomes interior to that of the blockage ratio for an annular jet affecting the recirculation region at all the lip thickness considered in the present study.

Keywords- *Co-flow, Velocity Ratio, Thin Lip Thickness, High Subsonic Jet, and Jet Mixing.*

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