inovine Scientific Meetings

International conference on AEROSPACE & AERONAUTICAL ENGINEERING

JULY 22, 2025 | VIRTUAL EVENT

Virtual: Zoom Meeting (GMT+2) Time in Amsterdam, Netherlands

Scientific Program

Oral Presentations

12:30–12:50	**Title: The crosslinking behaviors tune the performances of PMR polyimide matrix of advanced carbon fiber composites** **Baode Zhang** Liaoning Petrochemical University, China
12:50–13:10	**Title: Azodye Photoaligned Nanolayers for Liquid Crystal Devices: New Displays and Sensor Applications** **Vladimir G. Chigrinov** Hong Kong University of Science and Technology, Hong Kong
13:10–13:30	**Title: P-PGITN-Physics of Gyroscopic Inertial Torques Nullification** **Ryspek Usubamatov** Kyrgyz State Technical University after I.Razsakov, Kyrgyzstan
13:30–13:50	**Title: AI-Powered Predictive Maintenance Framework for Aircraft Engines Using Flight Data Recorder Logs** **Allen John Darin J** Mahendra Engineering College, India
13:50–14:10	**Title: Hybrid Flow Control Over NACA4412 Airfoil Using Surface Roughness Grits and Plasma Actuators** **Shubham Rahal** Indian Institute of Technology Roorkee, India
14:10–14:30	**Title: Passive Thermal Control for Cubesats Using Phase Change Materials** **Dhinesh S** Mahendra Engineering College, India
14:30–14:50	**Title: Revolutionizing Urban Mobility: The Rise of Hybrid Electric eVTOL Aircraft** **Tumma Anusha** Mahendra Engineering College, India

Poster Presentation

14:50–15:10	**Title: Life Estimation Model Based On Performance Parameters In Turbofan Aircraft Engines: A Thermodynamic And Data-Driven Approach** **Halil Ibrahim Ozdemir** Yildiz Technical University, Turkey

Oral Presentations

15:10–15:30	**Title: Aerospace And Aeronautics Industry in Developing Countries** **Calvin S. Kawere** Middle East Technical University (NCC), Turkey
15:30–15:50	**Title: Cork-based TPS: Heritage, Properties and Future Potential in Aerospace** **Joao Campos** University of Lisbon, Portugal
15:50–16:10	**Title: Diamond-Hardened Bearings Compatible with Lunar Environments** **Oleg A. Voronov** Diamond Materials, Inc. (Diamond Materials of Monroe) PA 18301, USA
16:10–16:30	**Title: In-Flight Power Generation for UAVs Using a Deployable Savonius Turbine** **Aaditya Mathur** Khan Lab School, USA
16:30–17:00	**Title: will be updtaed soon** **Eduard Babulak** Staffordshire University, USA

Panel Discussion

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SPEAKER PRESENTATIONS (VIRTUAL)

Baode Zhang
Liaoning Petrochemical University School of Petrochemical Engineering, China

The Crosslinking Behaviors Tune the Performances of PMR Polyimide Matrix of Advanced Carbon Fiber Composites

Advanced fiber reinforced polyimide matrix composites are achieving acceptance as engineering materials for the design and fabrication of high performance aerospace structural components. The addition-type polyimides known as PMR (in situ polymerization of monomer reactants) polyimides has been developed as laminating resins for high temperature carbon fiber reinforced composites. The monomers are essentially unreactive at room temperature, but undergo sequential in situ condensation and are thermally imidized to generate well defined polyimide oligomers that are endcapped with terminated groups. The condensation reaction forming low molecular weight oligomers occurs in the temperature range of 121-232°C, and then ring-opening addition crosslinking reactions at even high temperatures form a thermo-oxidatively stable polyimide matrix resin. Polyimide oligomers can undergo diverse addition copolymerization or homopolymerization, such as reverse Diels Alder reaction and cyclotrimerization. This paper discuss the crosslink mechanism of current status of PMR polyimides with different reactive capping reagents. In order to explain the capping reagents on the thermal properties, molecular dynamic (MD) simulation is carried out to investigate the glass transition temperature (Tg) of different PMR polyimides from PMR-15, AFR-700B and novel PMR polyimides. MD results indicate that the addition copolymerization or homopolymerization of oligomers occurred at elevated temperature leads to diverse 3D crosslinking structures, which tailor the Tg and thermal stability. Therefore, exploring the crosslink chemistry mechanism of oligomers with reactive capping reagents with the assistance of MD simulation is of significance in design high performance PMR polyimides.

Biography:

Baode Zhang has completed his postdoctoral studies University of Freiburg Institute of Physics. He is the board member of China Mainland Region of Society for the Advancement of Materials and Process Engineering. He has published more than 50 papers in reputed journals and has been serving as an editorial board member of repute.

Vladimir G. Chigrinov
Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong

Azodye Photoaligned Nanolayers For Liquid Crystal Devices: New Displays And Sensor Applications

Photoalignment and photopatterning has been proposed and studied for a long time Light is responsible for the delivery of energy as well as phase and polarization information to materials systems. It was shown that photoalignment liquid crystals by azodye nanolayers could provide high quality alignment of molecules in a liquid crystal (LC) cell. Over the past years, a lot of improvements and variations of the photoalignment and photopatterning technology has been made for photonics applications. In particular, the application of this technology to active optical elements in optical signal processing and communications is currently a hot topic in photonics research. Sensors of external electric field, pressure and water and air velocity based on liquid crystal photonics devices can be very helpful for the indicators of the climate change.

We will demonstrate a physical model of photoalignment and photopatterning based on rotational diffusion in solid azodye nanolayers. We will also highlight the new applications of photoalignment and photopatterning in aerospace display and sensors, such as: (i) fast high resolution LC display devices, such as field sequential color ferroelectric LCD; (ii) LC sensors; (iii) LC lenses; (iv) LC E-paper devices, including electrically and optically rewritable LC E-paper; (v) photo induced semiconductor quantum rods alignment for new LC display applications; (vi)100% polarizers based on photoalignment; (vii) LC smart windows based on photopatterned diffraction structures; (vii) LC antenna elements with a voltage controllable frequency.

Biography:

Professor Vladimir G. Chigrinov is Professor of Hong Kong University of Science and Technology since 1999. He is an Expert in Flat Panel Technology in Russia, recognized by the World Technology Evaluation Centre, 1994, and SID Fellow since 2008. He is an author of 6 books, 31 reviews and book chapters, about 317 journal papers, more than 668 Conference presentations, and 121 patents and patent applications including 36 US patents in the field of liquid crystals since 1974. He got Excellent Research Award of HKUST School of Engineering in 2012. He obtained Gold Medal and The Best Award in the Invention & Innovation Awards 2014 held at the Malaysia Technology Expo (MTE) 2014, which was hosted in Kuala Lumpur, Malaysia, on 20-22 Feb 2014. He is a Member of EU Academy of Sciences (EUAS) since July 2017. He got A Slottow Owaki Prize of SID in 2018. He is 2019 Distinguished Fellow of IETI (International Engineering and Technology Institute).

Since 2018 he works as Professor in the School of Physics and Optoelectronics Engineering in Foshan University, Foshan, China. 2020-2024 Vice President of Fellow of Institute of Data Science and Artificial Intelligence (IDSAI) Since 2021 distinguished Fellow of Institute of Data Science and Artificial Intelligence

Ryspek Usubamatov
Kyrgyz State Technical University after I.Razsakov, Bishkek, Kyrgyzstan

P-PGITN-Physics of Gyroscopic Inertial Torques Nullification

The physics of gyroscopic effects turned out to be more sophisticated than contemplated by scientists. This is proven by the fact that the nature of gyroscopic effects was only described in our time and their physics is presented in the breakthrough gyroscope theory that scientists have tried to find for a long time. The rotating mass of the spinning disc generates the four inertial torques acting around each axis of the Cartesian coordinates which are two centrifugal forces, one Coriolis force, and the torque of the change in the angular momentum. The system of 12 inertial torques is interrelated by the feedback dependency and results in motions of the spinning disc around the axes of coordinates. These inertial torques and motions make up the fundamental principles of the gyroscope theory based on the mechanical energy conservation law. The mathematical models for gyroscopic effects are validated by practical tests. Among gyroscopic effects stands out one phenomenon, which is the deactivation or nullification of gyroscopic inertial torques. This phenomenon is a result of the inertial torques' interrelations and motions of the gyroscope under the condition of blocking rotation around one axis. The blocking of the gyroscope's precessional motion nullifies all inertial torques except for the torque of the change in the angular momentum. Identifying the reasons for nullifying the inertial torques was a significant challenge for physicists. The physics of the selective nullification of the inertial torques is today clearly described. Addressing this issue simplifies analytical solutions for problems involving gyroscopic devices.

Keywords: Gyroscopic effects; inertial torque nullification; angular rotation

Biography:

Dr. Ryspek Usubamatov studied Manufacturing Engineering at Bauman Moscow State Technical University, graduated as a professional engineer in 1966, received his Ph.D., in 1972 and the Dr. Tech. Sc. in 1993. He worked as a professor at the Kyrgyz State Technical University and at the universities in Malaysia. He has published over 400 research manuscripts, 8 books, 30 brochures, and 60 patents of inventions. His fundamental scientific books are "Productivity Theory for Industrial Engineering", Taylor & Francis, 2018, 2021, London, New York, Boca Raton, and "Theory of Gyroscopic Effects for Rotating Objects", 2nd ed. Springer, Cham, Switzerland, 2022.

Allen John Darin J
Mahendra Engineering College, India

AI-Powered Predictive Maintenance Framework for Aircraft Engines Using Flight Data Recorder Logs

The aviation industry faces significant challenges in optimizing engine maintenance schedules while ensuring safety and cost efficiency. Traditional maintenance practices, based on fixed intervals or reactive inspections, often miss early signs of engine degradation observable in operational flight data. This paper proposes a modular AI-powered predictive maintenance framework that utilizes Flight Data Recorder (FDR) logs to monitor key engine health parameters, including vibration, exhaust gas temperature, pressure ratios, and thrust output.

By applying anomaly detection algorithms and unsupervised learning techniques, the system identifies deviations from standard operating behavior, providing actionable insights for preemptive maintenance decisions. Unlike existing proprietary solutions confined to original equipment manufacturers (OEMs), the proposed framework offers a transparent and adaptable approach suitable for airlines and Maintenance, Repair, and Overhaul (MRO) providers. The proof of concept is validated using publicly available turbofan engine degradation datasets, demonstrating high sensitivity in fault detection with a low false positive rate.

This work aims to bridge the gap between data-rich operations and predictive maintenance capabilities, contributing to reduced unscheduled engine removals, optimized maintenance costs, and enhanced operational safety in commercial aviation.

Keywords: Predictive maintenance, flight data recorder, aircraft engine health monitoring, AI in aerospace, anomaly detection, turbofan degradation, MRO analytics.

Biography:

Allen is a third-year Aerospace Engineering student at Mahendra Engineering College. His interests include aircraft design, aerodynamics, and AI-driven safety systems. He has participated in national-level hackathons and completed internships with aerospace organizations, focusing on predictive maintenance and FEA analysis. At this conference, he will present his project on AI-Powered Predictive Maintenance Framework for Aircraft Engines Using Flight Data Recorder Logs. Allen aims to apply his skills to solve real-world aerospace challenges and contribute to innovative safety solutions.

Shubham Rahal
Indian Institute of Technology Roorkee, Roorkee, India

Hybrid Flow Control Over NACA4412 Airfoil Using Surface Roughness Grits And Plasma Actuators

Flow separation is a major challenge in improving the aerodynamic performance of airfoils at low Reynolds numbers. This study investigates a hybrid flow control method on a NACA4412 airfoil by combining surface-mounted roughness grits with dielectric barrier discharge (DBD) plasma actuators. Experiments were conducted at a Reynolds number of 25,000. Roughness elements of varying roughness were applied in the mid-chord region (45–60% chord) to promote early boundary layer transition. Plasma actuators were positioned downstream (60–90% chord) to energize the flow in separation-prone zones. Aerodynamic performance was evaluated airfoil surface and wake dynamics using HWA, PIV and pressure transducer. Results showed that roughness elements alone enhanced boundary layer stability by inducing transition. When combined with plasma actuation, flow separation was delayed further, and stall onset occurred at higher angles of attack. The hybrid configuration yielded improved aerodynamic performance. The hybrid method offers practical potential for small UAVs, micro air vehicles, and low-speed aerodynamic systems.

Biography:

Shubham Rahal is a Ph.D. scholar at the Indian Institute of Technology Roorkee, specializing in experimental fluid dynamics and aerodynamic flow control, and has over five years of experience as a Teaching Assistant. He holds an M.Tech. degree from IIT Ropar. His M.Tech. thesis specialized in designing lotus-like self-cleaning superhydrophobic surfaces using carbon nanotubes and analyzing the sliding/rolling behavior of water droplets. His PhD research focuses on active, passive, and hybrid flow control methods. Shubham has published in reputed journals and actively contributes to experimental aerodynamics and unsteady flow investigations.

Dhinesh S
Mahendra Engineering College, India

Passive Thermal Control for Cubesats Using Phase Change Materials

CubeSats in Low Earth Orbit (LEO) face rapid thermal cycling due to alternating sunlight and shadow phases. This work presents a low-cost, passive thermal regulation method using Phase Change Materials (PCMs), specifically paraffin wax, which absorbs and releases latent heat during phase transitions. A comparative setup with two insulated enclosures— one with PCM and one without—demonstrates the temperature-stabilizing effect of PCMs under simulated orbital heating. Experimental results show significant delay in temperature rise and fall within the PCM-insulated box, validating its effectiveness for thermal control in miniaturized space platforms.

Introduction: Small satellites like CubeSats operate in Low Earth Orbit (LEO), where they undergo frequent transitions between extreme thermal environments. Conventional active thermal control systems are often unsuitable due to mass, volume, and power constraints. This study investigates a passive thermal control technique using PCMs, which can absorb and release thermal energy during phase transitions to maintain a stable temperature range.

Experimental Setup: Two identical 10x10x10 cm insulated enclosures were fabricated to simulate a CubeSat module. Both boxes were internally lined with aluminum foil to mimic spacecraft insulation. Each contained a temperature sensor (DS18B20) connected to an Arduino Uno for real-time data logging. Box A included paraffin wax (melting point ~28°C) as the PCM, while Box B did not.

A controlled heat source (60W incandescent lamp) simulated solar radiation exposure. Data was collected during heating and cooling phases to replicate orbital day-night cycles.

Results and Discussion: We are currently in the testing phase, refining the setup and collecting more data to further validate the consistency and repeatability of the thermal regulation performance. Preliminary results already indicate the viability of PCMs for CubeSat applications, and we aim to expand the study with multiple PCM types and varying thermal loads.

Conclusion: This experiment proves the concept of passive thermal regulation using PCMs for CubeSats. It offers a sustainable, lightweight, and power-free alternative to conventional active systems, especially valuable for nanosatellites operating in LEO. The design is scalable and can be integrated into structural panels or payload compartments for enhanced thermal resilience.

Biography:

Mr. Dhinesh S is an aspiring aerospace engineering student from Mahendra Engineering College, India. With a deep interest in space systems and advanced thermal technologies, he has focused his research on spacecraft thermal management, particularly for small satellites like CubeSats. His recent work, titled "Passive Thermal Control for CubeSats Using Phase Change Materials," explores innovative and sustainable solutions for managing temperature extremes in space environments using passive techniques.

Through his academic journey, Mr. Dhinesh has cultivated a strong foundation in thermodynamics, propulsion, and space systems engineering. He is passionate about contributing to the miniaturization and efficiency of space technologies. His participation in the Aerospace Congress 2025 represents his first international conference appearance, where he aims to share his findings and gain insights from global experts in the field.

Driven by a vision to be part of future space exploration missions and satellite innovation, Dhinesh continues to expand his knowledge through research, collaborative projects, and academic presentations.

Tumma Anusha
Mahendra Engineering College, India

Revolutionizing Urban Mobility: The Rise of Hybrid Electric eVTOL Aircraft

The development of Electric Vertical Take-Off and Landing (eVTOL) aircraft is revolutionizing the future of urban and regional air mobility. These vehicles combine fixed-wing efficiency with rotorcraft versatility, using hybrid electric propulsion to reduce emissions, noise, and operating costs. This paper focuses on hybrid eVTOLs, which use both electric motors and fuel-based generators or turbines to achieve optimal performance.

By leveraging distributed electric propulsion and vertical lift capabilities, hybrid eVTOLs enable safe, quiet, and compact take-offs and landings in congested areas, making them ideal for short-distance city-to-city travel. The hybrid system overcomes the limitations of current battery technology by extending range and endurance, while maintaining environmental benefits compared to conventional aircraft.

The abstract will explore the key components of hybrid eVTOLs, such as lightweight airframes, battery-gas turbine hybrids, and advanced control systems. It will also address major challenges including battery weight, energy management, thermal control, certification, and safety. Case studies from companies like Joby Aviation, Lilium, and Airbus will be used to show real-world progress.

Overall, hybrid eVTOLs present a promising bridge between fully electric aircraft and traditional aviation, opening new frontiers in sustainable air travel.

Keywords: Hybrid Aircraft, eVTOL, Urban Air Mobility, Electric Propulsion, Aerospace Innovation

Biography:

Tumma.Anusha a third-year Aerospace Engineering student at Mahendra Engineering College. Her interests include aircraft design, aerodynamics, and Rocket sciences. She had participated in paper presentations, international conferences and completed internships with aerospace organizations, focusing on predictive maintenance and FEA analysis. At this conference, she will present her project on Electric Vertical Take off and landing for pollution free air. Anusha aims to apply his skills to solve real-world aerospace challenges and contribute to innovative safety solutions.

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POSTER PRESENTATION (VIRTUAL)

Halil Ibrahim Ozdemir
Yildiz Technical University Institute of Science and Technology, Turkey

Life Estimation Model Based On Performance Parameters In Turbofan Aircraft Engines: A Thermodynamic And Data-Driven Approach

Accurate estimation of aircraft engine life plays a crucial role in ensuring operational reliability and reducing maintenance costs. This study proposes a hybrid model that combines thermodynamic principles and data-driven methods to estimate sortie-based engine life for turbofan engines. The model incorporates key performance parameters including thermal efficiency (η_{th}), turbine entry temperature (TET), exhaust gas temperature (EGT), and specific fuel consumption (SFC). Using the NASA C-MAPSS dataset, degradation coefficients are determined, and exponential deterioration patterns are modeled. The remaining useful life (RUL) is calculated through a parametric formula that tracks the deviation of these parameters from critical thresholds over sorties. The results indicate that the TET parameter reaches its critical threshold earlier than others, making it a key indicator for engine health monitoring. The proposed hybrid approach achieves higher prediction accuracy compared to traditional time-based models, offering enhanced responsiveness to real-time sensor data and better alignment with physical engine behavior. This methodology provides valuable insights for strategic fleet management and predictive maintenance planning in the aviation industry.

Keywords: Turbofan engine, Remaining Useful Life, Thermal Efficiency, C-MAPSS, Hybrid Model

Biography:

Halil İbrahim Özdemir is a master's student in Mechanical Engineering, working in the aerospace field. His research focuses on analysing the performance of aircraft engines, thermodynamic modelling and predictive maintenance using hybrid modelling techniques. He has contributed to integrating sensor-based degradation modelling and real-time operational data into maintenance planning strategies for turbofan engines.

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SPEAKER PRESENTATIONS (VIRTUAL)

Calvin S. Kawere
Middle East Technical University (NCC), Turkey

Aerospace And Aeronautics Industry in Developing Countries

Technological advances in the aeronautical industry of developing countries have created a transformative shift in the global aerospace capabilities, hinging on strategic partnerships with established industry powerhouses and focused technological developments and initiatives within the countries. This fosters global competitiveness, intercontinental cooperation, innovation, and economic growth, thereby enhancing the local industry's competitiveness.

This study focuses on initiatives and advancements within these developing nations that solidify their presence in the aerospace and aeronautics industry. Through a combination of case studies and surveys, key factors contributing most to the industry's development are identified as a blueprint for other countries. Furthermore, the research also identifies the gaps and constraints hindering the growth of aerospace in these developing countries, and seeing how they affect the innovation and security side of the industry of the Global South, and through addressing these challenges, opportunities are presented to create a catalyst for building a very competitive aerospace sector.

Biography:

Calvin is a second-year undergraduate aerospace engineering student at Middle East Technical University (METU). I am an aspiring aerospace engineer with a focus on the development of the aerospace and aviation industries in developing countries and or economies.

Joao Campos[1*] & Helena Pereira[2]
[1]Tecnico+ Advanced Training, IST,University of Lisbon, Lisboa, Portugal
[2]Center for Forestry Studies, ISA, University of Lisbon,Lisboa, Portugal

Cork-based TPS: Heritage, Properties and Future Potential in Aerospace

Cork, the renewable bark of *Quercus suber* L., is attracting interest as a lightweight, multifunctional aerospace material. Phenolic-bonded cork agglomerates, now used in thermal-protection systems, have bulk densities of 200–300 kg m^{-3} and withstand 50–70% compressive strain with near-complete recovery, delivering exceptional energy absorption for launch shocks and debris impacts. Their closed-cell architecture provides room-temperature thermal conductivities of 0.03–0.07 $Wm^{-1}K^{-1}$ while remaining serviceable from cryogenic conditions to several hundred °C.

When exposed to high-enthalpy heating, cork chars in a uniform, controlled manner; plasma-arc tests show the cellular skeleton remaining coherent above 2000°C, a behaviour validated in flight programmes from Minuteman missiles through Apollo, the Space Shuttle and Falcon 9 first-stage shields. Beyond insulation, cork's visco-elastic cell walls add inherent acoustic and vibration damping, and crushing in sandwich cores offers passive micrometeoroid- and debris-impact mitigation.

Life-cycle analyses highlight a low-waste, net-negative carbon footprint: cork is harvested cyclically every 9–10 years without felling the tree, aligning with circular-economy and "space environmentalism" objectives. Portugal—the world's leading cork producer—therefore sits at the centre of a potential European value chain for green thermal-protection systems, structural cores and debris-shield laminates, positioning the country as a key contributor to the emerging space economy.

The paper consolidates laboratory data and documented flight heritage to define the current performance envelope of cork composites, identifies practical constraints such as adhesion challenges on cryogenic tanks , and outlines research priorities—including hyper-velocity impact testing and higher-temperature binders—needed for wider adoption in next-generation reusable launchers and orbital-service platforms.

Keywords: Ablative insulators, green materials, cork agglomerates, spacecrafts, thermal protection systems

Biography:

Joao Campos is a Business Coordinator for Space at Técnico+ (Instituto Superior Técnico, Lisbon), where he spearheads B2B partnerships and the new executive Master of Business Engineering in Space Systems. A naval engineer by training, he managed engineering programmes at Salt Technologies, EU-funded project portfolios at the Atlantic International Research Centre, and guided NOVA SBE's Earth Observation current and future market-analysis for the New Space Portugal Agenda.

Helena Pereira is an Emeritus Professor at the School of Agriculture, University of Lisbon, with an intense research activity on biology and material's science of natural products. She is a world known specialist on cork with numerous publications, including reference works. A former president of the Portuguese Science and Technology Foundation and rector of the Technical University of Lisbon, she also acted as coordinator or various European R&D projects and evaluator of academic institutions.

Oleg A. Voronov
Diamond Materials, Inc. (Diamond Materials of Monroe) PA 18301, USA

Diamond-Hardened Bearings Compatible with Lunar Environments

Diamond-hardened bearings and tools to work on Lunar surface are under development. Bearings will be able to operate in cold and dusty environments, without active powered heating and dust mitigation. The biggest challenge for long-term operation is presented by lunar regolith, which is the fine-scale dust with unique physical properties. These bearings with *dust-tolerant surfaces* are suitable for lunar applications. The bearings will experience negligible wear and provide long working life, *with limited or no maintenance* in the low temperature-vacuum environments existing on the Moon. The invention of such diamond-hardened bearings and other mechanisms (in collaboration with NASA, Patent No: US 9,574,080 B1, 2017) indicates a pathway to production. This new class of diamond-hardened materials should also be ideal for mining tools and rock-drill bits. Diamond Materials, Inc. (DMI) was founded by a group of scientists to work in the service business. DMI services include research and development (R&D) in field of physical sciences We have discovered that an increase of friction coefficients in vacuum-cryogenic conditions does lie in very physical nature of solid state and tribology. In this case the solid-state lubricant can be used to decrease a friction between tribological surfaces, but only if a hardness of the surfaces is much greater than a hardness of the solid-state lubricant material. Diamond is the hardest known material. Hardness value of Lunar dust is high, but much lower than the hardness of superhard diamond. Superhard tribological surfaces help to solve the problems encountered in cryogenic-vacuum-dusty environments. Our research shows that Lunar dust does not scratch diamond surface. Diamond tribological surfaces cannot be worn by dust but dust only lubricates them. Our high-pressure assisted method enables a fabrication of diamonds and mechanisms at relatively low cost. Practical technology solutions are needed to support both lunar and Mars missions.

Biography:

Dr. O.A. Voronov (Dr. of Science, Physics & Mathematics) is the inventor of the “High Pressure and High Temperature Apparatus”. He has more than 100 scientific publications (in Russian and English), contract final reports, author's certificates of invention (U.S.S.R.-[Russian Federation]) and US patents. Dr. Voronov is Co-Founder and President of Diamond Materials, Inc. (DMI, that is a small, 100% USA private company, for profit, originally incorporated in New Jersey (1995). It operates now in Pennsylvania under the name Diamond Materials of Monroe). Dr. Voronov participates also currently in the innovation on the “High-Pressure Plasma Reactor for Nuclear Fusion of Deuterated Materials” (with Rutgers University & Spark Astra Company) that is most worthy to be mentioned.

Aaditya Mathur
Khan Lab School, USA

In-Flight Power Generation for UAVs Using a Deployable Savonius Turbine

This study explores the feasibility of generating in-flight power using a deployable vertical-axis wind turbine (VAWT) mounted on a lightweight unmanned aerial vehicle (UAV). The goal is to determine whether the power generated can offset the added drag and increase overall flight endurance. Airborne Wind Energy (AWE) systems offer a promising alternative to ground-based turbines by accessing higher-altitude winds and reducing material and infrastructure demands. Three VAWT configurations, Savonius, Helical Darrieus, and H-Type Darrieus, were prototyped and tested under controlled wind conditions. The Savonius turbine, demonstrating superior voltage output, was selected for further study. To evaluate the trade-off between power generation and aerodynamic performance, the turbine was integrated into a deployable system and tested both experimentally and through Computational Fluid Dynamics (CFD) simulations. Results showed that the turbine generated an average of 21.59 watt-hours at 3.9 rad/s (30 m/s), producing approximately 1.47 N of thrust. However, this came at a cost: the average lift-to-drag ratio dropped from 21.17 to 9.56, reducing glide distance from 2582.74 meters to 1165.56 meters and glide time from 86.05 to 38.86 seconds. Despite these aerodynamic penalties, both simulations and testing confirmed the feasibility of harvesting meaningful electrical power during non-powered or low-powered segments of flight. The energy generated could support onboard electronics, communication modules, or sensor payloads. Although glide efficiency was reduced by more than 50%, selective deployment during descent or loitering can mitigate this trade-off. This regenerative approach offers a novel method to extend UAV endurance and enable persistent sensing or energy storage for ground-based systems.

Biography:

Aaditya Mathur is a junior at Khan Lab School in Mountain View, California, with a focused interest in aerospace engineering and sustainable aviation. His current research investigates the integration of wind turbines into aircraft to improve energy efficiency. The goal of his work is to harness in-flight wind energy to support long-endurance, low-emission flight.

Outside of his research, Aaditya plays soccer and is part of his school's robotics team. He mentors middle school students through his school's robotics and aerospace club and has completed advanced programming coursework through Columbia University's summer USACO program.

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