ANTHARIKSH

The Space...

DEPARTMENT OF AEROSPACE ENGINEERING

LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING

MYLAVARAM, ANDHRA PRADESH, INDIA.

Vision of the Department:

To achieve academic excellence and produce highly competent professionals in the field of Aerospace Engineering

Mission of the Department:

DM1: To impart high quality education in Aerospace Technology through class room teaching and laboratory practice

DM2: To develop indigenous Aerospace Technology by carrying out research in collaboration with industry and research organizations

DM3: To train and inspire the student community to possess effective communication and leadership skills with ethical values

DM4: To harness the technological development by being consistently aware of societal needs and challenges

Program Educational Objectives (PEOs)

PEOs	Statement
PEO1	To provide students with sound mathematical, engineering and multidisciplinary knowledge to solve Aerospace and Allied Engineering problems
PEO2	To prepare students to excel in higher education programs and to succeed in industry/academia profession.
PEO3	To inculcate ethical attitude, leadership qualities, problem solving abilities and life-long learning for a successful professional career

PROGRAM OUTCOMES (POs)

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

PO2: 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.

PO3: 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.

PO4: Conduct Investigation 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.

PO5: Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including predictions and modeling to complex engineering activities with an understanding of the limitations.

PO6: 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.

PO7: 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.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: 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.

PO11: 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.

PO12: 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.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: To apply the knowledge of Aerodynamics, Propulsion, Aircraft structures and Flight Dynamics in the Aerospace vehicle design

PSO2: To prepare the students to work effectively in Aerospace and Allied Engineering organizations

FOCUS AND SCOPE

A department magazine bridges the gap between students and faculty. Typically, a department magazine consists of Technical articles, ideas, project outcomes, language skills, literary articles, technical updates, success stories, career tips, academic advice, the latest events and happenings related to campus. Cover-stories have to be written in an engaging format. We can also include interviews of former students who have achieved success through dedication and hard work.

PUBLICATION FREQUENCY:

Magazine is published quarterly, appearing in the months of January, April, July and October.

Send your articles to the following mail ID.

E-Mail: antharikṣh.lbrce@gmail.com

Disclaimer

Some of the contents published in this magazine are from open sources. The contents of this magazine are for information purposes only, enabling the faculty and students to have easy and quick access to information and do not have any legal sanctity. This magazine is intended for circulation among students of the Department of Aerospace Engineering of LBRCE only.

FROM HOD's DESK

IDENTIFY AND RECOVER WASTED TIME

Instead of watching a one-hour TV show, tape it and watch it in 45 minutes by fast-forwarding through the commercials. Don't spend a half hour typing a lengthy email when you could accomplish the same thing with a 10-minute phone call. Batch your errands together and do them all at once. Trying to cut out time-wasting habits is a common starting point for people who desire to become more efficient, but I think this is a mistake. Optimizing your personal habits should only come later. Clarity of purpose must come first. If you don't have clarity, then your attempts to install more efficient habits and to break inefficient habits will only fizzle. You won't have a strong enough reason to put your time to good use, so it will be easy to quit when things get tough. You need a big, attractive goal to stay motivated. The reason to shave 15 minutes off a task is that you're overflowing with motivation to put that 15 minutes to better use.

Dr. P. Lovaraju

Multifunctional Structural Batteries: Redefining Aircraft and Vehicle Structures

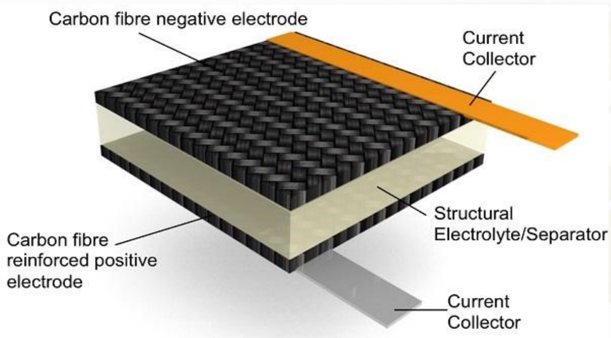
Nazumuddin Shaik
Senior Assistant Professor

The evolution of modern engineering systems, particularly in aerospace and electric mobility, demands solutions that simultaneously enhance performance, efficiency, and sustainability. One of the most promising breakthroughs in this direction is the development of multifunctional structural batteries, a class of advanced materials capable of acting both as load-bearing structures and energy storage devices.

Unlike conventional designs where structural components and batteries exist as separate entities, structural batteries integrate these functionalities into a single unified system. This paradigm shift enables significant reductions in weight and volume, making them highly suitable for aircraft, electric vehicles (EVs), drones, and portable electronic systems.

At the core of structural battery technology lies the concept of dual functionality. These materials are engineered to carry mechanical loads while simultaneously storing electrochemical energy.

Typically, the structure consists of:



- Carbon Fiber-reinforced polymer (CFRP) acting as a stiff anode.
- A lithium-based cathode.
- A solid or gel electrolyte facilitating ion transport.

Carbon Fibers, traditionally used for structural reinforcement, are repurposed here as active electrochemical components. This integration eliminates the need for separate battery packs, thereby transforming "inactive mass" into a functional energy-storing structure.

Key Features and Advantages

1. Dual Functionality:

Structural batteries perform the role of:

- Load-bearing elements (e.g., fuselage panels, vehicle chassis)

Energy storage units

This reduces redundancy in system design and enhances overall efficiency.

2. Weight Reduction and Efficiency:

One of the most significant advantages is weight saving, which can reach up to 10% in electric vehicle applications. In aerospace, even marginal weight reductions translate into:

- Lower fuel consumption
- Increased payload capacity

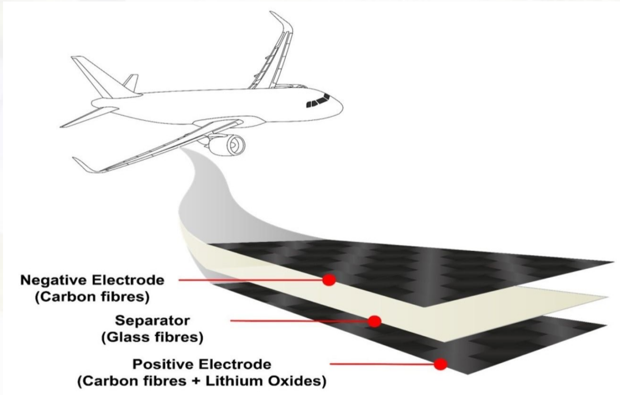
Enhanced range and endurance

3. Improved System-Level Energy Density:

By embedding energy storage into the structure, the effective energy density of the entire system increases, even if the battery material itself has slightly lower electrochemical performance than conventional lithium-ion cells.

4. Space Optimization:

Structural batteries free up valuable internal volume, enabling more compact and streamlined designs—critical in aircraft and UAV configurations.



Carbon Fiber-Based Energy Storage

Recent research, including work by the Korea Advanced Institute of Science and Technology, focuses on developing thin, high-density structural batteries using carbon Fiber composites. These innovations aim to enhance both mechanical stiffness and electrochemical capacity.

Integration in Electric Vehicles

Tesla, Inc. has pioneered the concept of structural battery packs using its 4680-cell architecture, where the battery pack contributes directly to the vehicle's structural rigidity.

Emerging Aerospace Applications

In aerospace engineering, structural batteries are being explored for:

- Wing skins and fuselage panels
- Unmanned aerial vehicles (UAVs)
- Hybrid-electric propulsion systems

These applications align closely with the industry's push toward more electric and all-electric aircraft.

GUIDING LIGHTS OF THE SKY

Runway Signal Lights for Safe Arrival and Smooth Departure

G V SURYA NARAYANA
Asst. Professor

ARRIVAL RUNWAY SIGNAL LIGHTS:

The Silent Visual Guides for a Safe Landing.
When an aircraft approaches an airport for landing, the pilot depends not only on instruments and air traffic control but also on a carefully designed set of runway signal lights that provide visual guidance. These arrival lights are extremely important during night operations, rain, fog, or poor visibility because they help the pilot identify the runway position, alignment, height, and touchdown area. Without these lights, judging the exact landing path from the sky would be very difficult. The first lights visible to an arriving aircraft are the Approach Lighting System (ALS). These are a series of bright white light bars extending outward from the runway threshold into the approach zone. Their purpose is to help the pilot line up the aircraft correctly with the runway centreline and maintain the proper descent angle during final approach. On many precision runways, flashing sequence lights are also added, creating a running pattern that draws the pilot's eye directly toward the landing strip.

At the beginning of the runway, Threshold Lights are installed. These lights appear green to the approaching pilot, clearly marking the exact point where the runway starts. This allows the pilot to judge when the aircraft is crossing into the landing surface. On either side of the runway, Runway Edge Lights emit steady white light, outlining the full landing width. Near the final portion of the runway, these may turn yellow, warning the pilot that the remaining runway distance is reducing.

Another important arrival aid is the Runway Centreline Lights, which are fixed white lights arranged at equal intervals along the middle of the runway. These help the pilot keep the aircraft exactly cantered after touchdown. In large international airports, Touchdown Zone Lights are also provided for the first portion of the runway, helping pilots identify the safest landing contact area. Together, these arrival signal lights act like a glowing pathway in the darkness, ensuring that the aircraft lands smoothly, accurately, and safely even under adverse weather conditions.

DEPARTURE RUNWAY SIGNAL LIGHTS:

Lighting the Path for a Powerful and Controlled Take-off.
Just as runway lights guide an aircraft during landing, a different combination of signal lights supports the pilot during departure. During take-off, the pilot must accelerate in a perfectly straight line, maintain directional balance, and identify the usable runway length ahead. This becomes especially critical during night flights or low-visibility conditions. Departure runway lights, therefore, serve as visual references that help pilots maintain control and confidence during the high-speed take-off roll.

The most basic departure guidance is provided by the Runway Edge Lights, which appear as two long parallel rows of bright white lights on both sides of the runway. These lights define the exact pavement boundaries and prevent the aircraft from drifting sideways during acceleration. Along the centre of major runways, Runway Centreline Lights are installed at close spacing, creating a straight illuminated line that helps the pilot maintain precise nose alignment during the take-off run. These centreline lights remain white initially, then alternate red and white, and finally become red near the runway end to indicate the approaching limit of available runway.

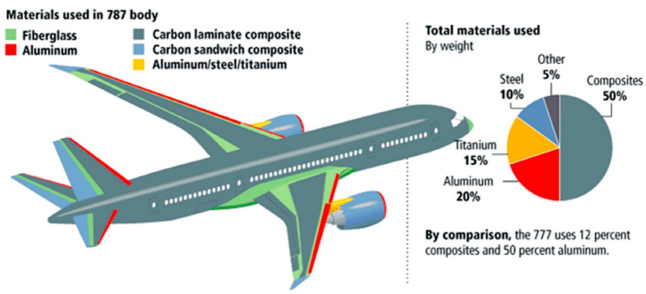
At the far end of the runway, Runway End Lights glow red, indicating the physical end of the take-off strip. This gives the pilot a strong visual awareness of the remaining distance during acceleration. In addition, Taxiway Lead-On Lights guide the aircraft from taxiways onto the runway before departure, ensuring that the aircraft enters the centreline correctly. Some advanced airports also use Runway Status Lights and stop-bar signals that automatically warn pilots if another aircraft or vehicle is occupying the runway.

Modern airports now employ high-intensity lighting systems whose brightness can be adjusted according to weather and visibility. These departure signal lights create a clear illuminated corridor, allowing pilots to focus on speed, engine performance, and rotation timing without losing directional orientation. Thus, departure runway lights play a silent but vital role in ensuring every take-off begins with precision, stability, and complete safety.

The Rise of Composite Materials in the Aerospace Industry

Mr. S. Indrasena Reddy

Sr. Assistant Professor



A raft of new materials is set to change the face of aircraft manufacturing in the years ahead. The global aerospace industry has bounced back strongly from the inevitable pandemic slowdown. Demand is increasing by some 4-5 per cent each year and is expected to continue over the next two decades. To meet that demand – and align with net zero emissions – manufacturers and suppliers will need to look at new materials and more effective ways of working

Advanced composites like carbon fiber reinforced plastics (CFRP) are a case in point. Composite materials are becoming more prevalent in aerospace due to their high strength-to-weight ratio, and some 50% of modern aircraft structures, like the Airbus A350 and Boeing 787 Dreamliner, are made from CFRPs. carbon fiber composites are the future, especially in supersonic flight.

With weight reduction a primary industry focus, aluminum alloys, such as 7178-T6 and 7079-T6, are strong, lightweight, relatively cheap and fast to machine. However, with a lower melting point than many other structural metals, they are potentially unsuitable for high-temperature applications and aluminum's relative softness means it can't withstand as much wear.

High-strength steels offer exceptional strength and impact resistance but can be difficult to machine. The same goes for stainless steels, which are used less in aerospace applications.

With sustainability high on the industry agenda, nickel-based super alloys, predominantly used in the turbine sections of aircraft engines, are likely to improve fuel efficiency and overall engine performance and are critical in the push towards sustainable aviation fuels.

A new approach that proliferation of new composite materials in the aerospace industry means that approaches to machining and tooling will also have to evolve. 3D printing and Additive Manufacturing (AM) will have an increasing role to play, especially given that its introduction has proved to be smoother than was perhaps feared.

Space Debris and Its Impact on Satellite Operations

Dr. A Revanth Reddy

Associate Professor

Space exploration and satellite technology have become essential parts of modern civilization. Satellites support communication, navigation, weather forecasting, scientific research, national security, and global internet connectivity. However, the increasing number of objects launched into space over the past several decades has created a serious problem known as space debris. Space debris, also called orbital debris or space junk, refers to nonfunctional human-made objects orbiting Earth. These include abandoned satellites, spent rocket stages, broken spacecraft components, and fragments produced by collisions or explosions in orbit. The rapid growth of space debris poses a major threat to satellite operations and the future of space activities.

The problem of space debris began during the early years of space exploration in the 1950s and 1960s. Since the launch of the first artificial satellite, thousands of rockets and satellites have been sent into orbit. Many of these objects eventually became inactive but remained in space because there was no proper disposal system. Over time, collisions between objects created even smaller fragments, increasing the amount of debris orbiting Earth. Today, millions of debris particles of varying sizes travel around the planet at extremely high speeds, often exceeding 28,000 kilometers per hour. Even tiny particles can cause severe damage due to their enormous kinetic energy.

Space debris exists mainly in Low Earth Orbit (LEO), where most satellites and the International Space Station operate. This region has become highly congested because of the growing number of communication satellites and satellite constellations. As more countries and private companies enter the space industry, orbital traffic continues to increase rapidly. The accumulation of debris raises the likelihood of collisions, creating a dangerous environment for operational spacecraft.

One of the greatest impacts of space debris is the threat it poses to satellite operations. Satellites are designed to perform specific functions over many years, but collisions with debris can damage critical systems such as solar panels, communication antennas, sensors, and propulsion units. Even a small fragment only a few millimeters in size can puncture spacecraft surfaces or destroy sensitive equipment. Large debris collisions can completely disable satellites, leading to loss of communication, navigation services, or scientific data collection.

Satellite operators constantly monitor the movement of debris to avoid potential collisions. Space agencies use tracking systems and radar networks to observe thousands of objects in orbit. When a possible collision is detected, satellites may perform collision avoidance maneuvers by changing their orbit slightly. Although these maneuvers help protect satellites, they consume fuel and reduce the operational lifespan of the spacecraft. Frequent adjustments also increase operational complexity and costs for satellite companies.

The danger of space debris became widely recognized after several major incidents. In 2009, an inactive Russian satellite collided with an active American communication satellite, producing thousands of debris fragments. This event demonstrated how collisions could significantly worsen the debris problem. Another major concern is the possibility of a chain reaction known as the Kessler Syndrome. This theory suggests that collisions between objects in orbit could create more debris, leading to additional collisions and eventually making certain orbital regions unusable for future missions. If such a situation occurs, satellite operations and space exploration activities could face severe limitations.

Space debris also threatens human spaceflight missions. Astronauts aboard the International Space Station are vulnerable to debris impacts because the station continuously orbits within regions containing numerous debris particles. Protective shielding is installed on spacecraft and stations to reduce the risk of damage, but large debris objects remain extremely dangerous. In some cases, astronauts have had to take shelter in emergency spacecraft due to the threat of nearby debris.

The economic impact of space debris is also significant. Modern economies depend heavily on satellite services for telecommunications, banking, navigation, weather monitoring, and military operations. Damage to satellites can disrupt essential services and lead to substantial financial losses. The cost of designing debris-resistant spacecraft, monitoring orbital traffic, and performing avoidance maneuvers adds further expenses to satellite operations. Insurance costs for satellites may also increase as orbital risks continue to grow.

The rapid rise of mega-constellations has intensified concerns regarding orbital congestion. Private aerospace companies are launching thousands of small satellites to provide global internet coverage and communication services. While these systems offer major technological benefits, they also increase the possibility of collisions and debris generation. Effective traffic management and international coordination are therefore necessary to ensure the safe operation of satellites in crowded orbital regions.

To address the growing debris problem, scientists and engineers are developing several mitigation strategies. One important approach is designing satellites with end-of-life disposal systems. After completing their missions, satellites can be moved into lower orbits where they burn up in Earth's atmosphere or transferred to graveyard orbits away from active satellites. Space agencies also recommend reducing the release of mission-related objects during launches and preventing explosions caused by leftover fuel or battery failures.

Active debris removal is another promising solution. Researchers are studying technologies capable of capturing and removing large debris objects from orbit. Proposed methods include robotic arms, nets, harpoons, magnetic systems, and laser-based techniques. Some experimental missions have already demonstrated the possibility of debris capture in space. Removing large abandoned satellites and rocket stages could significantly reduce the risk of future collisions.

International cooperation is essential for solving the space debris problem because outer space is shared by all nations. Organizations such as the United Nations and various space agencies have established guidelines for responsible space operations and debris mitigation. However, these guidelines are mostly voluntary, and stronger international regulations may be needed in the future. Countries and private companies must work together to improve tracking systems, share orbital data, and develop common safety standards.

Technological advancements in artificial intelligence and automation are also helping improve debris monitoring and satellite protection. AI-based systems can analyze large amounts of orbital data and predict potential collision risks more accurately. Autonomous satellites may eventually perform avoidance maneuvers without direct human control, increasing response speed and operational efficiency.

Public awareness about space debris is growing as dependence on satellite technology increases worldwide. Educational programs, scientific research, and international discussions are helping highlight the importance of maintaining a sustainable space environment. Protecting Earth's orbital regions is essential not only for current satellite operations but also for future generations of explorers and scientists.

In conclusion, space debris has become one of the most serious challenges facing modern aerospace operations. The accumulation of abandoned satellites, rocket fragments, and collision debris threatens the safety, efficiency, and sustainability of satellite missions. Collisions with debris can damage spacecraft, disrupt communication systems, endanger astronauts, and increase operational costs. As the number of satellites in orbit continues to grow, the risk of orbital congestion and chain-reaction collisions becomes more significant. However, through technological innovation, international cooperation, responsible satellite design, and active debris removal efforts, humanity can reduce these risks and ensure the long-term sustainability of space activities. Addressing the space debris problem is essential for protecting the future of satellite operations and preserving outer space as a valuable resource for all mankind

Public awareness about space debris is growing as dependence on satellite technology increases worldwide. Educational programs, scientific research, and international discussions are helping highlight the importance of maintaining a sustainable space environment. Protecting Earth's orbital regions is essential not only for current satellite operations but also for future generations of explorers and scientists.

In conclusion, space debris has become one of the most serious challenges facing modern aerospace operations. The accumulation of abandoned satellites, rocket fragments, and collision debris threatens the safety, efficiency, and sustainability of satellite missions. Collisions with debris can damage spacecraft, disrupt communication systems, endanger astronauts, and increase operational costs. As the number of satellites in orbit continues to grow, the risk of orbital congestion and chain-reaction collisions becomes more significant. However, through technological innovation, international cooperation, responsible satellite design, and active debris removal efforts, humanity can reduce these risks and ensure the long-term sustainability of space activities. Addressing the space debris problem is essential for protecting the future of satellite operations and preserving outer space as a valuable resource for all mankind.

Beyond the Cockpit: Smart Instruments Shaping Modern Flight

Mr. G V Surya Narayana

Asst. Professor

The evolution of aviation has transformed aircraft cockpits from collections of traditional analog gauges into highly advanced digital workstations. Modern aircraft are equipped with smart instruments that continuously monitor flight conditions, engine performance, navigation, weather, and surrounding traffic. These technologies not only reduce pilot workload but also improve accuracy, efficiency, and passenger safety.

One of the most significant innovations is the Glass Cockpit. Instead of dozens of mechanical instruments, large electronic displays present all critical flight information in an organized and easy-to-read format. Pilots can quickly access altitude, airspeed, heading, engine parameters, navigation maps, and weather information on a few multifunction displays. This digital integration reduces confusion and enables faster decision-making during flight.

Another revolutionary technology is the Flight Management System (FMS). Acting as the aircraft's navigation computer, the FMS calculates the most efficient flight path, fuel consumption, cruising altitude, and estimated arrival time. By combining information from GPS, navigation aids, and aircraft sensors, it guides the aircraft accurately from take-off to landing while minimizing fuel usage and operational costs.

The Head-Up Display (HUD) has become an essential instrument in many commercial and military aircraft. It projects critical flight information directly onto a transparent screen in front of the pilot. This allows the pilot to monitor speed, altitude, runway alignment, and flight guidance without looking down at the instrument panel. HUD technology is especially valuable during poor visibility and precision landings.

A major advancement in aviation safety is the Synthetic Vision System (SVS). Using terrain databases, GPS information, and onboard computers, SVS creates a realistic three-dimensional image of mountains, airports, and surrounding terrain. Even when visibility is poor due to fog or darkness, pilots can clearly understand the aircraft's position relative to the environment.

Modern aircraft also use Enhanced Vision Systems (EVS), which employ infrared cameras to detect runways, obstacles, and terrain that may not be visible to the naked eye. This technology improves landing safety during nighttime operations and adverse weather conditions, giving pilots additional confidence during critical flight phases.

Weather remains one of aviation's greatest challenges. The Weather Radar System continuously scans the atmosphere ahead of the aircraft and displays thunderstorms, heavy rainfall, turbulence, and other hazardous weather. Pilots can safely alter their route well in advance, protecting passengers and the aircraft from dangerous conditions.

To prevent collisions in increasingly crowded skies, aircraft are equipped with the Traffic Collision Avoidance System (TCAS). This intelligent system monitors nearby aircraft using transponder signals. If another aircraft comes too close, TCAS provides immediate visual and voice instructions, directing pilots to climb or descend to maintain safe separation.

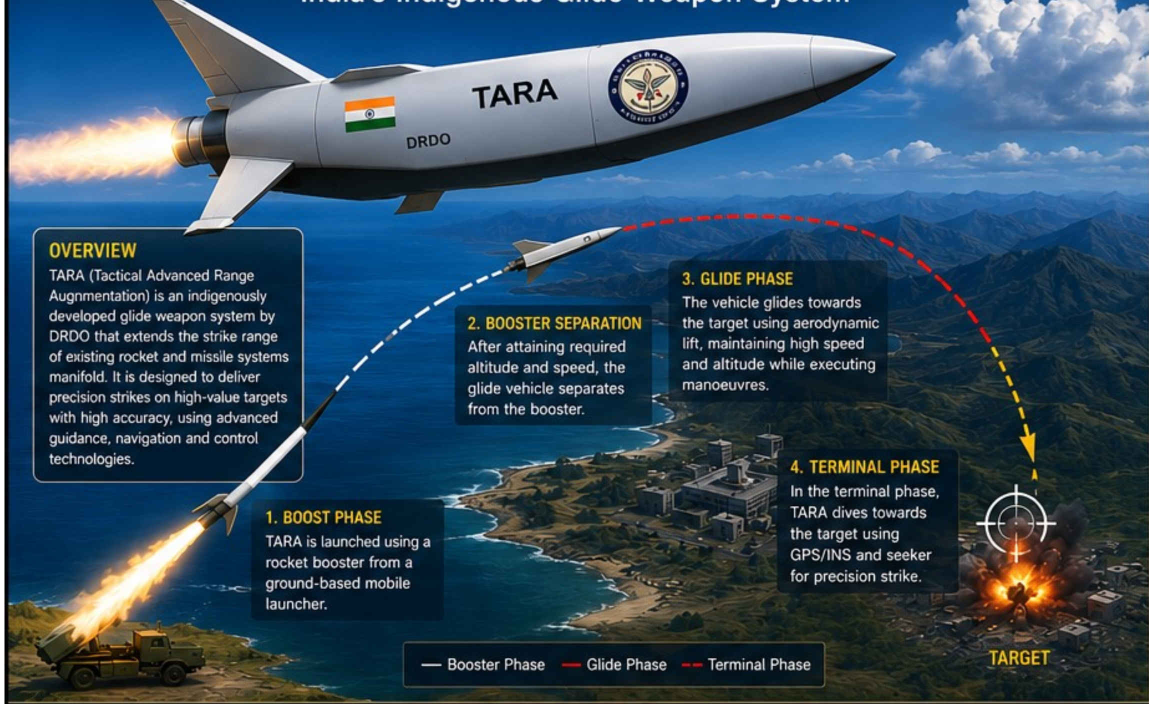
Another indispensable instrument is the Global Positioning System (GPS) integrated with satellite navigation. GPS provides highly accurate aircraft positioning anywhere in the world, allowing pilots to follow precise routes with exceptional reliability. Combined with advanced navigation software, GPS has greatly improved flight efficiency and reduced navigation errors.

Aircraft engines are constantly monitored through sophisticated Engine Indication and Crew Alerting Systems (EICAS) or Electronic Centralized Aircraft Monitoring (ECAM) systems. These systems continuously analyze engine health, fuel flow, hydraulic systems, electrical systems, and flight controls. If any abnormal condition occurs, the system immediately alerts the pilots and recommends corrective actions, ensuring quick and informed responses.

The future of aircraft instrumentation is even more exciting. Artificial Intelligence (AI), predictive maintenance, augmented reality displays, satellite communication, and autonomous flight technologies are gradually becoming part of next-generation aircraft. These innovations promise greater operational efficiency, enhanced safety, lower maintenance costs, and environmentally friendly aviation.

Advanced aircraft instruments have revolutionized modern aviation by transforming complex flight operations into safer, smarter, and more efficient missions. As technology continues to evolve, tomorrow's cockpits will become even more intelligent, supporting pilots with unprecedented levels of automation while maintaining the highest standards of safety. These remarkable instruments truly represent the future of flight, where innovation and precision work together to connect the world through aviation.

Tactical Advanced Range Augmentation
TARA
India's Indigenous Glide Weapon System



KEY TECHNOLOGIES

Glide Body Design
High lift-to-drag ratio configuration with advanced aerodynamic launtrol surfaces enables long-range glide and high manoeuvrability.

Advanced Guidance & Navigation
Integrated INS/GNSS with anti-jam capability and terrain contour matching ensures high accuracy even in GPS-denied environments.

Control & Actuation System
Electro-mechanical actuators control canards and fins for real-time manoeuvring and path correction during glide.

Thermal Protection System
Advanced composites and ablative materials withstand high temperatures during high-speed glide through atmosphere.

Seeker & Targeting
Electro-optical / IR seeker in the terminal phase ensures precise target acquisition and impact on moving or static targets.

SALIENT FEATURES

- **Extended Range** – Significantly increases the range of existing rockets and missiles.
- **High Precision** – Circular Error Probable (CEP) in single-digit meters.
- **All-Weather Capability** – Operates in day, night and adverse weather conditions.
- **Low Radar Signature** – Stealthy design reduces detectability.
- **High Survivability** – Capable of complex manoeuvres to evade enemy defences.
- **Rapid Deployment** – Compatible with multiple launcher systems.

WORKING PRINCIPLE

TARA works on the principle of "boost-glide-strike". It is carried to a high altitude and velocity by a rocket booster. Once the required energy is achieved, it separates from the booster and enters the glide phase. During this phase, its aerodynamic design generates lift, allowing it to glide over long distances while maintaining high speed. The onboard guidance system continuously calculates the optimum path, and control surfaces adjust the trajectory to reach close to the target area. In the terminal phase, the seeker takes over to acquire and engage the target with high precision.

TECHNOLOGY IN DETAIL

1. **Airframe and Aerodynamics**
   TARA has a blended body-wing configuration with a sharp nose, delta wings and moving control surfaces. The design ensures a high lift-to-drag ratio for maximum glide range and manoeuvrability. The airframe is built using lightweight composite materials for strength and thermal resistance.
2. **Propulsion and Launch**
   It is launched using a solid rocket booster that provides the initial thrust. The booster is jettisoned after achieving the required velocity and altitude. TARA does not have any propulsion of its own during the glide phase, thus relying on aerodynamic lift for long-range travel.
3. **Guidance, Navigation and Control (GNC)**
   TARA uses a combination of Inertial Navigation System (INS) and Global Navigation Satellite System (GNSS) for precise navigation. It has an advanced flight computer that executes guidance algorithms for mid-course updates. In GPS-denied conditions, terrain contour matching and stored maps help ensure accurate navigation.
4. **Control System**
   The vehicle is equipped with multiple control surfaces such as canards, elevons and rudders, which are actuated by high-precision electro-mechanical actuators. These surfaces allow it to perform roll, pitch and yaw manoeuvres for path correction and evasion of enemy interceptors.
5. **Seeker and Targeting System**
   In the terminal phase, an electro-optical or infrared seeker is activated for target acquisition. It can engage both stationary and moving targets with high accuracy. The seeker is resistant to countermeasures and has image processing capabilities for precise hit.
6. **Thermal Protection and Stealth**
   During high-speed glide, the outer surface experiences extreme temperatures due to aerodynamic heating. TARA uses advanced thermal protection materials and coatings to withstand the heat. Its low radar cross-section (RCS) design makes it difficult to detect and track.

APPLICATIONS

- Precision strikes on high-value targets like command centres, radar installations, ammunition depots and critical infrastructure.
- Capable of launch from multiple platforms and existing rocket systems.
- Ideal for deep-strike missions in contested and high-threat environments.

DEVELOPER: Defence Research and Development Organisation (DRDO), India

PHOTO GALLERY

Tactical Advanced Range Augmentation (TARA)

DEPARTMENT ACHIEVEMENTS

ANTHARIKSH

THE SPACE...

DEPARTMENT OF AEROSPACE ENGINEERING
LAKIREDDY BALI REDDY COLLEGE OF ENGINEERING
MYLAVARAM, ANDHRA PRADESH, INDIA.

antharikshlbrce@gmail.com