CAD Flightframe:
SolidWorks Project Under India Space Lab

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Preface

This report has been prepared as part of my internship at **India Space Lab (ISL)**. It documents the learnings and experiences gained while working on the project titled *"CAD Flightframe: SolidWorks Project Under India Space Lab"*. The internship was designed to provide practical exposure to 3D CAD modeling and introduce real-world applications in the field of aerostructure design.

The objective of this report is to present a clear and concise summary of the work undertaken, tools and techniques used, challenges encountered, and the skills developed during the course of this internship. Through this project, I gained insights into interpreting engineering drawings, using SolidWorks efficiently, and applying aerospace design considerations to a real-world component.

This report serves as a reflection of my efforts and learnings, and is intended for academic review, portfolio reference, and future learning documentation. I hope it proves informative and demonstrates the technical growth I achieved through this internship experience.

Acknowledgement

I would like to express my heartfelt gratitude to **India Space Lab (ISL)** for offering me this valuable internship opportunity. The project provided me with deep insights into drone frame design and practical exposure to CAD modeling using SolidWorks. I am thankful to the entire ISL team for their constant guidance, encouragement, and support throughout the duration of the internship.

This internship has been a pivotal part of my academic journey, where I was able to bridge theoretical knowledge with practical application. The structured learning modules, hands-on design assignments, and continuous mentor feedback helped enhance my understanding of aerospace design principles and professional engineering practices.

I extend my sincere thanks to my university, **Rashtriya Raksha University**, for facilitating my participation in this program and providing the necessary academic and administrative support. I am particularly grateful to my faculty mentors and academic coordinators for motivating me to explore such technical opportunities beyond the classroom.

This experience has not only helped me build technical competency but has also instilled confidence in my ability to take on real-world engineering challenges. I am confident that the knowledge and skills gained during this internship will significantly contribute to my future academic pursuits and professional development.

Contents

1 Introduction **5**

2 Organization Profile **5**

3 Internship Objectives **5**

4 Roles and Responsibilities **6**

5 Project Title **6**

6 Project Overview **6**

7 Tools and Technologies Used **7**

8 Implementation Methodology **7**

9 Challenges and Solutions **8**

10 Skills Acquired **9**

11 Skills Acquired **9**

12 Conclusion and Learnings **10**

13 Annexures **10**

14 References **10**

Introduction

Unmanned Aerial Vehicles (UAVs), commonly known as drones, have become increasingly significant in fields ranging from defense and surveillance to delivery, mapping, and agriculture. One of the most critical aspects of drone technology lies in its structural integrity and design precision. Understanding how to design drone frames that are lightweight yet strong is essential for efficient performance and flight stability.

This internship, conducted under the guidance of **India Space Lab (ISL)**, provided me with the opportunity to delve into the fundamentals of drone aerostructure design. The primary task was to model a drone frame in **SolidWorks**, a powerful computer-aided design (CAD) software. The goal was to replicate a drone frame from given 2D engineering drawings and convert it into a fully detailed 3D model, applying appropriate design features and mechanical considerations.

Through this project, I explored the process of translating conceptual and dimensional data into a digital design that is both functionally accurate and manufacturable. The assignment involved operations such as sketching profiles, applying extrusion and cut features, and utilizing tools like fillets, chamfers, and symmetry patterns to reflect real-world drone components.

The internship served not only as a practical application of classroom knowledge but also as a platform to build skills in professional modeling tools. By working on this structured task, I developed a deeper understanding of how theoretical design principles are applied in engineering workflows. The report that follows outlines the entire process — from conceptualization and software implementation to outcomes and reflections — providing a comprehensive overview of the technical and professional growth achieved during the internship.

Organization Profile

India Space Lab (ISL) is a technical education platform offering workshops and internships in aerospace, robotics, and CAD modeling. It focuses on bridging academic learning with industry practice.

Internship Objectives

As a **Space Tech Intern** at India Space Lab, the primary objective of my internship was to gain practical exposure to engineering design concepts applied in aerospace and UAV systems. The internship aimed to bridge the gap between theoretical knowledge and its application in the space and defense sector through hands-on technical assignments.

My chosen assignment — *Drone Frame Design Using SolidWorks* — was aligned with the following key objectives:

- To understand the fundamentals of aerostructure design relevant to UAVs.
- To interpret and translate 2D engineering drawings into accurate 3D CAD models.

- To develop proficiency in SolidWorks for modeling mechanical components.
- To simulate industry practices in aerospace design through a structured design workflow.
- To build a technically sound and portfolio-ready project reflecting real-world space-tech applications.

Roles and Responsibilities

During the internship, I undertook the role of a **Space Tech Intern** with a focus on structural CAD modeling. I was responsible for completing the drone frame design assignment using SolidWorks, following the engineering specifications provided by ISL.

My responsibilities included:

- Carefully studying the given 2D CAD drawings and understanding the dimensional constraints.
- Creating a fully defined 3D model of the drone frame using relevant features in SolidWorks.
- Applying modeling techniques such as Extrude, Cut, Fillet, Chamfer, Mirror, and Pattern tools.
- Ensuring structural accuracy, symmetry, and consistency with aerospace design standards.
- Managing the file naming conventions and final submission in the required format.
- Documenting the process and compiling a detailed report showcasing learning outcomes.

Project Title

CAD Flightframe: SolidWorks Project Under India Space Lab

Project Overview

As part of my role as a Space Tech Intern at India Space Lab (ISL), I undertook a technical assignment focused on the 3D design of a drone frame using SolidWorks. This project aimed to simulate the process of designing an aerostructural component typically used in unmanned aerial vehicles (UAVs), which are increasingly relevant to both space and defense applications.

The assignment involved converting detailed 2D engineering drawings into a fully functional 3D CAD model of a drone frame. These drawings provided multiple views and precise

dimensional data, requiring careful interpretation to ensure geometric and structural accuracy in the digital model. The task reflected real-world design challenges that engineers face when building airframes for lightweight aerial platforms.

The project was structured to help interns like me gain experience in CAD-based aerospace design workflows. I had to utilize key features of SolidWorks, such as sketching, extrusions, cuts, fillets, chamfers, and symmetry tools, to build a structurally sound and design-ready model. Emphasis was placed on maintaining dimensional accuracy, structural balance, and manufacturability of the design.

In addition to hands-on modeling, the project also served as a platform to understand the importance of documentation, precision, and iterative design — all of which are essential in space technology and UAV system development. The resulting model serves as a foundational artifact for my portfolio and demonstrates my ability to apply engineering concepts to real-world aerospace challenges.

Tools and Technologies Used

The following tools and technologies were utilized during the completion of the drone frame design project under the ISL Space Tech Internship:

- **SolidWorks 2024**: The primary 3D CAD software used for designing the drone frame. SolidWorks enabled parametric modeling, feature-based design, and high-precision control over dimensions and geometry. Key operations included:
  - *Sketching Tools*: Line, circle, rectangle, dimensioning, constraints
  - *Feature Tools*: Extruded Boss/Base, Extruded Cut, Fillet, Chamfer, Mirror, and Linear Pattern
  - *Reference Geometry*: Planes and axes used for symmetric and multi-view design
- **2D Engineering Drawings (provided by ISL)**: Official design schematics used as the base reference for dimensioning and layout.

Implementation Methodology

The drone frame design was implemented through a structured, step-by-step modeling process using SolidWorks. The methodology followed industry-inspired CAD workflows to ensure dimensional precision, structural feasibility, and alignment with the provided 2D drawings. The major stages are as follows:

1. **Analysis of 2D Drawings:** The assignment began with a thorough study of the engineering drawings provided by India Space Lab. Multiple orthographic views (top, front, and side) were examined to understand dimensions, hole placements, geometry, and structural layout.
2. **Sketch Creation:** The base profile of the drone frame was sketched in SolidWorks using tools like lines, rectangles, circles, and centerlines. Geometric constraints and smart dimensions were applied to fully define the sketch before any feature was added.

3. **Feature-Based Modeling:** Using the sketch as a base, 3D features were created through:
    - *Extruded Boss/Base* to build the frame structure
    - *Extruded Cut* to remove material for slots and holes
    - *Fillet and Chamfer* to smooth edges and reduce stress concentration
4. **Symmetry and Repetition:** To maintain uniformity and reduce manual repetition, features were mirrored and replicated using the *Mirror* and *Linear Pattern* tools wherever applicable.
5. **Design Verification:** Dimensions were rechecked against the original 2D drawings to ensure the model's fidelity. Adjustments were made where necessary to align with standard drone design practices.
6. **File Finalization and Naming:** The final model was saved in the required `.SLDPRT` format with the file name `VivekYadav_DroneFrame.SLDPRT`, as per ISL submission guidelines.
7. **Documentation and Reporting:** Screenshots of the model were captured from multiple views, and a detailed report was compiled to describe the process, tools used, challenges faced, and outcomes of the project.

Challenges and Solutions

While working on the drone frame design project, several challenges emerged during different phases of modeling and interpretation. Each issue provided an opportunity to apply problem-solving skills and deepen my understanding of CAD workflows. The major challenges and their corresponding solutions are detailed below:

- **1. Interpreting Complex 2D Drawings:** The provided engineering diagrams included overlapping dimensions and intricate views that were initially difficult to interpret, especially for feature alignment and spacing.
    - *Solution:* The drawings were broken down into smaller logical components. I created reference sketches and auxiliary lines to better visualize relative positioning before proceeding with modeling.
- **2. Maintaining Dimensional Accuracy:** Small deviations in measurements could lead to asymmetric or structurally flawed designs.
    - *Solution:* SolidWorks Smart Dimension and constraint tools were used extensively to ensure that every sketch was fully defined before applying features.
- **3. Modeling Symmetry Across Multiple Features:** Manually replicating similar cutouts and mounting points across symmetrical arms or segments was tedious and error-prone.

  - *Solution:* Mirror and Linear Pattern tools were effectively used to automate the duplication of features, ensuring geometric consistency.

- **4. Fillet and Chamfer Conflicts:** Some fillets overlapped with existing cuts, leading to rebuild errors or broken geometry.
  - *Solution:* The order of operations was revised. Fillets and chamfers were applied at the final stages after completing all essential cut features, and values were adjusted as needed.

- **5. System Performance Limitations:** At times, the modeling software lagged due to complex geometry and rendering.
  - *Solution:* Sketch complexity was reduced by simplifying constraints and suppressing certain features temporarily during editing.

Skills Acquired

- 3D modeling with SolidWorks
- Engineering drawing interpretation
- Drone frame structure understanding
- Project documentation

Skills Acquired

The internship experience provided me with an opportunity to apply academic knowledge to a real-world design task. By completing the drone frame modeling assignment, I was able to acquire the following technical and professional skills:

- **Proficiency in SolidWorks:** Developed a strong understanding of 3D CAD modeling techniques, including sketching, feature-based modeling, and design automation tools like mirror and pattern.
- **Engineering Drawing Interpretation:** Improved ability to analyze and convert 2D orthographic projections into 3D models with correct dimensional accuracy and geometric relationships.
- **Aerostructure Design Fundamentals:** Gained insight into structural considerations for drone frames such as weight distribution, symmetry, and component mounting zones.
- **Design Thinking and Problem Solving:** Strengthened logical thinking and troubleshooting skills by resolving modeling errors and design conflicts throughout the assignment.

- **Technical Documentation:** Learned to document the design workflow, tools used, challenges encountered, and outcomes in a structured and professional report format.
- **Time and Task Management:** Managed deadlines and deliverables within the internship schedule while maintaining attention to detail in design.
- **Industry-Relevant Exposure:** Gained awareness of practical CAD design applications in the aerospace and UAV sector, aligning academic learning with industry expectations.

Conclusion and Learnings

The internship experience at India Space Lab has been a significant milestone in my academic and professional journey. As a Space Tech Intern, I had the opportunity to apply engineering concepts in a practical setting through the drone frame design assignment using SolidWorks. This hands-on project not only enhanced my technical proficiency in 3D CAD modeling but also deepened my understanding of real-world aerostructure design.

One of the most valuable outcomes of this internship was the ability to interpret complex 2D engineering drawings and translate them into precise 3D models. The project challenged me to think critically, approach problems methodically, and maintain design accuracy throughout the modeling process. It also familiarized me with common design constraints and best practices in aerospace engineering workflows.

Beyond the technical domain, the internship improved my documentation skills and introduced me to the discipline required in professional design environments. Working independently while adhering to structured timelines helped me develop time management and self-reliance—qualities essential in both academic and industry settings.

Overall, this internship has provided me with a strong foundation in mechanical CAD design and a deeper appreciation for the design and development process behind aerospace systems. The skills and insights gained will undoubtedly support my future pursuits in engineering, whether in advanced academic projects, research, or space-tech industry roles.

Annexures

- Final Drone Frame CAD Model — `VivekYadav_DroneFrame.SLDPRT` (submitted digitally)

References

- ISL 2D Drawing Material
- SolidWorks Help
- Workshop notes