Project Documentation: Design and Simulation of a basic Quadcopter using SolidWorks and MATLAB

Anum Siddiqui, Srivathsa Thotakura

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Abstract

This report was made as documentation on the project **Design and Simulation of a basic Quadcopter** as part of the convenor training for ERC Tenure 2024-2025. It involves the use of SolidWorks to build a quadcopter with propellers, and using MATLAB to simulate the flight of the drone.

Link and Guide for the Installation of SolidWorks 2021 Education License: `http://ftp.iitb.ac.in/ftp/IITB_private/SolidWorks/2021/`
Please connect to Internet IITB or IITB Wireless to install OR use SolidWorks. If not on campus, connect to IITBADV VPN:`https://www.cc.iitb.ac.in/authenticate/content/tabs/howto/vpn.php`

To install MATLAB, go to `https://in.mathworks.com/downloads/` and make a MathWorks account with your LDAP ID. Then download the software and login again, with the same account.
Post installation of MATLAB, go to the Addins marketplace and install the Simulink and Simuscape Multibody Addins. These will enable MATLAB to recognize the physical features of our SolidWorks model.

To install the **Simuscape Multibody Link Plugin** for SolidWorks, go to `https://in.mathworks.com/help/smlink/ug/installing-and-linking-simmechanics-link-software.html`

Documentation

0.1 Introduction

0.1.1 Modelling in SolidWorks

We used multiple tools from SolidWorks to build our model. The basics were the same sketching, dimensioning and constraining as we did in Fusion 360. The tools are quite similar to what we used.
Following are the tools which are most often used:

- Sketch tools: Centre Line, Circle, Rectangle, Line, Trim, Mirror, Linear Pattern, Circular Pattern
- Extrude
- Cut Extrude
- Revolve
- Reference Planes (for offset drawings)

The Assembly methods, are somehow a bit different from Fusion 360. SolidWorks does not take input of explicit mentioning of Joints and Movement. Rather, It is more close to reality. It expects you to make joints, screws etc and constrain them so as to simulate the object close to reality. This ensures that all possible scenarios are covered and no unnecessary motion takes place.

0.2 Robotic Arm Design in SolidWorks

0.2.1 Modeling Approach

(Briefly explain your design approach in SolidWorks. Did you use existing components or create custom parts?) (Mention the degrees of freedom (DOF) of your robotic arm.)

0.2.2 3D Model Description

(Include a detailed description of your 3D model in SolidWorks. Use subsections for different parts if necessary.) (Include figures generated in SolidWorks to illustrate your model. Use `\includegraphics` command for this.)

0.3 Robotic Arm Simulation in MATLAB

0.3.1 Software and Libraries

(Specify the version of MATLAB and any toolboxes used for simulation (e.g., Robotics Toolbox).)

0.3.2 Kinematic Modeling

(Explain how you modeled the robot's kinematics in MATLAB. Did you use Denavit-Hartenberg parameters?) (Include relevant equations for forward and/or inverse kinematics if applicable. Use `\begin{align*}...\end{align*}` for aligned equations.)

0.3.3 Simulation Setup

(Describe the setup of your MATLAB simulation. Did you use Simulink or a script-based approach?) (Include a block diagram or relevant code snippets if using Simulink. Use `\begin{lstlisting}...\end{lstlisting}` for code blocks.)

0.4 Results and Discussion

(Present the results of your simulation. Include plots, figures, or tables to show the robot's behavior (e.g., workspace, trajectory).) (Discuss the performance of your robotic arm design based on simulation results.)

0.5 Conclusion

(Summarize the key achievements of your project.) (Mention potential improvements or future work directions.)

0.6 References

(List all references used in your report.)