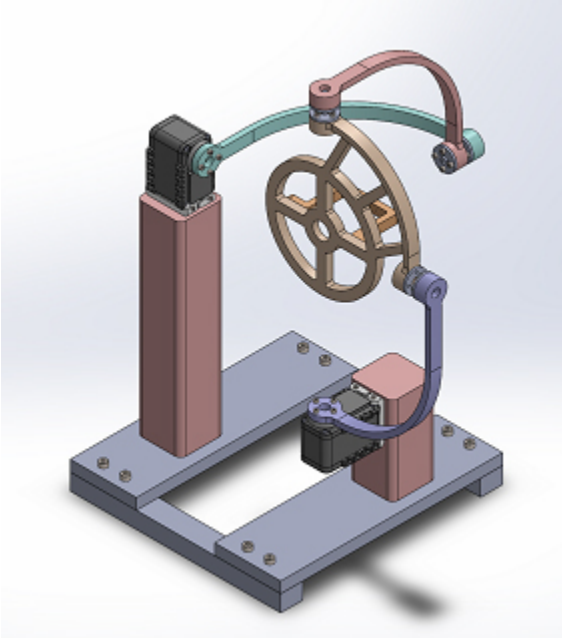
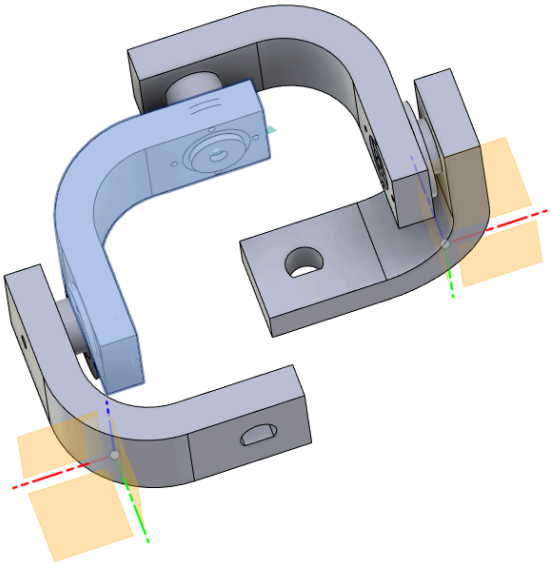
Prototyping of a 2-DOF Parallel Robot





Project Objectives

To learn the entire process of robot prototyping through the example of a 2-degree-of-freedom (2-DOF) parallel robot and to apply the skills acquired from a prototyping course in the design, development, and manufacturing of the robot.

1. **Design Phase:**
    - Develop a detailed 3D model of the 2-DOF parallel robot.
    - Simulate the robot's kinematics and dynamics to ensure optimal performance.
2. **Manufacturing Phase:**
    - 3D printing materials using ANYCUBIC printer.
    - Assemble the robot with bearings.
3. **Control and Testing Phase:**
    - Testing robot’s movement.
    - Conduct tests to evaluate the robot’s accuracy, repeatability, and operational efficiency.

Justification of the parameters of the robot structure

1. To optimize printing time, we focused on developing a mini robot. This approach not only reduces the manufacturing time but also allows for quicker iterations during the prototyping phase. The miniaturized design maintains functionality while being more time-efficient to produce.

Progress of Prototype Manufacturing

1. **Design Finalization:**
    - Completed the CAD model and simulation studies. The design was iterated based on simulation results to optimize performance.
2. **G-code Generation and 3D Printing:**
    - After finalizing the 3D model of the robot in SolidWorks, the G-code for the robot parts was generated.
    - Using PETG filament and an ANYCUBIC 3D printer, the parts of the robot were printed.
3. **Component Fabrication:**
    - Searched for proper bearings in the robotics lab 105a to ensure smooth joint operation.
    - Polished inaccuracies from the 3D printing process to ensure proper fit and alignment of all components.
    - Installed the bearings into the printed parts.
4. **Assembly:**
    - Assembled the robot structure, ensuring precise alignment of all components.
5. **Initial Testing:**
    - Conducted preliminary tests to verify the mechanical integrity and basic functionality of the robot.

Main Conclusions

- **Design Viability:**
    - The 2-DOF parallel robot design partially meets the initial objectives in terms of workspace.
- **Manufacturing Precision:**
    - Low-precision manufacturing techniques resulted in not a well-constructed prototype. Even polishing could not help to fully achieve the required workspace.
- **Functional Testing:**
    - Preliminary tests demonstrate that the robot performs as expected.
- **Next Steps:**
    - Redesign robot with bigger parts.
    - During design make sure to take account of printer precision, and thus use calibration.
    - Explore potential applications in industrial automation and conduct field tests to validate performance in real-world scenarios.

https://github.com/Rizo11/Intro2Prototyping/tree/main/proj