

Design And Manufacture a 3-DoF Constrained Link Robotic Arm

Faisal Mazlan

Supervisor: Dr Guido Hermann

Robotic Arm Goals:

1. Capable of motion in 3 degrees-freedom
2. Be of constrained link design like a desk lamp.
3. Be lightweight
4. Have a high power-to-weight ratio
5. Be simple and easy to manufacture and assemble
6. Ability to control forces of contact, backdrivable mechanism
7. Of a compact size, yet easy enough to demonstrate to a group

Constrained Link Robotic Arm

Advantages:

1. High power-to-weight ratio due to less mass moment of inertia
2. Rigid links avoid need to factor in elasticity compared to most antagonistic actuator designs
3. Mechanically very simple

Disadvantages:

1. Inverse kinematics are harder to compute than traditional articulated robotic arms
2. Awkward workspace arrangement
3. Increasing complexity with longer kinematic chains

Research into concepts, actuator choices, materials, and design constraints

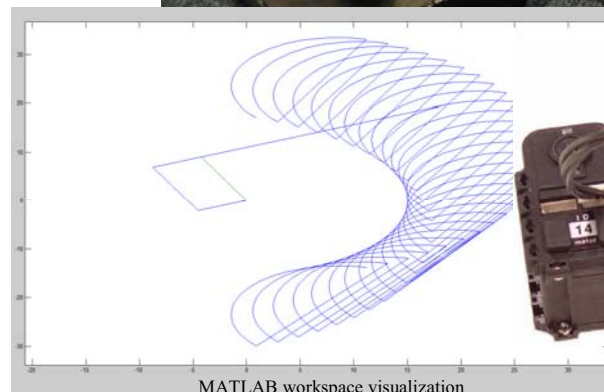
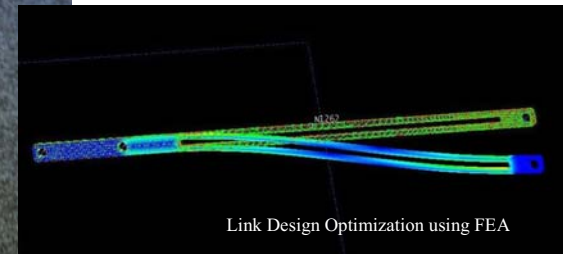
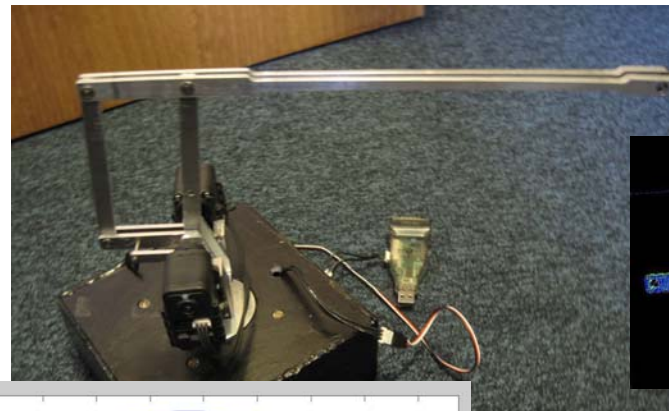
Computer Aided Design using NX-Ideas

Actuator requirements estimation and bending analysis using FEA

Basic MATLAB workspace visualization

Fabrication of parts in workshop and assembly

Practical Design Verification



MATLAB workspace visualization



Dynamixel AX-12+ servos

Smart Actuator, Robotis Dynamixel AX-12+ servos

- Simple to wire, ability to control multiple servos using single bus
- No special circuit needed for power. Any DC power supply up to 10v with adequate wattage is sufficient
- High torque for price range
- Integrated position, temperature, load and speed sensing
- Integrated position and speed control with possible load control
- Simple physical interface requiring just a power supply, USB2Dynamixel USB interface and a pc simplifies system integration