Design, Manufacturing, and Assembly of Modular Snake-Like Robotic Arm, Alongside Design and Implementation of System's Digital-Twin

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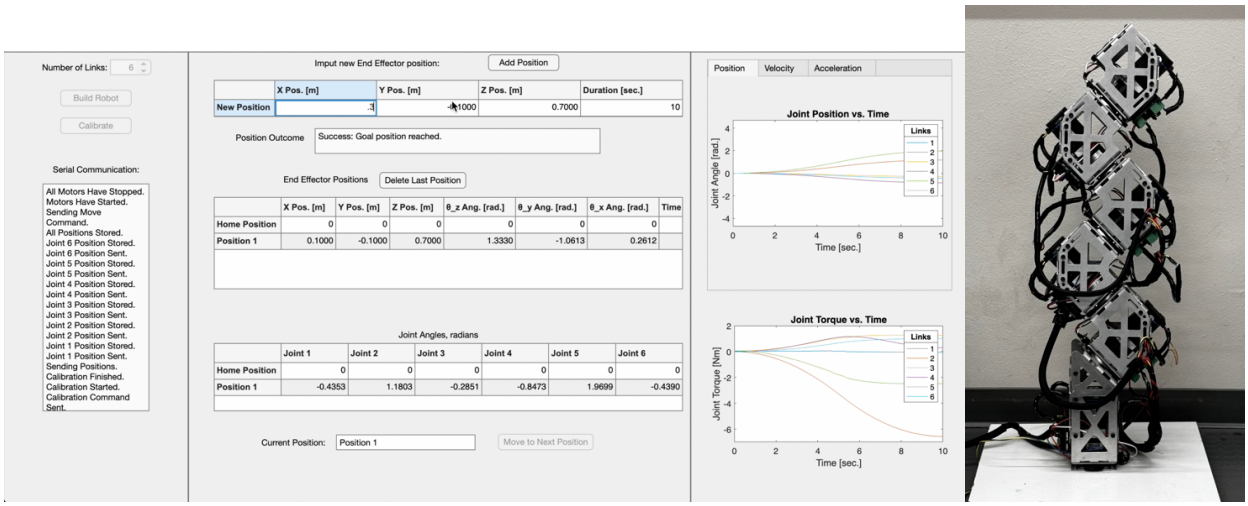

A unique modular snake-like robotic arm, also referred to as MA\RS – the Modular Arm \ Robotic System - was designed, manufactured, assembled, simulated, and programmed to create a modular robot which could move to a desired end position given the number of links, the position of the end link and the duration of motion. This robotic arm serves as the start of research into a modular space robotic system to be used in low-gravity environments. As such, this project focused on developing the initial design of the robot and its digital twin. The system's modularity allows for changes to the robot's workspace, which allow for the accomplishment of different tasks. The modular aspect of the robot required strong and lightweight links and used a bent sheet metal assembly to reduce mass and conserve strength. Each of the robot's links used a custom-built PCB to power the system, send signals from the MCU (an ESP32-S2) to the motor, and communicate to the main controller using CAN Bus. Simulation of the robot was performed using a MATLAB script and GUI built in MATLAB's App Designer, which calculated the system's path planning and inverse kinematics. The GUI communicated with the robot (through serial) and controlled the robot's motion as it was calibrated and moved from one location to another.

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