

Spring Validation Demonstration

Objective	Demonstrate manipulation in simulation and validate real-world reachability to a test object. Verify repeatability and perception integration, and independently demonstrate 3D reconstruction.
Element	Perception, Planning, Controls
Location	Wean Hall 1302
Equipment	Simulation Environment: MoveIt, MuJoCo, ROS2 Physical Setup: Robot arm with end-effector, Desktop Test Object: Basket, 3D printed object Perception System: ZED 1 Stereo/ Intel RealSense D435i
Personnel	Kartik, Emma, Megan, Shreya, Kailash
Procedure	
1. Launch simulation environment in MuJoCo and MoveIt, and initialize arms. 2. Run a simulation where the robotic arms pick up and manipulate objects. 3. Log planned vs. executed trajectories to analyze accuracy and performance. 4. Independently perform and validate 3D reconstruction of a known object with 3 cm precision. 5. Ensure the 3D reconstruction process outputs usable data within 10 minutes. 6. Set up the physical robotic arm in the real-world test environment. 7. Command the robotic arm to move and reach grasp points while staying within valid movement constraints. 8. Verify that the robotic arm reaches the intended position within tolerance ± 2 cm with a tape measure. 9. Record the motion execution and verify smooth movement without errors. 10. Measure the time taken for the arm to reach the basket. 11. Validate localization accuracy and confirm that planned vs. actual movement remains within acceptable error margins. 12. Repeat the verification at least three times with varying initial object poses. 13. Review data to verify system performance and identify potential improvements.	
Verification Criteria	
1. The arms in the simulation must successfully pick and manipulate objects. 2. The physical arm must successfully reach the grasp points in all trials while staying within movement constraints and pathfinding tolerance ± 2 cm. 3. MAPF should take within 4.4 ± 3.4 seconds to calculate arm trajectories. 4. The 3D reconstruction process should be completed within 10 minutes, and post-estimation should validate localization and positioning accuracy. 5. No unexpected errors, delays, or hardware failures should occur during execution.	