

Subject: Final Project Proposal: Comparative Study of Vision-Based Robotic Sorting

Dear Professor,

For my final project, I plan to implement and compare two different methods for an autonomous sorting task.

Project Objective: A `rtb.models.Panda()` arm, observed by a simulated camera, will autonomously sort "berries" (colored spheres) that appear at random locations on a tabletop. The robot must use its camera feed to locate the berries and place them into their corresponding color-coded bins.

Approach (The Core Comparison): I will solve this problem in two distinct ways to compare a classical robotics approach against a modern machine learning one.

1. Method 1: Classical CV & Motion Planning

- **Sensing:** I will use `OpenCV` to process the camera image, using HSV color masking to find the pixel coordinates of each berry.
- **Control:** After translating pixel data to world coordinates, I will use standard `roboticstoolbox` functions (like `ikine_...`) to plan and execute explicit pick-and-place trajectories.

2. Method 2: End-to-End Reinforcement Learning

- **Sensing & Control:** I will use a **Convolutional Neural Network (CnnPolicy)** that takes the raw camera image as direct input.
- **Training:** The agent will be trained (using `stable-baselines3`) in a headless `swift` simulation to learn its own policy for both "seeing" the berries and "acting" to sort them, based on a reward function.

Tools: This project will leverage the full suite of libraries we've used: `roboticstoolbox`, `spatialmath`, `spatialgeometry`, and `swift`, supplemented by `OpenCV` and `stable-baselines3`.