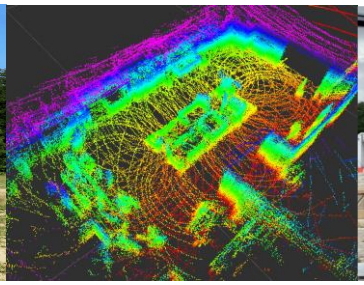
Machine Learning for Autonomous Forklift Pallet Drop Off onto Dunnage


Company Background:

At Stratom, we are driving the future of automation by developing unmanned ground vehicles and autonomous robotic systems for commercial and defense applications — whether in safe, controlled settings or dynamic and challenging terrain.

Specializing in unmanned cargo movement, autonomous mobile robots (AMR) and robotic refueling, our proven tools, methods, technologies and strategic services continuously meet our customers' unique and evolving needs in logistics and operations. Our solutions enable them to reduce monotonous, difficult or dangerous tasks to optimize uptime and efficiencies, address labor shortages, increase profitability, and keep people safe.

Project Description:


In military logistics applications, cargo pallets are typically placed onto dunnage - 4x4 wooden or rubber beams that elevate the pallet off the ground, allowing forklifts to insert their forks underneath for pickup and drop-off tasks. A standard drop-off requires three dunnage blocks, properly spaced and aligned to ensure the pallet sits level and is safely retrievable.

Reliable detection of dunnage is essential for autonomous systems like Stratom's Autonomous Pallet Loader (APL). Stratom's current system uses LiDAR-based perception pipelines to detect dunnage and evaluate drop-off zones. While effective in many cases, these pipelines can suffer from limitations in very noisy or unstructured environments, where pointclouds can be unreliable due to

occlusion and ground clutter like tall grass. This project explores the use of camera-based perception as a complementary or alternative solution.

Students will be provided with a camera and multiple pieces of dunnage and will collect and label their own dataset representing a variety of outdoor dunnage scenarios. The team will explore machine learning models to create an image based dunnage detection pipeline and integrate their detection algorithm into a ROS2-based software stack for real-time testing and visualization. The goal is not simply to detect the presence of dunnage through image segmentation or object classification, but to estimate the 3D pose of each beam, so the system can determine a drop off location for a pallet.

Stretch goals include classifying whether dunnage configurations are "good enough" for a safe drop-off and integrating the perception solution into the live camera feeds on Stratom's operational APL platform.

Through this project, students will gain hands-on experience in dataset development, algorithm design, model training and evaluation, and the integration of perception algorithms into a robotics-focused software stack. It offers a valuable opportunity to develop the practical skills needed to translate theoretical approaches into functional applications, preparing students to solve real-world perception challenges in autonomous logistics.

Desired Skillset:

- C++, Python
- ROS2
- Linux
- Docker
- Image processing, computer vision, and machine learning techniques
- 3D pose estimation

This project is an excellent way for students to leverage their foundation in C++ or Python to develop skills in computer vision, machine learning, and object localization and gain experience using ROS, an industry standard for robotics work. While experience in all of these skills is not strictly required, students should be up for the task of fast paced learning in these areas.

Team Size: ~4 Students

Location:

Meetings will primarily be held remotely using Teams or Zoom. Our office is located in Louisville at 331 South 104th Street, Suite 235, where students may have the opportunity to test their code on Stratom's Autonomous Pallet Loader platform as part of the project's stretch goals.

Note: All intellectual property developed as part of this project will be owned by Stratom