Using ROS2-CARLA Bridge to Integrate LiDAR into CARLA

The integration of LiDAR data into autonomous vehicle simulations is critical for realistic testing and development of autonomous driving algorithms. To connect CARLA with real-world robotic systems and advanced perception frameworks, middleware solutions like ROS2 (Robot Operating System 2) are often essential. The ROS2-CARLA bridge is a vital tool that facilitates seamless communication between CARLA and robotic systems, enabling real-world sensors and perception frameworks to interact effectively with simulated environments.

This project focuses on addressing the challenges of integrating LiDAR data streams with CARLA through the ROS2-CARLA bridge while leveraging efficient machine learning models for advanced perception tasks. The outcomes will improve the simulation's fidelity and enable more effective testing of autonomous driving algorithms, bridging the gap between simulation and real-world systems.

Technical Challenges

1. **Building Robust Connections**: Establishing reliable and efficient communication channels between CARLA and ROS2 via the ROS2-CARLA bridge for seamless LiDAR integration.
2. **Real-Time Data Streaming**: Achieving low-latency, high-throughput streaming of LiDAR data between CARLA and ROS2 to enable real-time perception and decision-making.
3. **Key function realization**: Integrating efficient machine learning models within the ROS2 framework to process LiDAR data in real-time.

Proposed Approach

1. **Literature Review and Setup**: Review the existing works on ROS2-CARLA bridge. Then, build the connection based on the existing methods and our requirements.
2. **LiDAR Integration and Data Streaming**: Configure ROS2 nodes to receive LiDAR point cloud data. Optimize the streaming pipeline to ensure low-latency, high-throughput data transfer between CARLA and ROS2.
3. **Machine Learning Model Implementation**: Implement the models (e.g., object detection with Yolo, distance estimation, and obstacle tracking), test their stability and latency, and integrate their results into Carla decision making.

Tentative Timeline

- **February:** Conduct literature review and set up the development environment. Build a basic pipeline with ROS2-CARLA bridge.
- **March**: Integrate LiDAR into ROS2 and implement the machine learning models, then feed the data back to Carla with the pipeline.
- **April**: Use the LiDAR data to replace Carla’s virtual LiDAR functions. Optimize the efficiency and robustness of the system.