Representation Learning

Context:

The EPFL Xplore Research Pole has the objective of building a legged robot. The robot is designed to autonomously navigate through challenging terrain using its on-board sensors. To achieve this, the project aims to enhance the robot's mapping capabilities.

Project description:

The objective of this project is to implement a Deep Learning Model aimed at enhancing the mapping capabilities of the Robot Perception system. The algorithm is based on the research paper titled: "**Neural Scene Representation for Locomotion on Structured Terrain**" from Ruben Grandia and al (ETH).

The input to the Model comprises sensor data from a stereo camera and a potential lidar. The model will be trained to accurately learn a precise representation of the environment.

Furthermore, the student will be an integral part of the Xplore Legged Robot Team, actively participating in its weekly meetings and working sessions. This collaboration will facilitate close interaction with other team members, and the student is expected to share their findings and progress with the team regularly.

Tasks:

The project involves a series of tasks, outlined below (note that this list is not exhaustive):

- **Literature Review and Familiarization** – Thoroughly understand the paper, "*Neural Scene Representation for Locomotion on Structured Terrain*" and conduct a literature review focused on representation learning in relevant contexts.
- **Model testing and data collection –** Conduct comprehensive testing of the implemented model. Collect relevant data from our legged robot, utilizing the stereo camera and lidar sensors. A good option is also to use NVIDIA's IsaacSim / IsaacGym simulation environment to create many randomized terrains and collect data on them using simulated sensors.
- **Algorithm Effectiveness Validation –** Demonstrate the efficacy of the algorithm by applying it to our legged robot data. Showcase how the model enhances mapping accuracy and contributes to the robot's ability to navigate swiftly and safely, particularly in the presence of obstacles.

Requirements:

- Prior experience with Deep Learning.
- Familiarity with ROS is also a plus, but not required.
- Basic knowledge of programming (C++ or Python) is however required.

Source:

- Hoeller, David, et al. "Neural scene representation for locomotion on structured terrain." IEEE Robotics and Automation Letters 7.4 (2022): 8667-8674.
- Paper video: https://youtu.be/3zsvqCrztLg?list=PLE-BQwvVGf8FpQdzY1eE1wqwp5asllXgU

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