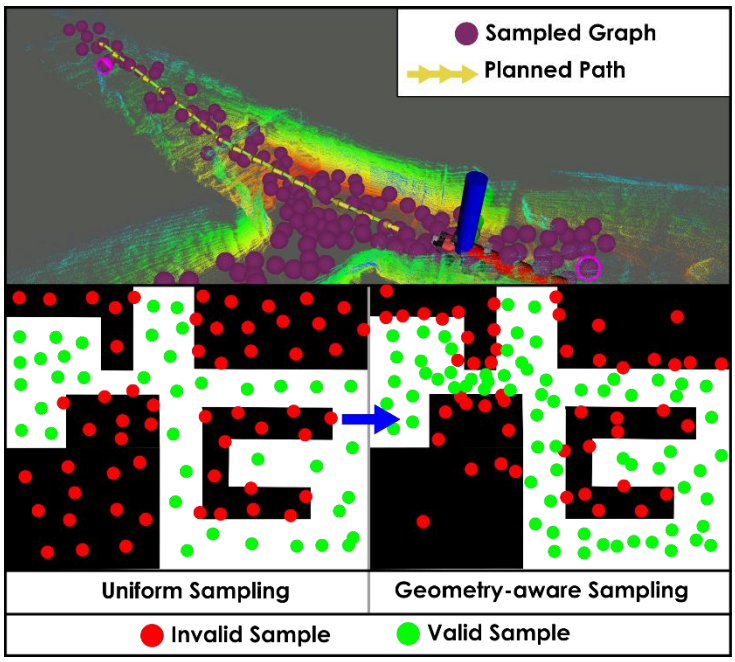
Environment Geometry-aware Probability Distribution Generation for Sampling-based Path Planning

Abstract: Sampling-based path planning is commonly used in complex environments and high-dimensional path planning tasks due to their low computation time. These algorithms sample robot states from a fixed probability distribution to build a graph/tree data structure (sometimes a set of those), where the vertices and edges lie in regions of the state space where the robot does not collide with the environment, to search for a path. However, due to the fixed sampling distribution, in complex environments, they suffer from sampling inefficiency where majority of the sampled states do not lie in collision-free regions. This project and thesis aim to solve this problem by creating a model (may or may not involve learning-based techniques) that can output a sampling distribution based on the environment geometry.



Tasks:

- Study and understand the basics of sampling-based path planning algorithms and other work related to environment geometry-aware sampling.
- Train the sampling policy
- Evaluate and improve the performance using standard sampling-based path planners
- Integrate with the current path planning stack of ARL.

Literature (indicative):

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[4] B. Ichter, J. Harrison and M. Pavone, "Learning Sampling Distributions for Robot Motion Planning," 2018 IEEE International Conference on Robotics and Automation (ICRA), Brisbane, QLD, Australia, 2018, pp. 7087-7094, doi: 10.1109/ICRA.2018.8460730.

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