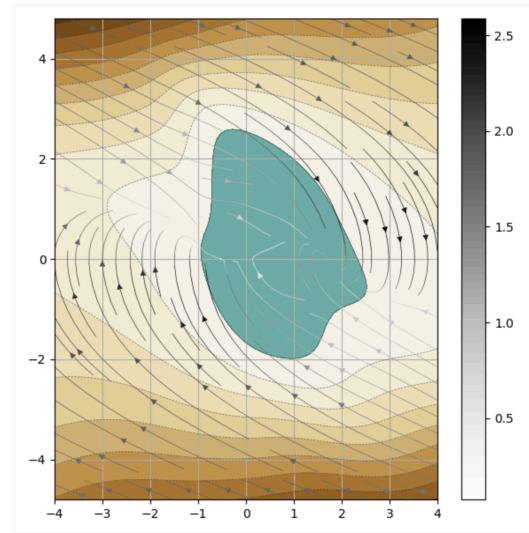


Safe Reinforcement Learning for Robot Navigation in Unstructured Environments



Abstract:

Navigation in novel and unstructured environments imposes operational risks to autonomous robots, as tracking errors and odometry drift may accumulate and lead to collisions. To augment the classic map-plan-act paradigm, modern autonomy stacks may feature learned visuomotor control policies, which directly make use of the available sensory information to augment the standard control task with collision avoidance capabilities to attenuate the risk of failures and collisions. This project aims to investigate the use of certificate functions from classical control theory (namely Control Barrier Functions (CBFs)) in a reinforcement learning task to improve overall safety and sample efficiency. The goal is to investigate theoretically-informed methods for utilizing CBFs directly during the training of visuomotor control policies, that enforce constraint satisfaction for safe navigation.

Tasks:

- Investigate Several CBF formulations/representations for the use in vision-based navigation
- Implement Plugin of a suitable CBF formulation as a reward structure for the use in the AerialGym Simulator used the RL training
- Investigate hierarchical reward structure to enable 'tuning-free' deployment of the CBF during training
- Train and deploy the resulting safe policy on an aerial robot

References:

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