CAREER: Robust Perception and Customization for Long-Term Autonomous Mobile Service Robots

Award # 2046955, April 1, 2021 - March 31, 2026 (Estimated)
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Challenges:

- Perception in the presence of constant changes
- Unexpected and unmodeled perceptual failures
- End-user customizability

Solution:

- ***Semantically meaningful*** long-term probabilistic object mapping
- ***Introspective perception*** for competence-aware autonomy
- ***Visual representation learning*** and ***neuro-symbolic program synthesis*** for customization

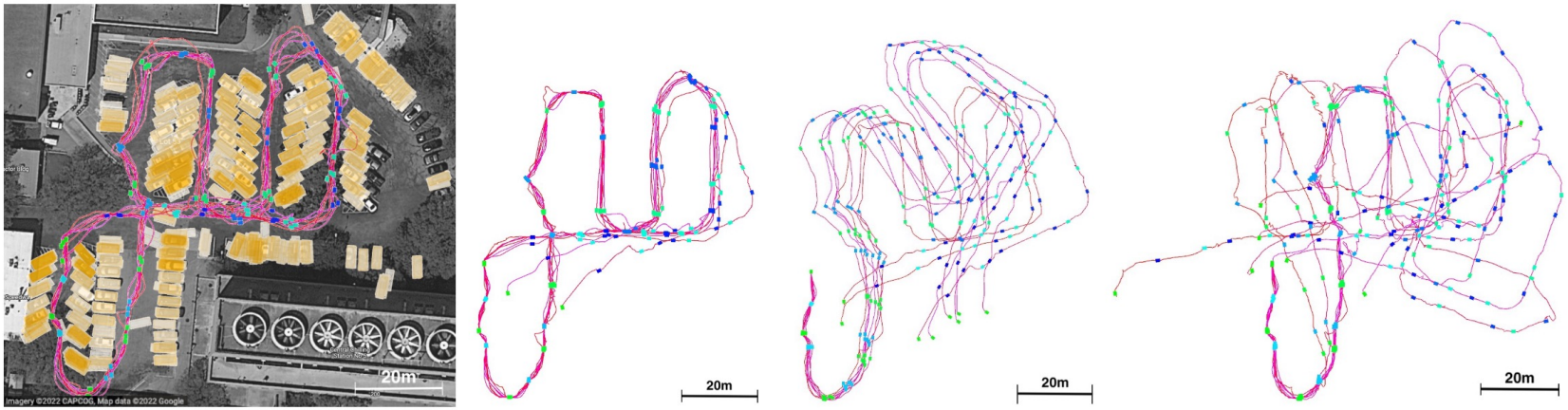
Scientific Impact:

- New probabilistic models for long-term perception
- Ability to autonomously reason about competence during deployments
- Novel learning paradigms for end-user customization

Broader Impact:

- Development of hands-on robotics courses: F1/10 Autonomous Driving, Autonomous Robots
- Ability to deploy robots without expert supervision
- Broader deployments of autonomous mobile service robots in real human environments

Probabilistic Object Maps for Long-Term Robot Localization



(a) POM-Localization with object detections (b) EnML (c) Cartographer (d) LeGO-LOAM

Fig. 5: Plots of trajectories through UT Austin Lot 53 as estimated by the approaches with highlighted blue/green waypoints. Performance of an approach is good when all estimates for a given waypoint are colocated. POM-Localization results are overlayed on a satellite view and shown with aggregated object poses from all trajectories.

Amanda Adkins, Taijing Chen, Joydeep Biswas (2021). Probabilistic Object Maps for Long-Term Robot Localization. arXiv Preprint arXiv:2110.00128

Competence-Aware Path Planning Via Introspective Perception

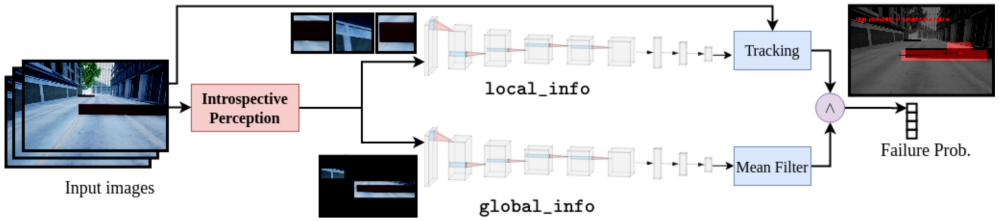
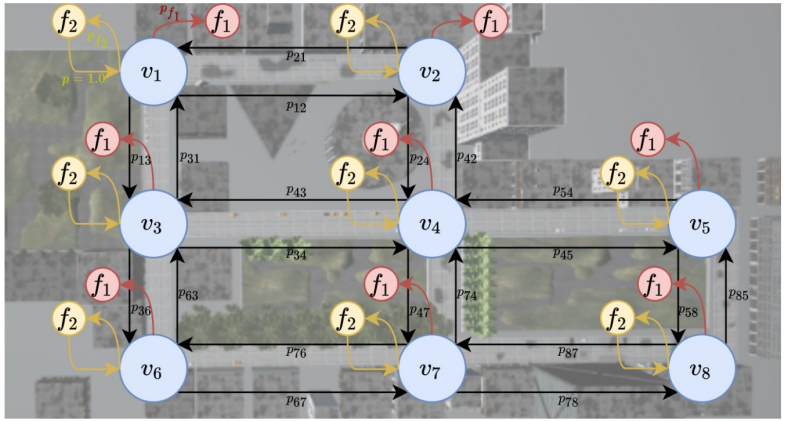
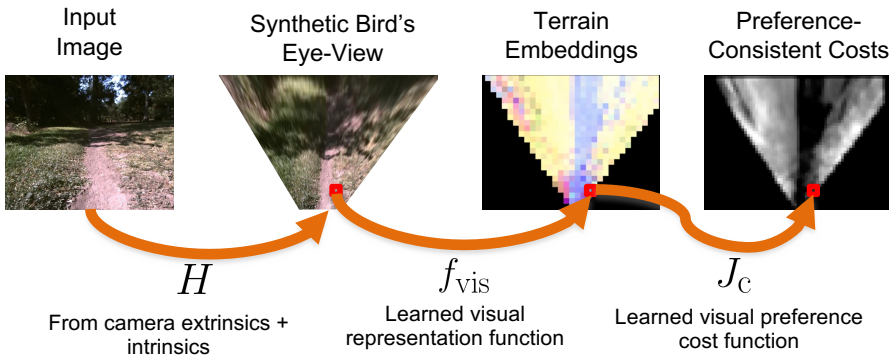


Fig. 2: Navigation competence predictor model architecture.



Sadegh Rabiee, Connor Basich, Kyle Hollins Wray, Shlomo Zilberstein, Joydeep Biswas (2022). Competence-Aware Path Planning via Introspective Perception. IEEE Robotics and Automation Letters

Visual Representation Learning For Preference-Aware Path Planning (**VRL-PAP**)



Kavan Singh Sikand, Sadegh Rabiee, Adam Uccello, Xuesu Xiao, Garrett Warnell, Joydeep Biswas (2022). Visual Representation Learning for Preference-Aware Path Planning. In *Robotics and Automation (ICRA), IEEE International Conference on*