NRI: FND: Life-long Learning for Motion Planning in Human Populated Environments

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Progress for 2021:

- A New Online Constrained Motion Planning Technique
- Novel Clique-based Graph SLAM Approach for Dynamic Environments

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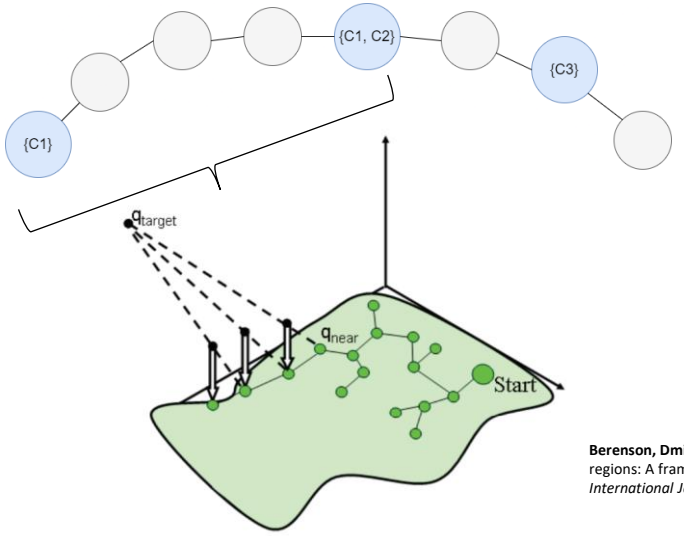
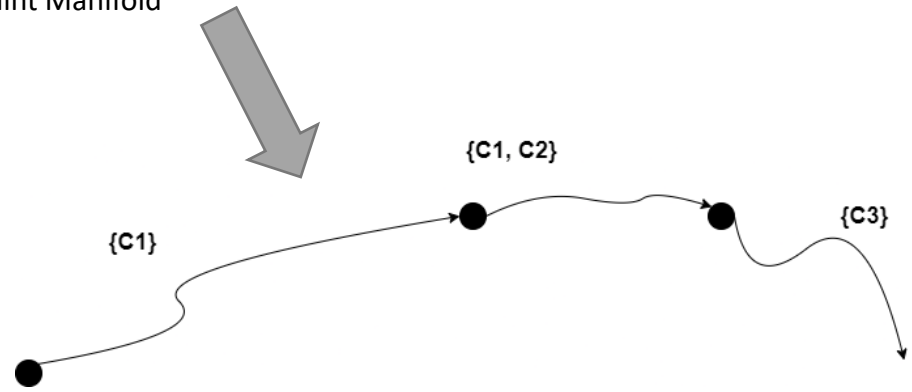
Reusable Constrained Roadmaps for Sequential Manifold Planning

- Constrained motion planning provides an avenue to a human-interpretable form of risk mitigation
- Sets of applicable constraints can change throughout a task, introducing a ***sequential constraint manifold planning problem.***
- Manifold projection techniques enable sampling-based planners to produce constraint compliant trajectories, but changing applicable constraints during task execution *without end-to-end replanning* is currently infeasible.



Constraint Manifold

Berenson, Dmitry, Siddhartha Srinivasa, and James Kuffner. "Task space regions: A framework for pose-constrained manipulation planning." *The International Journal of Robotics Research* 30.12 (2011): 1435-1460.

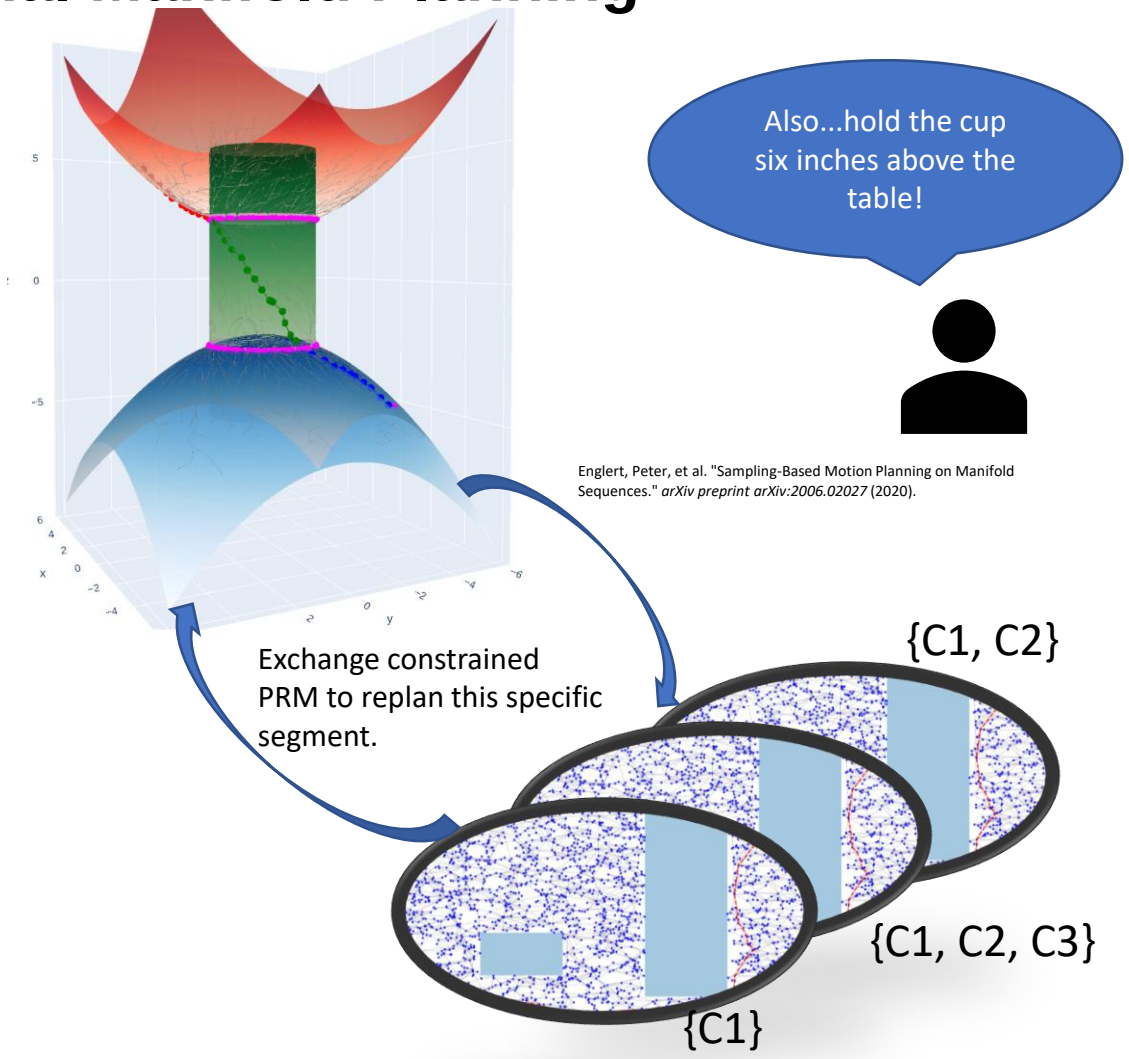


Reusable Constrained Roadmaps for Sequential Manifold Planning

- Planning roadmaps approximate constraint manifolds through sampling-based coverage...but this process is ***computationally expensive***.

- **Approach:** Use observed behavior to learn an atlas of constrained PRMs offline for problem-specific constraint sets, transitioning roadmaps when constraints change.

- **Benefit:** Multi-constraint models that can inexpensively adapt to changes in the environment (e.g. new collision objects) and constraint requirements, making online constrained motion planning feasible.



Better Together: Online Probabilistic Clique Change Detection in 3D Landmark-Based Maps (*IROS 2020*)

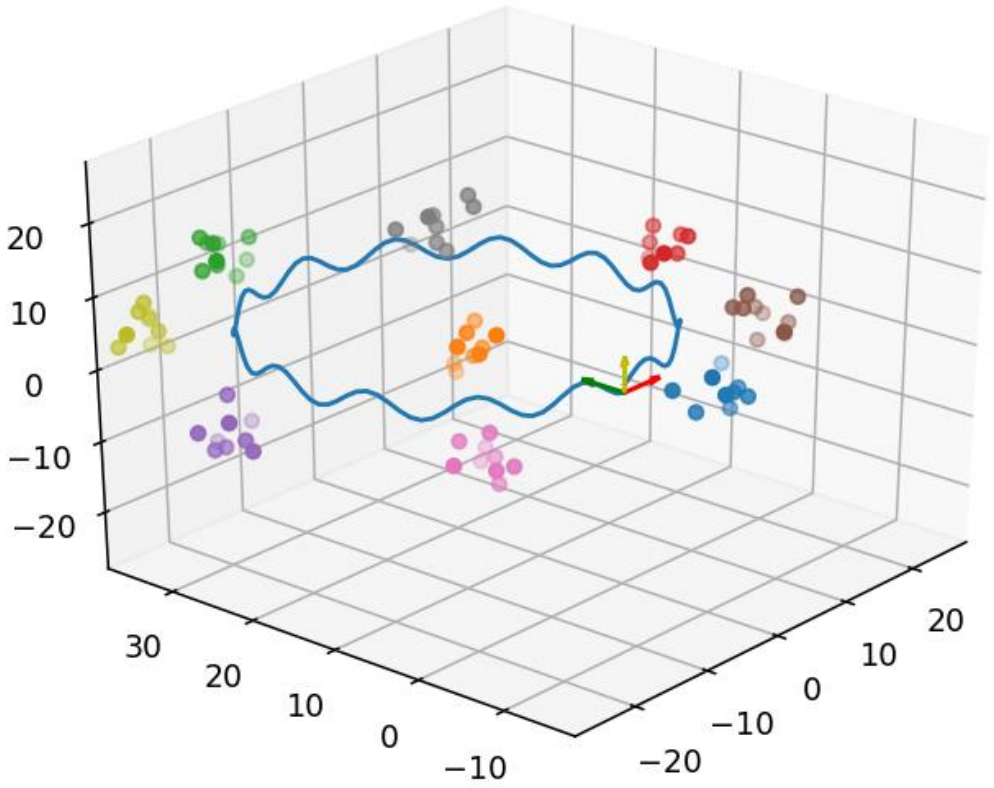


Figure: Mask R-CNN applied to Oxford RobotCar Dataset