# A Collaborative Visual Assistant for Robot Operations in Unstructured or Confined Environments

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# About The Project

Overview:
## Collaborative Visual Assistant for Robot Operations in Unstructured or Confined Environments

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# Restating the Project

- The goal is to have **2 robots and 1 operator**, where the **assisting robot autonomously and safely positions itself** in the cognitively best viewpoint for that particular task

- Assumes
  - Tasks have associated perceptual affordances
  - Space around the task activity can be partitioned into manifolds of equivalent viewpoint quality, aka a viewpoint quality map
  - There is a (partial) 3D model of the environment

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# Recent Discoveries on Question 2

## 2 What is a risk-aware path and motion planner that maximizes viewpoint quality while minimizing risk?
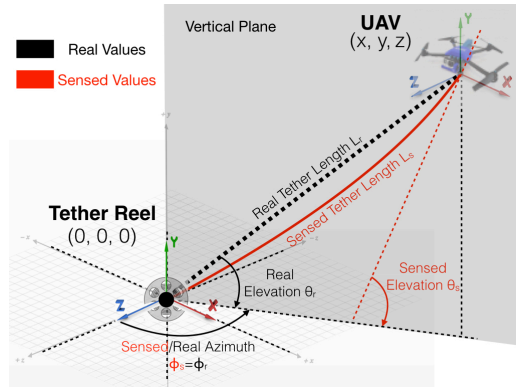
### How to represent and reason about risk?

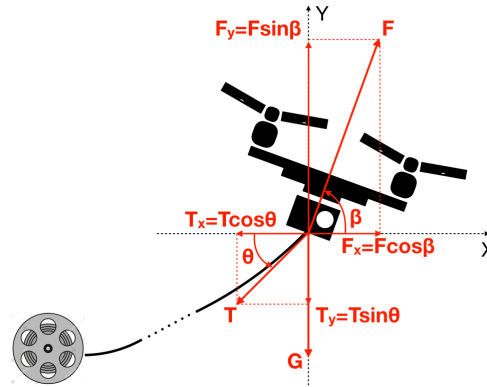*How to plan paths and motion control for a tethered UAV in restricted maneuverability spaces?*

*How to accurately localize the tether?*

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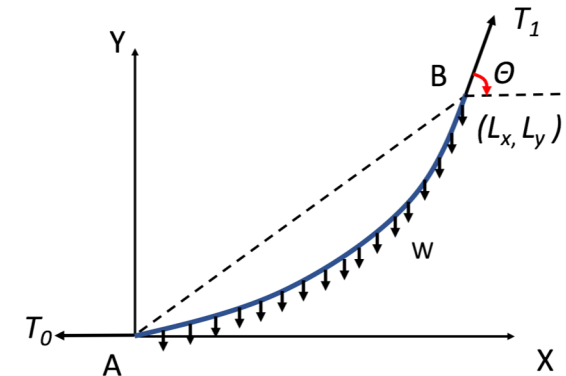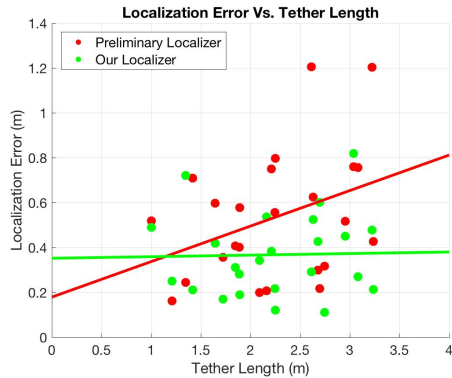
# Discovery: A Tether-based Localization Model


Ideal vs. Real Tether


FBD of UAV


FBD of Tether
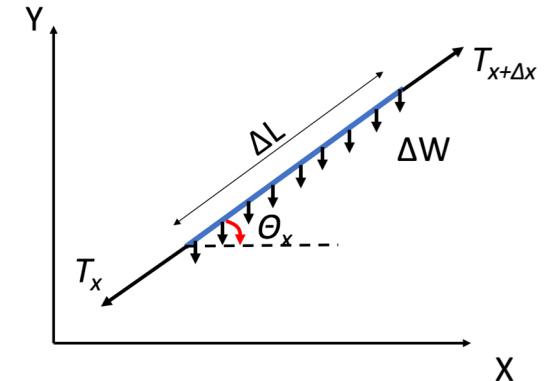

Improved Localization Accuracy
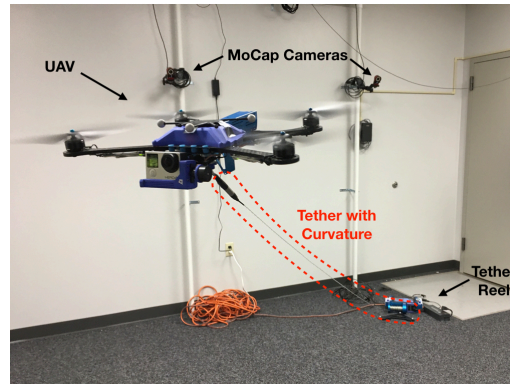

Experiment in MoCap Studio


FBD of Tether Segment

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# Discovery: Novel Tether-based Motion Planning Permitting Contact Points

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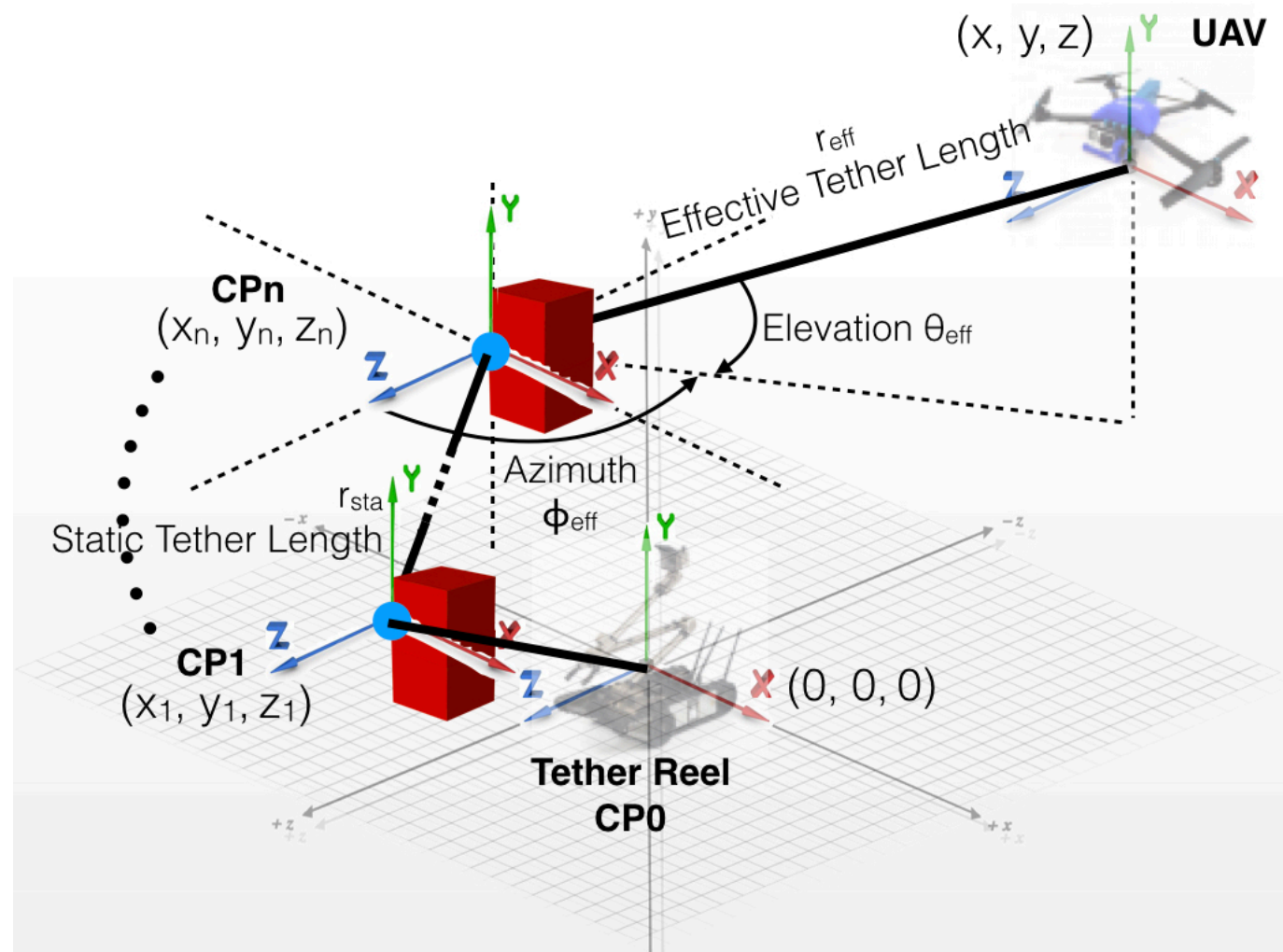
# Demonstration



Task: reach between columns to grasp hidden object

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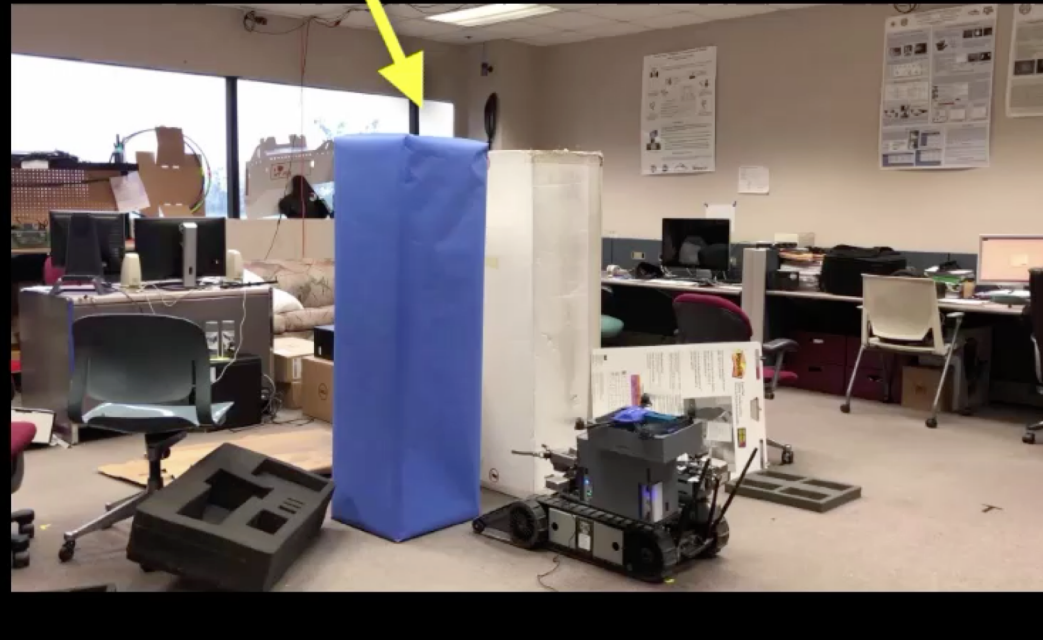
# Next Steps

- Finalize the risk-aware path planning method using the viewpoint quality map
    - Currently exploring Potential Field and Markov Decision Process based solutions
    - Viewpoint quality map is being learned in simulation with bomb squad operators
- Add the visual stability planner for the camera movements
- Integrate and test at Disaster City with responders

# Publications

- X. Xiao, J. Dufek, M. Suhail, and R. Murphy, "Motion Planning for a UAV with a Straight or Kinked Tether," in 2018 *IEEE/RSJ International Conference on Intelligent Robots and Systems*, Madrid, Spain, 2018.

- X. Xiao, Y. Fan, J. Dufek, and R. Murphy, "Indoor UAV Localization Using a Tether," in *2018 IEEE International Symposium on Safety, Security, and Rescue Robotics (SSRR18)*, 2018, pp. 1-6.

- R. R. Murphy, M. Gandillon, and S. Lupashin, "A Comparison of Two Alternative Types of Unmanned Aerial Vehicles for Indoor Spaces," in *Waste Management 2018*, Phoenix, AZ, 2018.

- X. Xiao, J. Dufek, and R. Murphy, "Visual servoing for teleoperation using a tethered UAV," in *2017 IEEE International Symposium on Safety, Security and Rescue Robotics (SSRR17)*, Shanghai, China, 2017, pp. 147-152.

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