HALO: Hazard-Aware Landing Optimization

(for Autonomous Systems)

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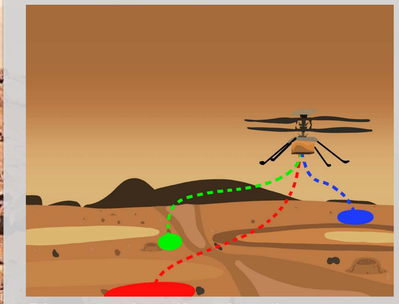
* Indicates equal contributions

Motivating Applications



Planetary Landing: Landing on planets or moons where little to no *a priori* information is known about the environment and contingency landing sites are necessary.

Drone Package Delivery: Landing in uncertain scenarios where higher level-semantic knowledge on the current environmental state is necessary for a safe landing.

Introduction

Objective:
Develop a framework that enables autonomous aerial vehicles to land **safely** in **unknown** environments.

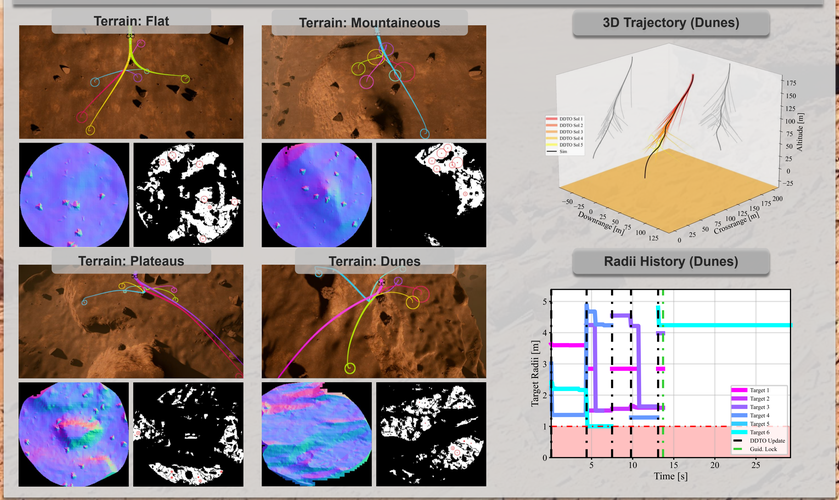
Contributions:
Two key algorithms developed and integrated (closed-loop) in the **AirSim** simulation environment:

1. **Adaptive Deferred-Decision Trajectory Optimization (ADDTO)**
2. **Hazard-Aware Landing Site Selection (HALSS)**

Click for link

Video (YouTube) **GitHub**

Simulation Results

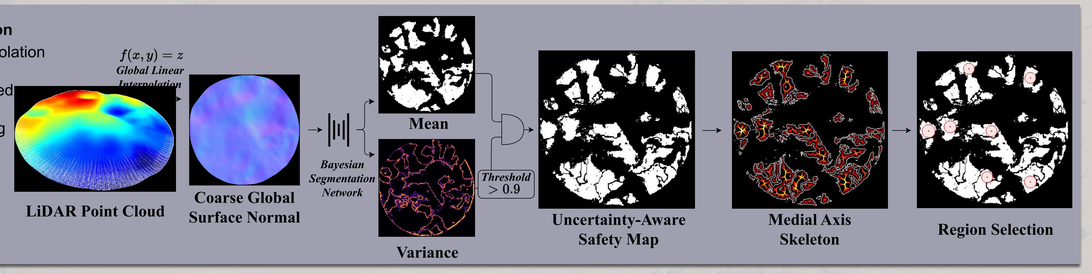


Perception

HALSS: Hazard-Aware Landing Site Selection

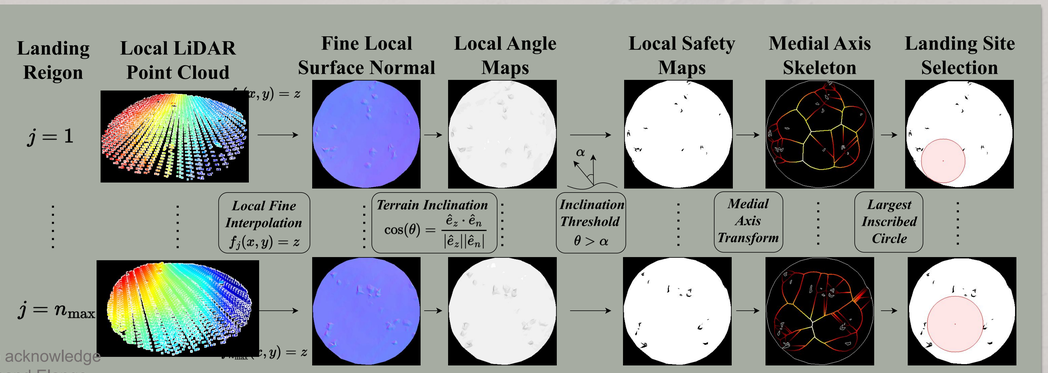
1 Region Selection

- Coarse Interpolation
- Global Scope
- Learning Based
- Semantic Understanding



2 Landing Site Selection

- Fine Interpolation
- Local Scope
- Repeated for each region
- Topography Based



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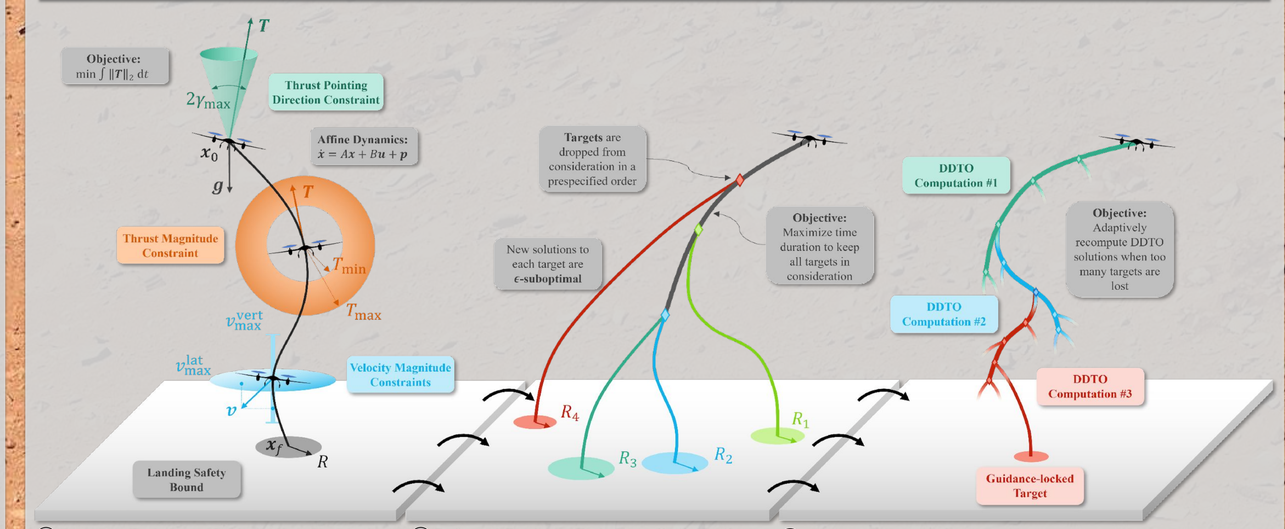
Path Planning

ADDTO: Adaptive Deferred-Decision Trajectory Optimization



1 Baseline Trajectory Optimization Problem

- 3 Degrees of Freedom
- Double integrator dynamics
- Convexified via lossless convexification
- Time-optimized via bisection search

2 Deferred-Decision Trajectory Optimization (DDTO)

- Embeds Baseline Problem
- Keeps multiple targets in consideration
- ϵ-suboptimal

3 Adaptive-DDTO

- Embeds DDTO
- Adaptive recomputations when targets are lost
- Decision functions encode desirable landing behaviors