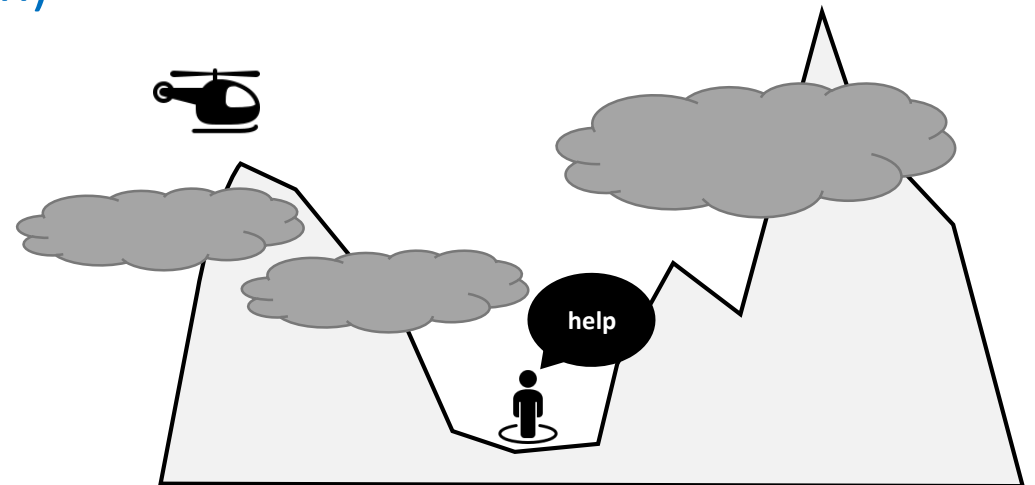# Path Planning for Helicopters

Algorithmic Workshop for Robotics Motion Planning
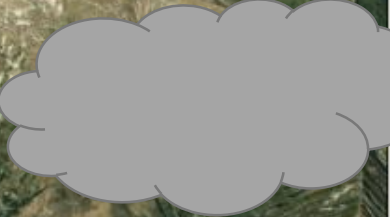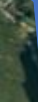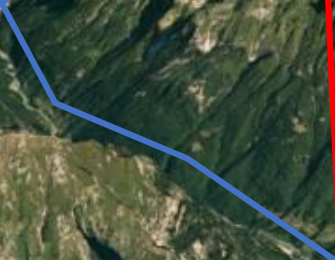
2018

Introduction

- Flying in bad weather conditions
  - No visual sight
  - Navigation based on tracking route (localize by GPS)

- Path planning requirements
  - Minimum distance from obstacles (terrain)
  - Easy to track (minimum turns)
  - Short (low fuel consumption)
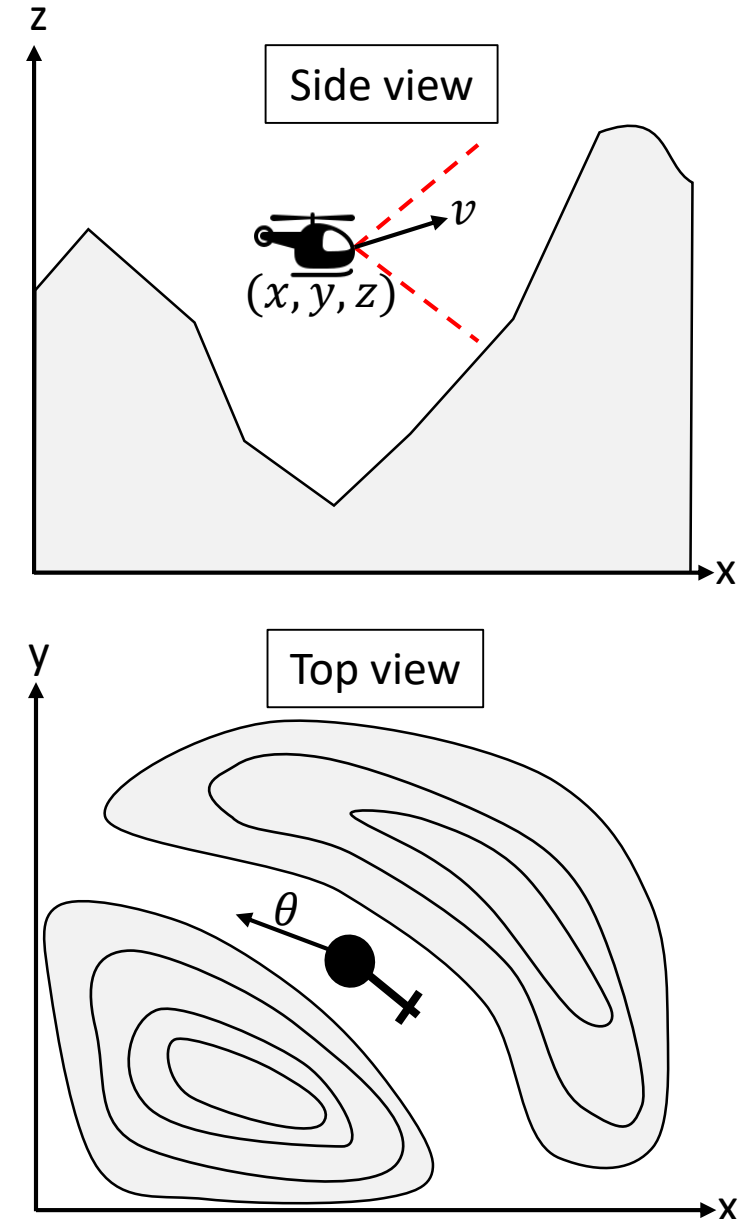
Arrival Direction

Target Point

Google Earth

Image © 2018 DigitalGlobe

Helicopter Model

- ## Configuration space(4d)
  - ### Point in 3d (x, y, z)
  - ### Direction around z axis (θ)
- ## Motion parameters
  - ### Constant velocity $(v \frac{\text{m}}{s})$
  - ### Maximum climb/descent rate $(c \frac{m}{s})$
  - ### Maximum turning rate $(\alpha \frac{°}{s})$

Side view

v

(x, y, z)

Top view

θ

Input

- Terrain data
  - UTM projection (x, y, z)
  - 30m resolution
  - Format - tif

- Minimum distance to obstacles
  - Vertical\Horizontal
  - No flight zones (polygons)

- Motion parameters

- Start and Target Points
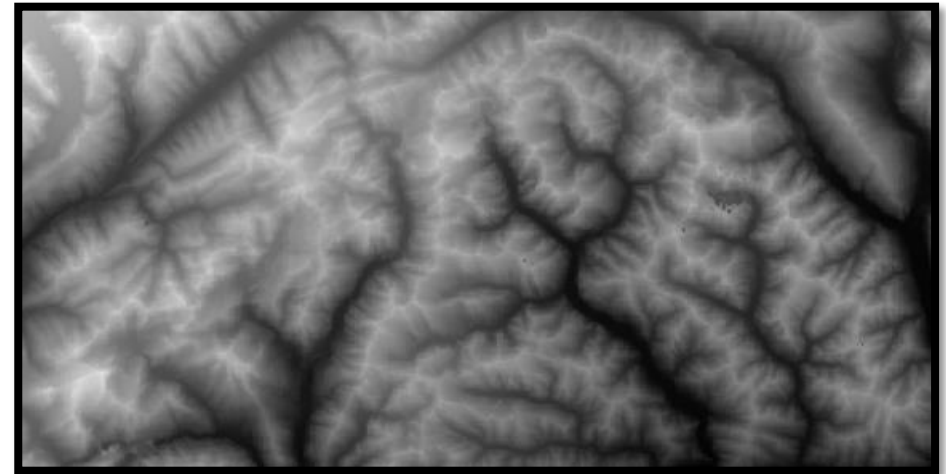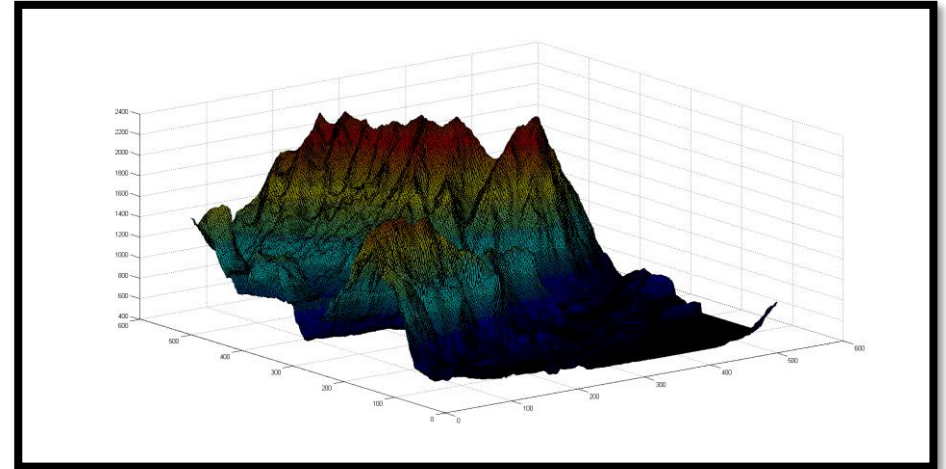
Output

- Flight path (x, y, z, θ)
  - Path smoothing (Post-processing)
- Path quality (total change in direction, path length)
- Query time

$(x_2, y_2, z_2, \theta_2)$

$(x_1, y_1, z_1, \theta_1)$

$(x_3, y_3, z_3, \theta_3)$

$(x_4, y_4, z_4, \theta_4)$

$(x_5, y_5, z_5, \theta_5)$