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Obstacle avoidance in 3D dynamic environment

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Obstacle avoidance in 3D dynamic environment

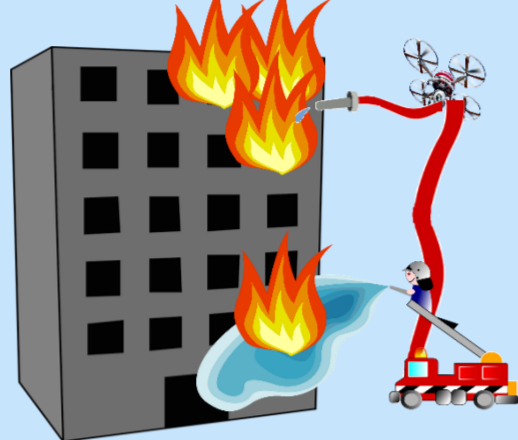
Kendric RUIZ * – Serge CHAUMETTE – Pierre MELCHIOR – Stéphane VICTOR

Context

Delivery



Rescue



Monitoring

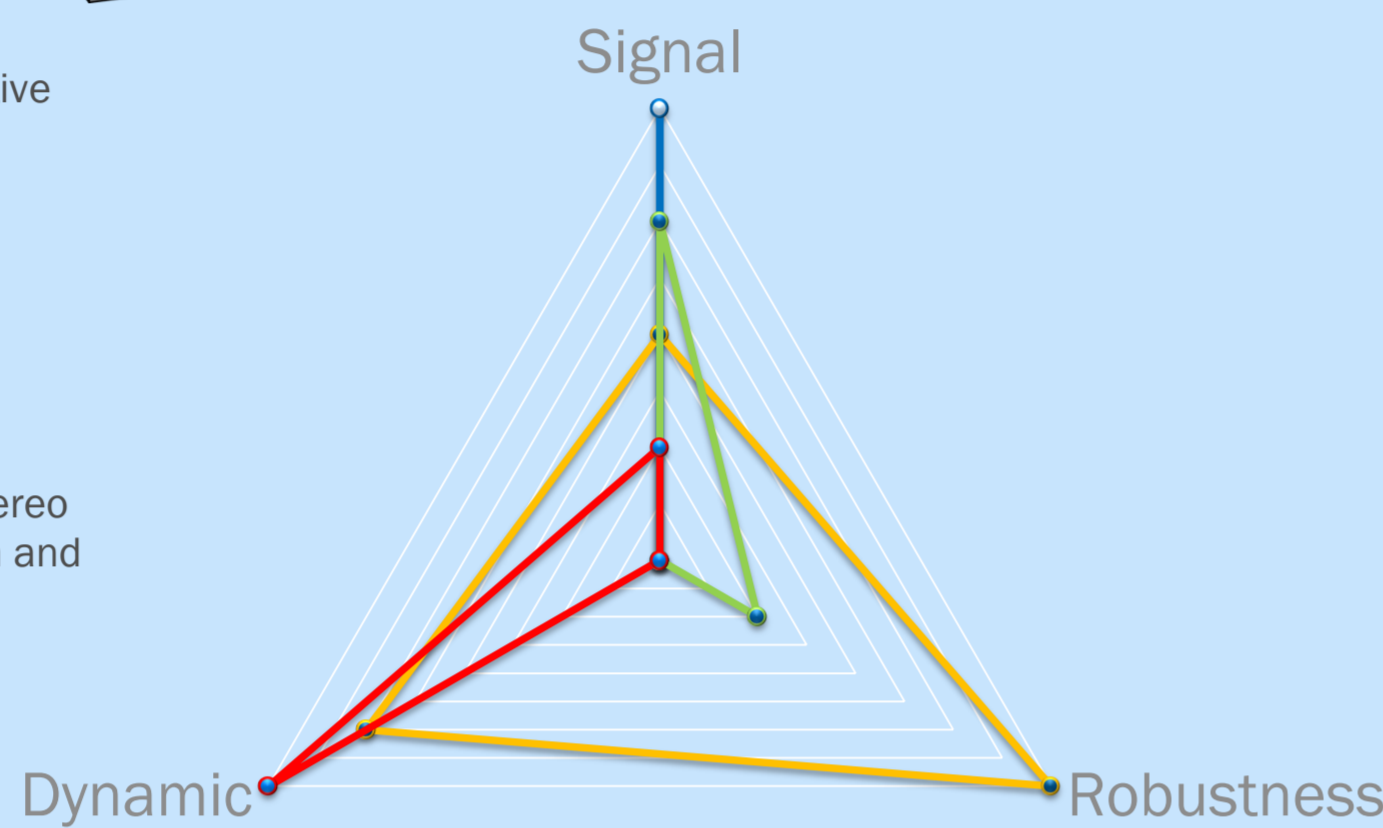


Sampling UAV Most Informative Diagnostic Signals

Our method

Efficient Optical Flow and Stereo Vision for Velocity Estimation and Obstacle Avoidance on an Autonomous Pocket Drone

UAV online path planning algorithm in a low altitude dangerous environment



Objectives

UAV path planning for surveillance in adverse and unknown dynamic environments

UAV make resilient to :

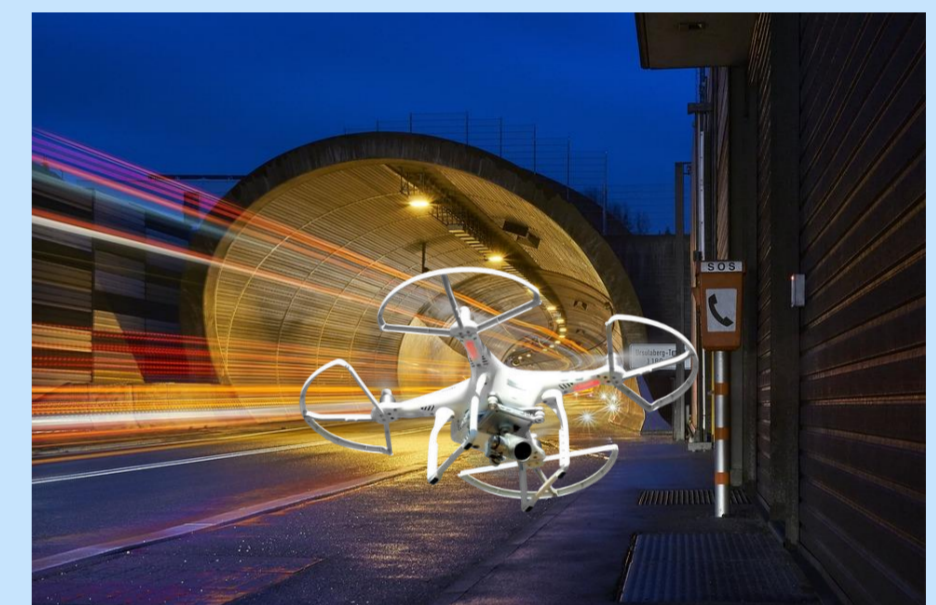
- parametric uncertainties (mass)
- disturbances (wind)
- signal loss (sensors, GPS)



Resilience Algorithm

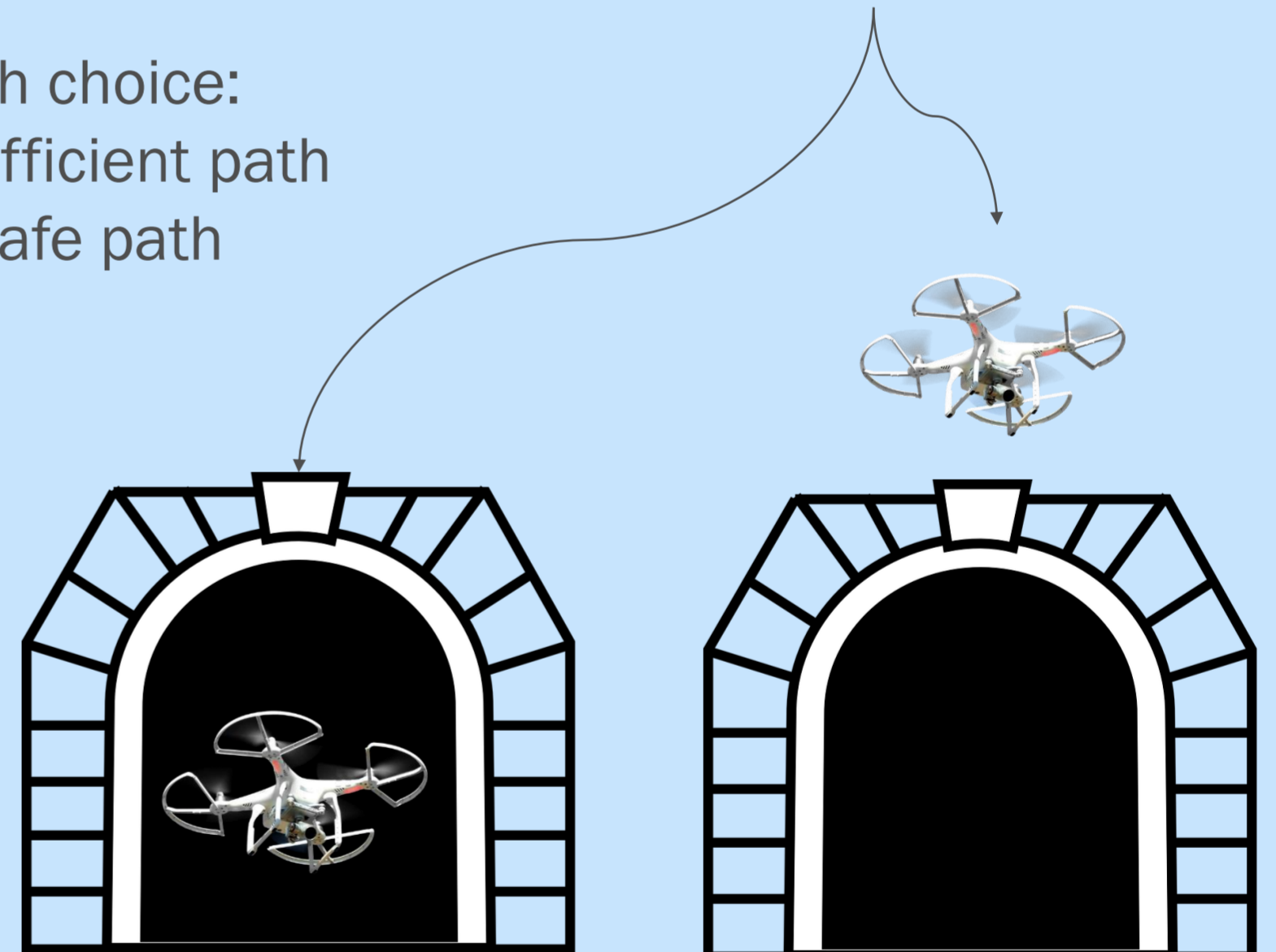
Analysis:

- Sensor data
- danger of the environment



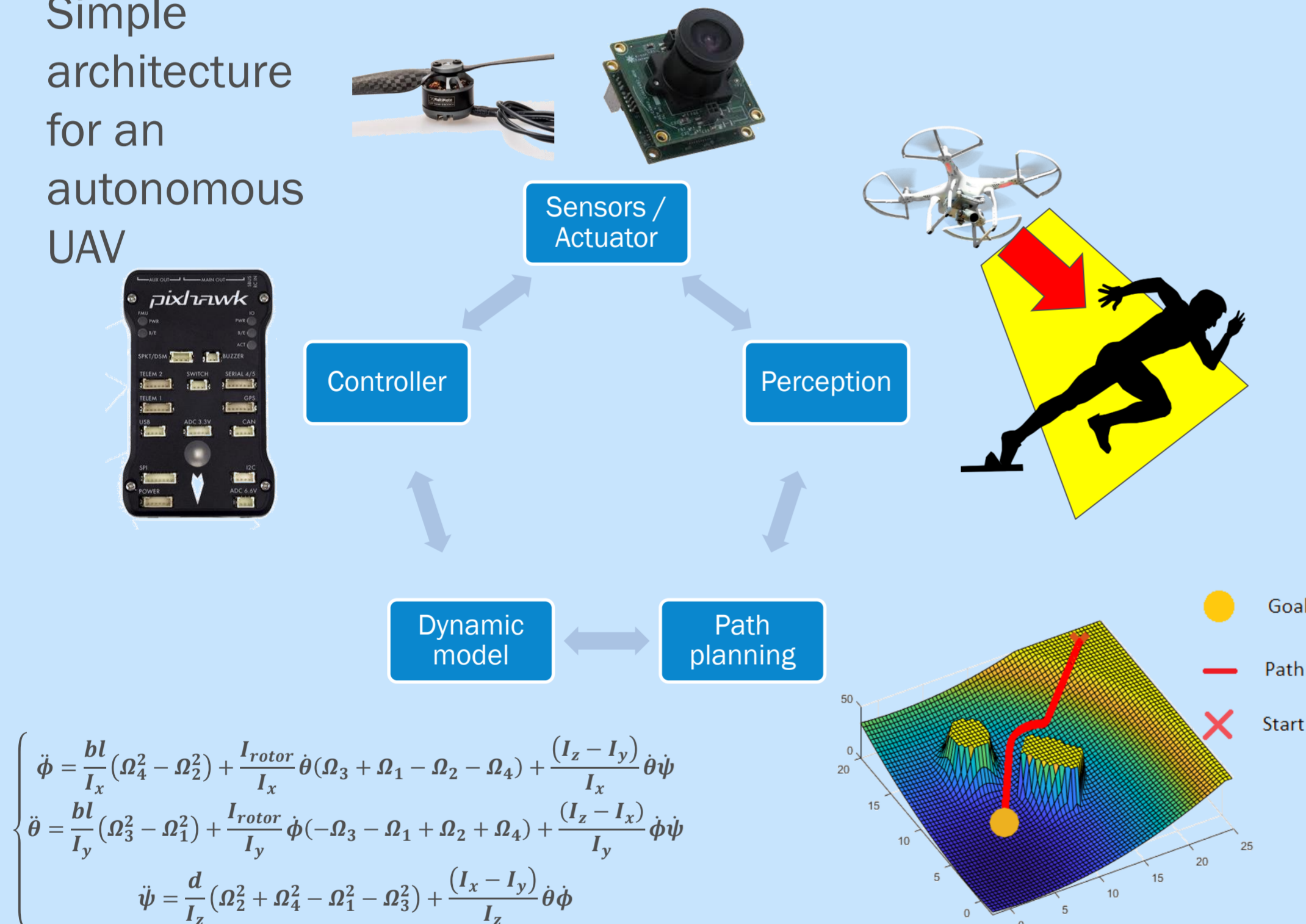
Path choice:

- efficient path
- safe path



Architecture

Simple architecture for an autonomous UAV



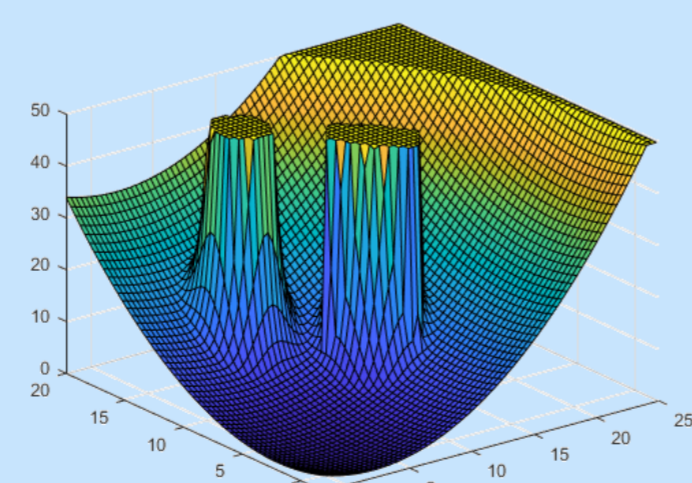
$$\begin{cases} \dot{\phi} = \frac{bl}{I_x}(\Omega_4^2 - \Omega_2^2) + \frac{I_{rotor}}{I_x} \dot{\theta}(\Omega_3 + \Omega_1 - \Omega_2 - \Omega_4) + \frac{(I_z - I_y)}{I_x} \dot{\theta} \psi \\ \dot{\theta} = \frac{bl}{I_y}(\Omega_3^2 - \Omega_1^2) + \frac{I_{rotor}}{I_y} \dot{\phi}(-\Omega_3 - \Omega_1 + \Omega_2 + \Omega_4) + \frac{(I_z - I_x)}{I_y} \dot{\phi} \psi \\ \dot{\psi} = \frac{d}{I_z}(\Omega_2^2 + \Omega_4^2 - \Omega_1^2 - \Omega_3^2) + \frac{(I_x - I_y)}{I_z} \dot{\theta} \phi \end{cases}$$

Research approach

Several scenarios like :

- path tracking
- road crossing with GPS failure
- road crossing without lighting

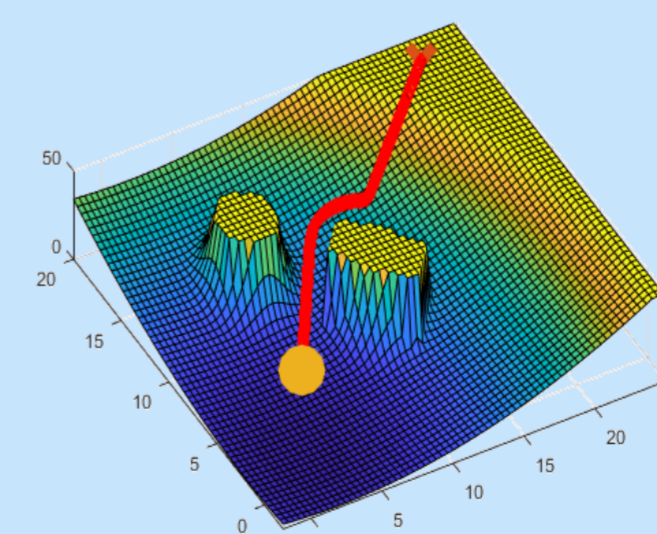
Potential Fractional Field Testing



Addition of 2 potentials fields :

- attractive potential: target is the lower potential
- repulsive potential: obstacles are the greater potentials

Path Planning



The UAV goes towards the lowest potential.

- Goal
- Path
- × Start

Validation by simulation



on prototype



Study of several situations

Simulation on Matlab

Simulation on Unity 3D

Implementing a UAV

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