# OMNIWORKS: Omnidirectional vision for human-UAV co-working

Universidad Politécnica de Madrid (Coordinator) Spain
Skybotix AG Switzerland
APIA XXI S.A. Spain

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# Computer Vision Group (CVG) www.vision4uav.com

## What We Do

Image Enhancement, Scene Inspection, Visual Controller, Video Stabilization, Nature Inspection, Object Tracking for Unmanned Ground Vehicle (UGV) and Unmanned Aerial Vehicle (UAV), where, 1 UGV and 14 UAVs, developing 8 projects currently

## Driverless Car: Citröen C3


## Colibri 1: Rotomotion SRA1

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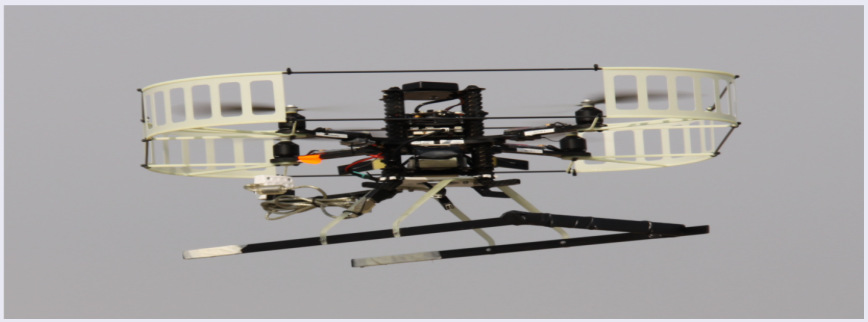
## Colibri 3: Rotomotion SR-20

## Spidercop I: Octocopter

## German Asctec Pelican: Quadcopter



## Sweden AB Linkquad: Quadcopter

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## Franch AR Drone Parrot I: Quadcopter

## Franch AR Drone Parrot II: Quadcopter

## Switzerland Skybotix AG: Hexacopter

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## International University Cooperation

- SnT-University of Luxembourg et al - Luxembourg
- Arizona State of University, Massachusetts Institute of Technology, University of Southern California et al - USA
- ARCAA-Queensland University of Technology et al - Australia
- ETHZ, École Polytechnique Fédérale de Lausanne et al - Switzerland
- Northwestern Polytechnical University, Beihang University, Beijing Institute of Technology et al - China
- other countries, e.g. Sweden, United Kingdom, Columbia, Costa Rica ...

## Controller

PID Controllers, Fuzzy Controllers, L1 Adaptive Controllers ...

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# Introduction and Requirment

## Goal: Tracking Sensor and Shelf Structure et al in Offshore Floating Platforms (90m)

## Each Partner Task:

- CVG-UPM: Visual and Laser Tracking Algorithms and Control of Aerial Vehicles
- Skybotix AG: Developing Aerial Vehicles
- APIA XXI S.A.: Field of Engineering and Construction

## Offshore Floating Platform.2nd

# Introduction and Requirment

## Working Environment


## Detailed Requirements:

- Minimum response time of control commands
- API to communicate in both directions with the aircraft
- Human-Machine Interface to non experienced users
- Online information of the weather conditions
- Simple ground station with Linux system
- Onboard visual and laser sensors
- Simulator environment to test control algorithms and strategies
- Instrument inspection
- Avoid mast collisions

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# Simulation Platforms: Locating at Santander, Spain

## Static and Moving Platforms:

## Platform Details:

- Controlled mast maximum angle movement:
  maximum movement angle capable of the test masts in $\pm 20$ degree
- Controlled mast maximum Frequency:
  maximum frequency under which the test masts movement can be performed 7.5 cycles/minute (0,78rad/s)
- Controlled mast height:
  controlled mast height has an altitude of 15m
- Maximum wave height:
  Maximum wave height is 1.5m

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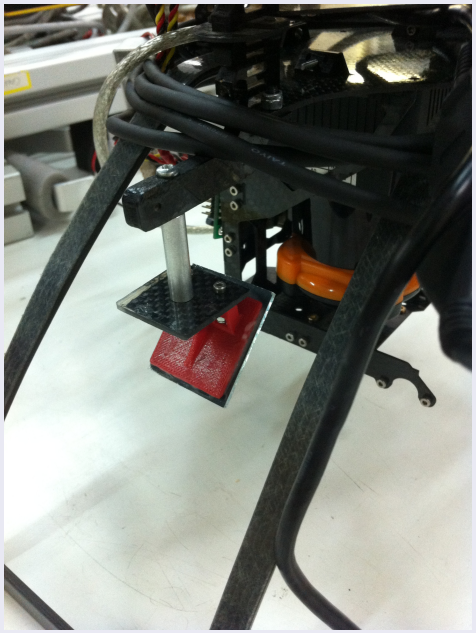
# UAV Test Platform: Asctec Pelican, Skybotix

## Asctec Pelican: GPS, IMU et al sensors

## Sensor Distributions:

- Top: Pan-Tilt Camera, Bottom: Laser
- Using Mirror for Height Measurement

## Height Detection:



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# Onboard Visual Tracking: Camera and Targets

## Camera: UI-3240CP-C-HQ

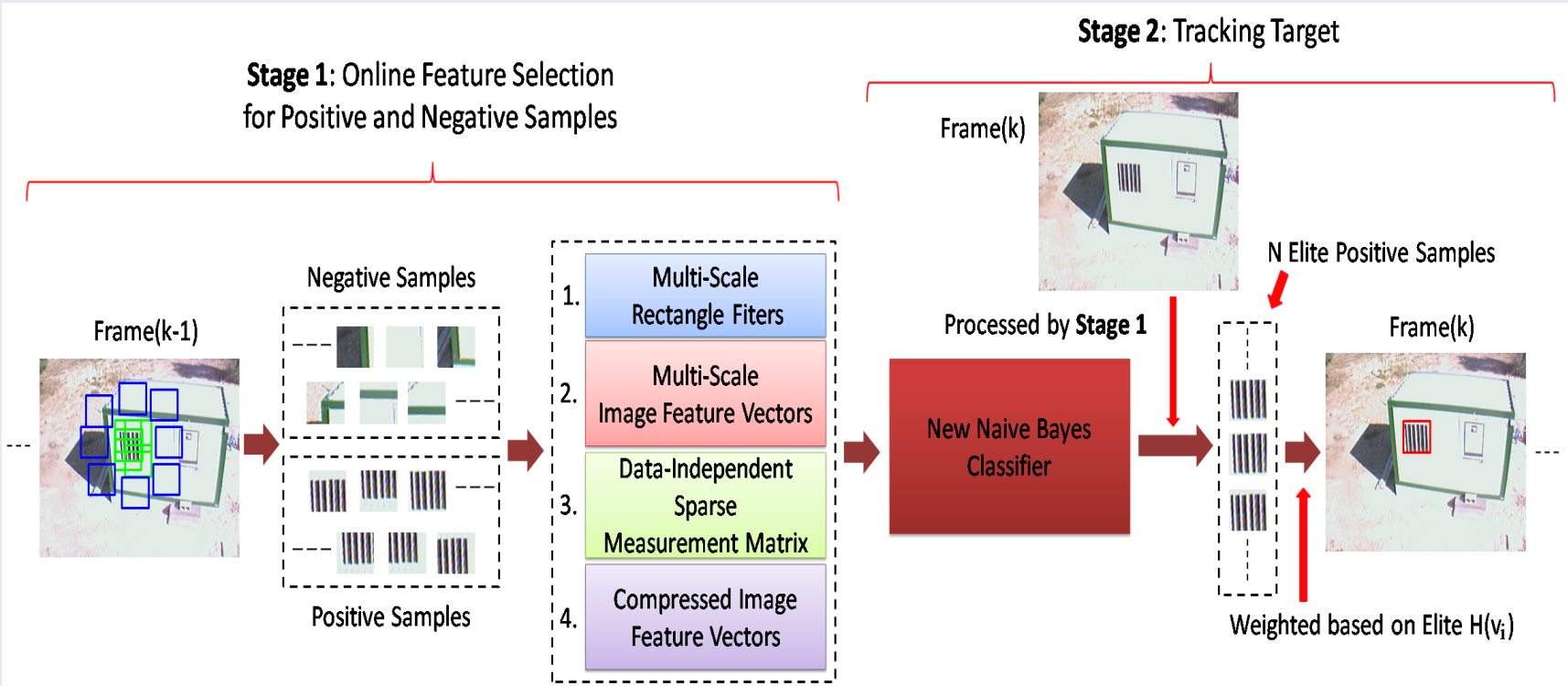

## Performances:

- High Resolution Image: 1280x1024
- Fast FPS: 60

## Sensors et al:

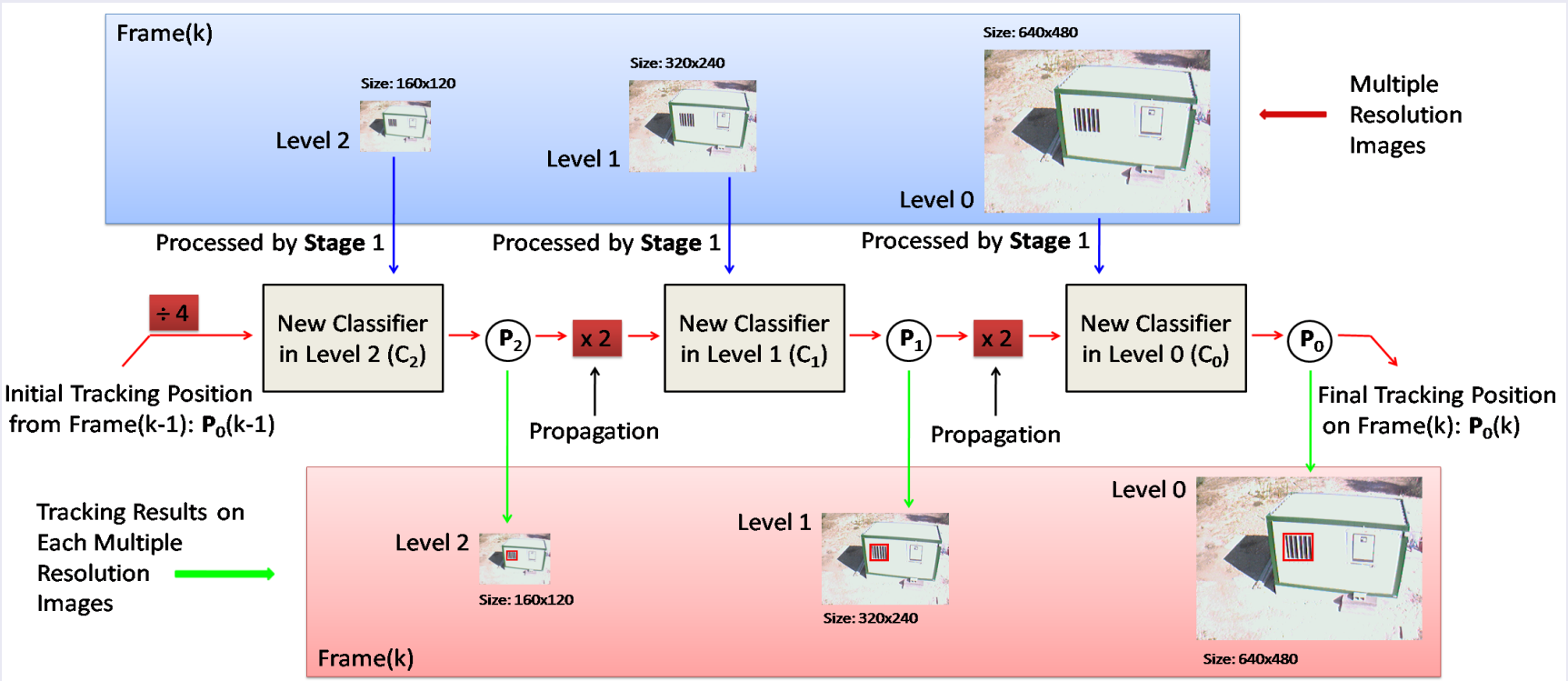
# Visual Tracking Algorithm (Discriminative Visual Tracking)

## Tracking-by-Detection Method



# Hierarchy-based Strategy

## Multi-Resolution Multi-Classifier Framework



# Visual Tracking: 1st Video Sequences (Sensor)

## 10th Real-time Frame:

## 30th Real-time Frame:

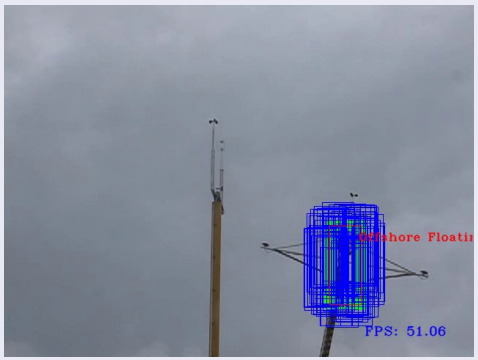
## 50th Real-time Frame:

## 70th Real-time Frame:

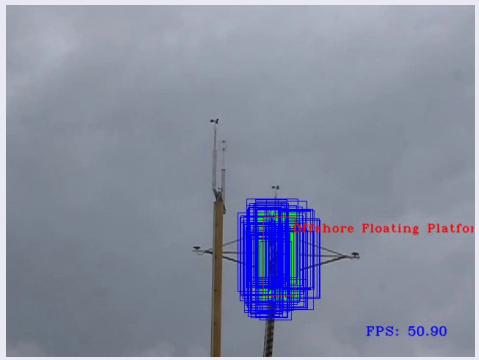
## 90th Real-time Frame:

# Visual Tracking: 2nd Video Sequences (Shelf Structure)

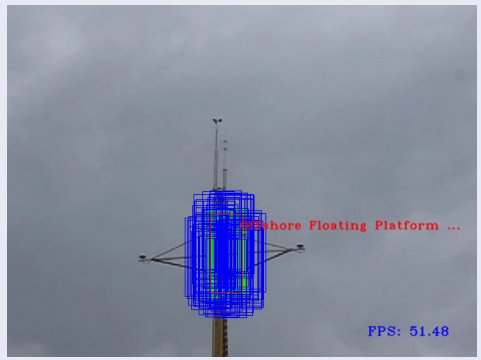
## 17th Real-time Frame:



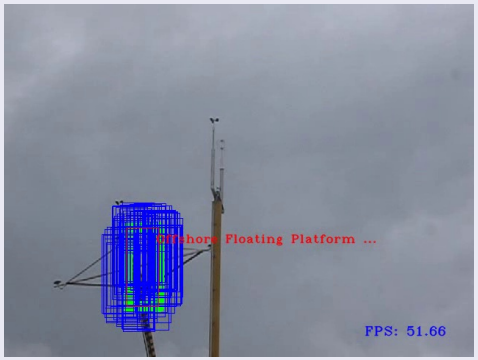

## 95th Real-time Frame:



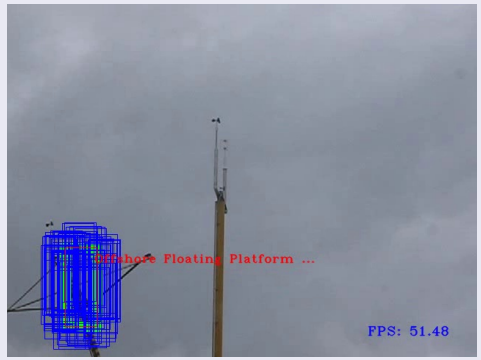

## 143th Real-time Frame:




## 214th Real-time Frame:

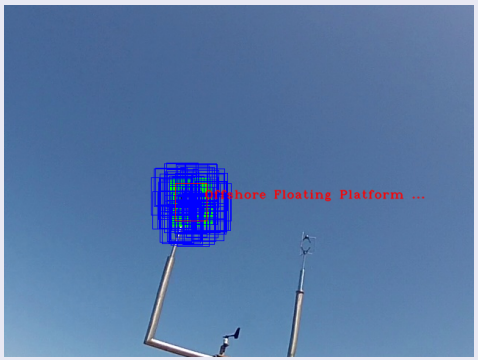



## 287th Real-time Frame:

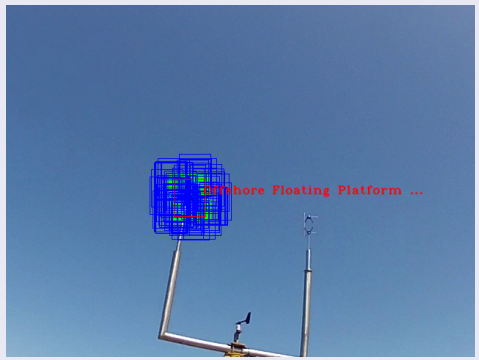


# Onboard Visual Tracking: Test 1 (Sensor Tracking)

## 113th Real-time Frame:

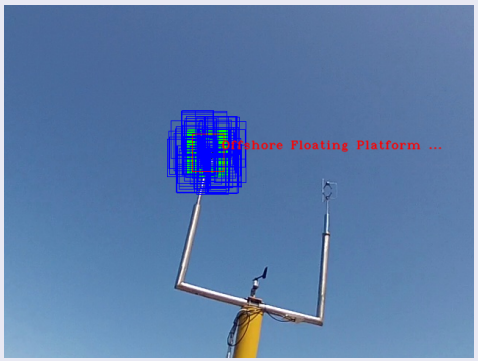


## 191th Real-time Frame:



## 264th Real-time Frame:

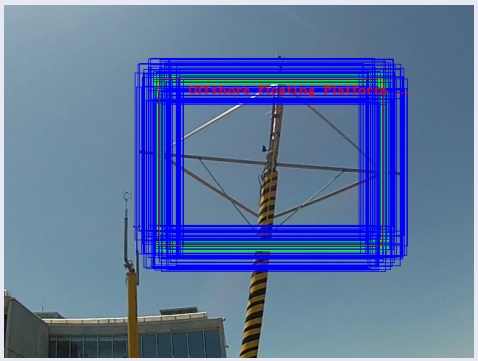
## 295th Real-time Frame:



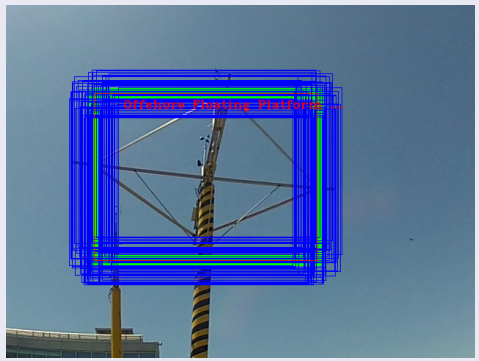
## 387th Real-time Frame:

# Onboard Visual Tracking: Test 2 (Shelf Tracking)

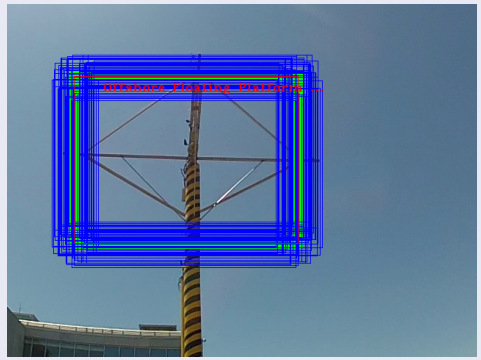
## State: Big Right



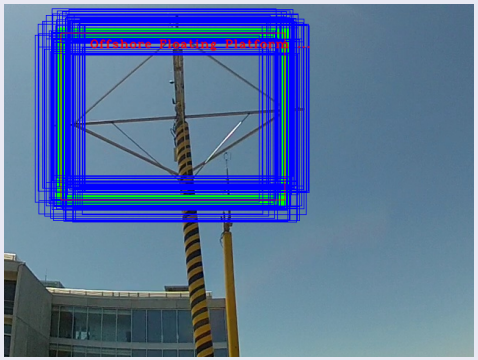
## State: Right



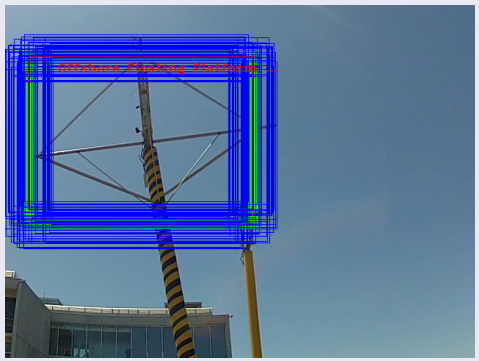
## State: Middle



## State: Left



## State: Big Left



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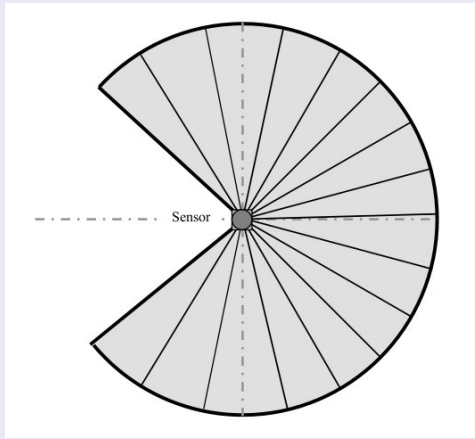
# Onboard Laser Sensor

## Laser: UTM-30LX

## Laser: Scan Example

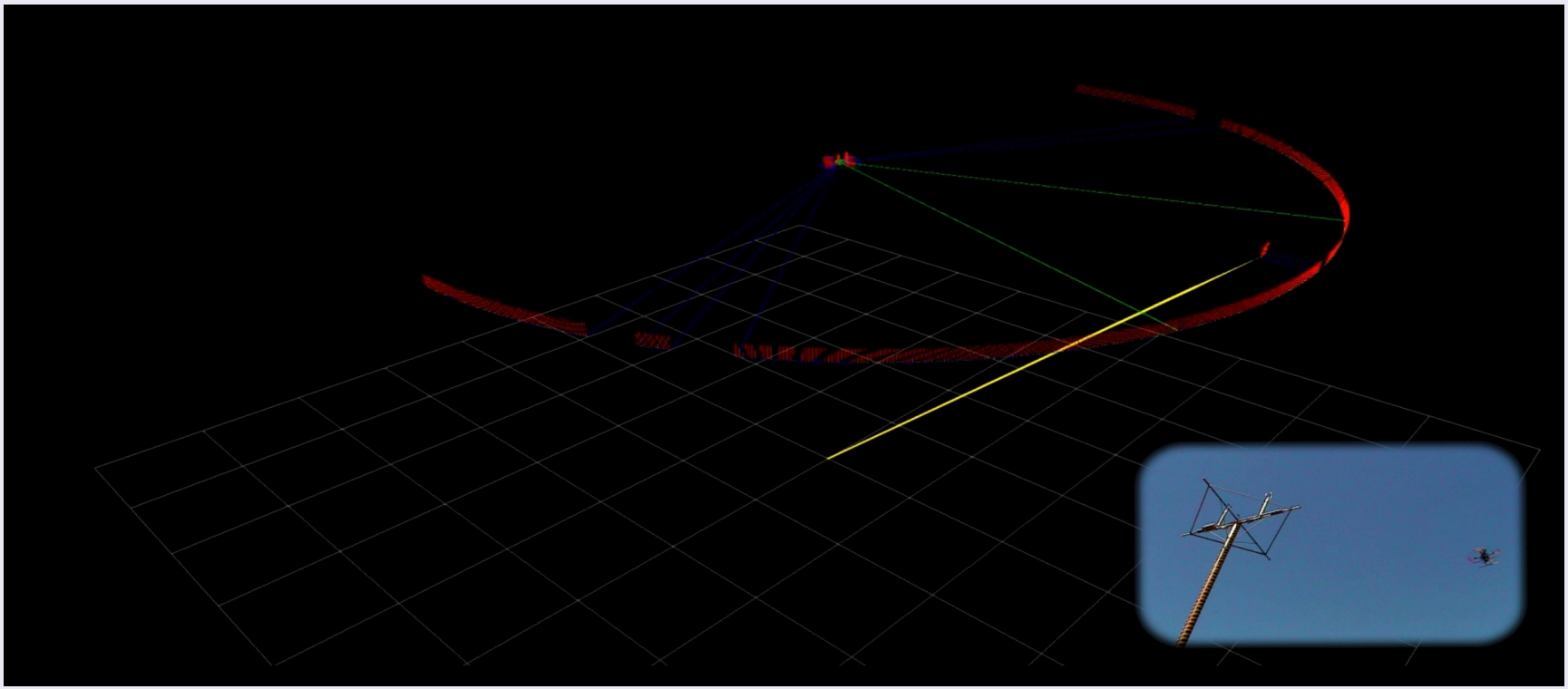



## Laser Performances:

- Measure Distance: 30m
- Detection Angle: 270°
- Angular Resolution: 0.25°
- Power Consumption: < 8W

# Onboard Laser Tracking: Real-time Feedback

## Onboard Laser Tracking for Moving Platform:



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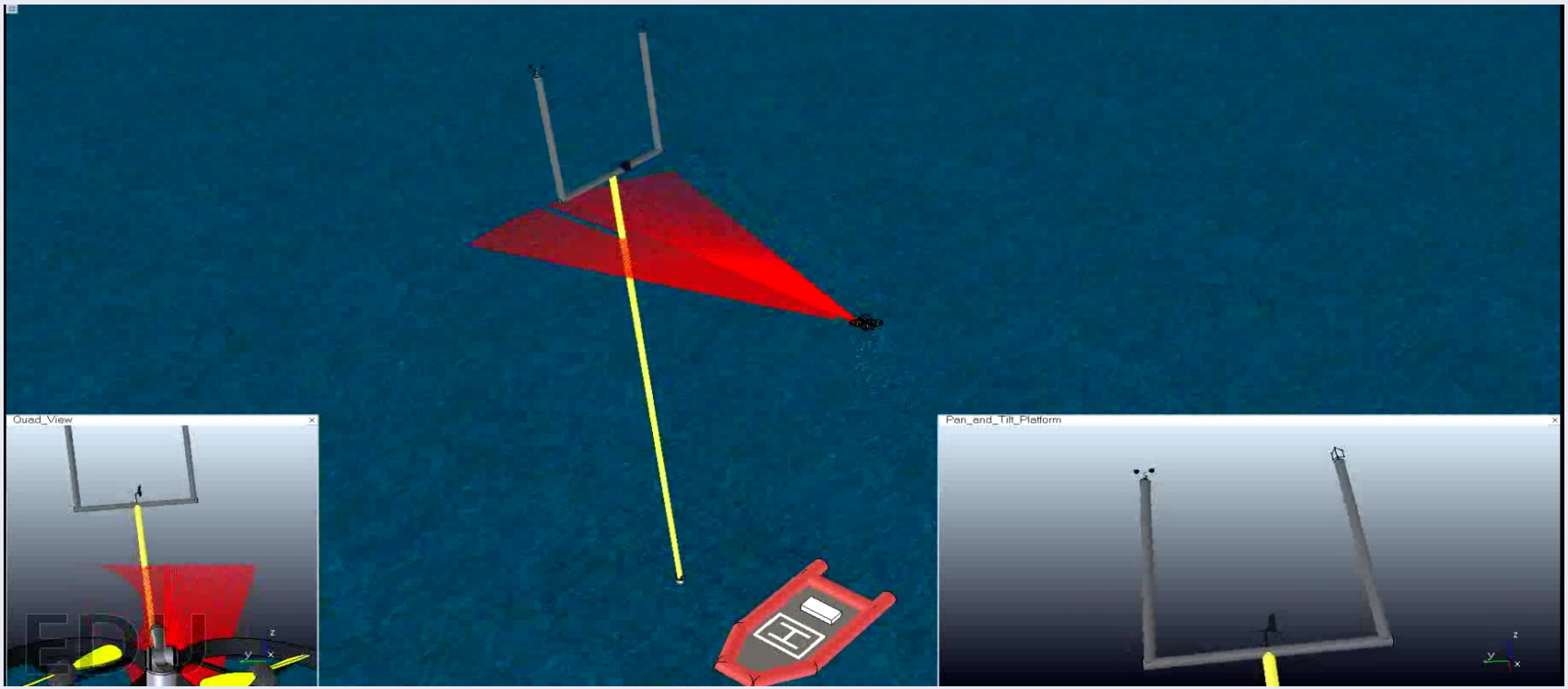
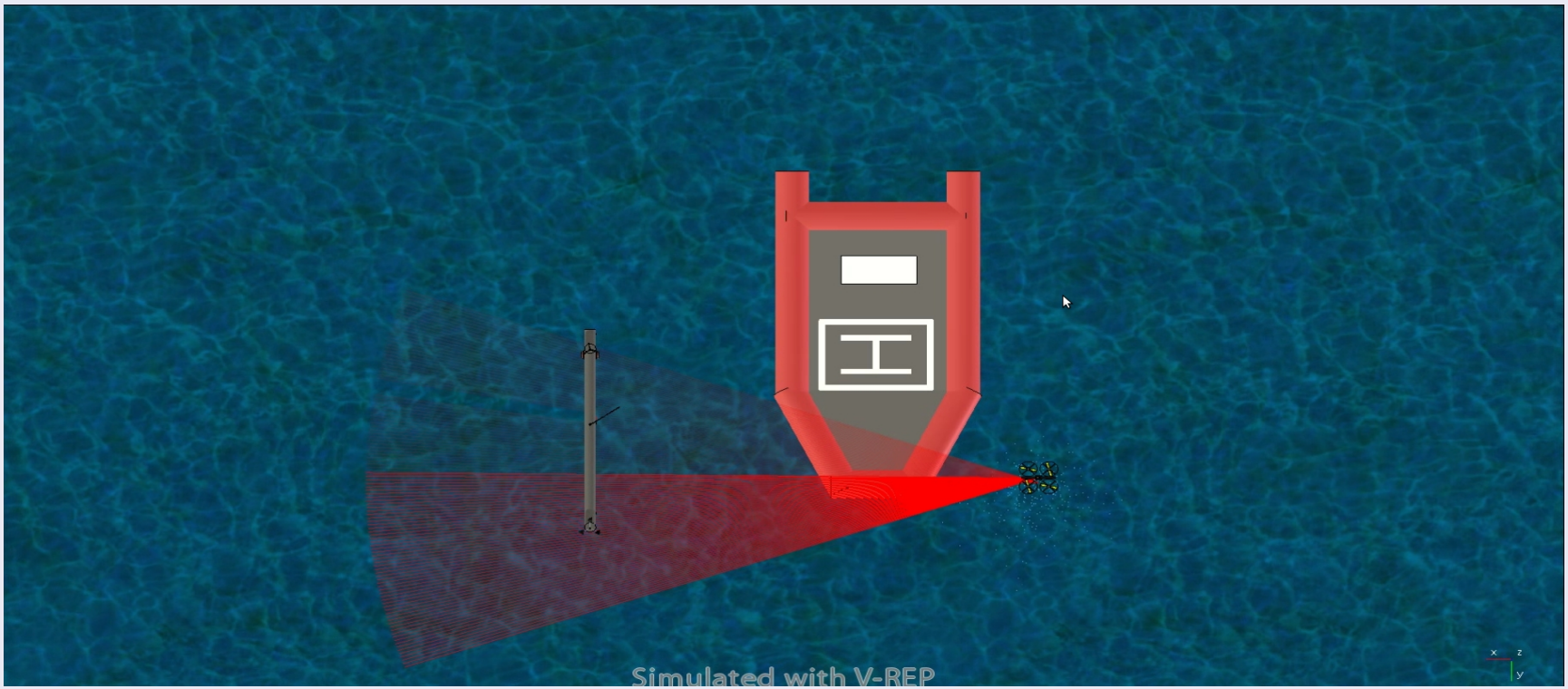
# Test in V-REP Simulation: Side View

## Sensor and Shelf et al Tracking



# Test in V-REP Simulation: Top View

## Sensor and Shelf et al Tracking



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# Current Work

## Current Work

- moving all the ROS-based developed modules to the Skybotix UAV platform, designing the Human-Machine Interface and testing the performances

Skybotix TECHNOLOGIES

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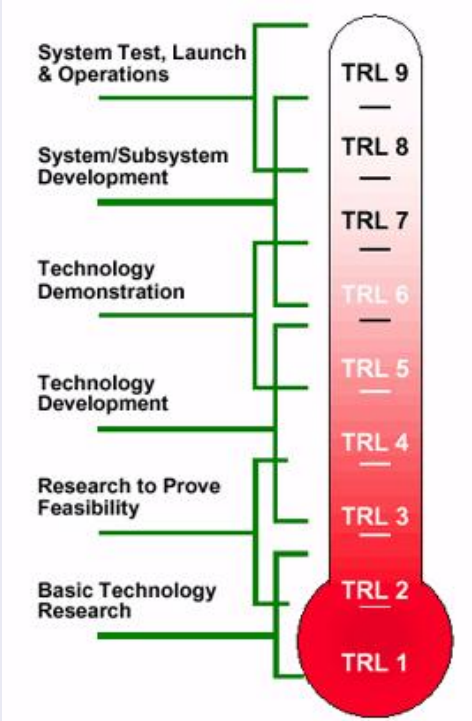
# Project Stage and Demo Demonstration:

## Project Stage:




## Demo Demonstration: Video

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# Questions?

## Thank you for your attention!

More Info., please check in www.vision4uav.com

Youtube Channel: colibriprojectUAV