

Trabajo Fin de Máster  
Máster en Ingeniería Electrónica, Robótica y  
Automática

Aerial co-workers: a task planning approach  
for multi-drone teams supporting inspection  
operations

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Universidad de Sevilla**

Sevilla, 2021





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# **Aerial co-workers: a task planning approach for multi-drone teams supporting inspection operations**

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supporting inspection operations

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El tribunal nombrado para juzgar el trabajo arriba indicado, compuesto por los siguientes profesores:

Presidente:

Vocal/es:

Secretario:

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Thanks for everything

*Álvaro Calvo Matos*

*Sevilla, 2021*





# Abstract

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**L**orem ipsum This Master's Thesis has faced problems that arise from the recent increase in the applications of cooperative UAV teams, which are the autonomy to operate for a long time with robustness in the face of possible failures, and the difficulty of providing the team with capabilities cognitive skills to be able to operate in dynamic environments with humans.



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# 1 Introduction

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## 1.1 Motivation

## 1.2 Objectives





## 2 Preliminaries

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### 2.1 Current technology

#### 2.1.1 UAVs

#### 2.1.2 Aerial co-workers

#### 2.1.3 Multi-drone teams

### 2.2 Related work

#### 2.2.1 Inspection applications with UAVs

#### 2.2.2 Task planning in multi-drone teams

#### 2.2.3 Drone behavior management

### 2.3 Tools

#### 2.3.1 ROS

#### 2.3.2 Gazebo

#### 2.3.3 Rviz

#### 2.3.4 UAL

#### 2.3.5 Behaviour Trees

#### 2.3.6 Groot



## 3 Problem Formulation

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### 3.1 Description of tasks

3.1.1 Inspection tasks

3.1.2 Monitoring tasks

3.1.3 Tool delivery tasks

### 3.2 Battery recharges

### 3.3 Connection losses

### 3.4 Task replanning situations



## 4 Design of the proposed solution

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### 4.1 Node diagram

### 4.2 Centralized module: task planner

### 4.3 Distributed module: behavior manager

#### 4.3.1 Main tree

#### 4.3.2 Inspection task tree

#### 4.3.3 Monitoring task tree

#### 4.3.4 Tool delivery task tree

### 4.4 Lower and upper level modules faker



# 5 Results

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## 5.1 Task planning

### 5.1.1 Battery

### 5.1.2 Connection lost

### 5.1.3 Replanning

## 5.2 Drone behaviour manager results

### 5.2.1 Battery management

### 5.2.2 Connection lost management

### 5.2.3 Replanning management

## 5.3 Simulations

### 5.3.1 One drone simulations

### 5.3.2 Multi-drone simulations





# **6 Conclusions and future work**

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## **6.1 Conclusions**

## **6.2 Future work**

### **6.2.1 Augmented reality**



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