

# 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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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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*Álvaro Calvo Matos*

*Sevilla, 2021*





# Abstract

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# Short Outline

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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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