



Universidad Politécnica
de Madrid

**Escuela Técnica Superior de
Ingenieros Informáticos**



Grado en Ingeniería Informática

Trabajo Fin de Grado

**Diseño y Desarrollo de un Prototipo de
Simulación para Robots Aéreos basado
en Unreal 5, ROS2 y Gazebo (Informe
Intermedio)**

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Resumen

Aquí va el resumen del TFG. Extensión máxima 2 páginas.

Agradecimientos

Gracias

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1. Introducción

1.1. Descripción General

La simulación de drones es un campo relativamente nuevo sin embargo, eso no implica que sea poco extenso. En los recientes años se han realizado grandes avances e investigaciones con diversos fines. Desde el estudio de sus físicas para su posterior implementación en entornos virtuales para su simulación, como estudios para descubrir los posibles usos que se les puede dar a estas versátiles máquinas. Como puede ser ejemplo su uso en seguridad[2], mantenimiento de campos de placas solares[3] e incluso entretenimiento[1] con enjambres de cientos de estos pequeños robots.

Los drones son vehículos aéreos no tripulados que se crearon en un inicio, con fines militares. Sin embargo, con el paso del tiempo se han encontrado una amplia variedad de usos como mencionaba anteriormente. Es esta diversificación y popularización de los drones la que nos lleva a querer utilizarlos en problemas de la vida cotidiana. Es por esto que simular el comportamiento de una máquina de este tipo se ha vuelto esencial, tanto para prever que movimientos será capaz de realizar según que condiciones se encuentre e incluso poder hacer pruebas sin equipamiento real para así no dañarlo. Con esto en mente es que se crean los simuladores, entornos virtuales tridimensionales los cuales pueden recrear una gran variedad de situaciones.

Con respecto a los avances actuales en el campo de los simuladores, podemos encontrar una gran cantidad de estos gratuitos, los cuales sirven para aprender a controlar un dron con un mando e incluso videojuegos de simulación de carreras de drones[4]. A nivel más profesional podemos encontrar AirSim[5], simulador de vuelo creado por Microsoft en el motor de juego de Unreal Engine (UE). Al mismo tiempo existe un simulador desarrollado para el motor de juego de Unity, Flightmare[6], muy similar al que queremos crear. Sin embargo, este simulador se basa en el simulador de físicas Gazebo, el cual para ciertas ocasiones es muy limitado.

La mayoría de los simuladores previamente descritos hacen uso de 2 SDK (Software Development Kit) externos, Gazebo y ROS/ROS2. El primero siendo un motor de físicas el cual gestiona todo lo relacionado con la física que interactúa con el dron, ya sea su movimiento, velocidad...etc. El segundo, ROS, es un software que se centra en el intercambio de mensajes, más concretamente, se encarga de enviarle las instrucciones al controlador del dron para manejar al mismo. Le envía datos como por ejemplo el modo de vuelo, velocidad y demás. Estos modos de vuelo y datos pueden variar dependiendo de que tipo de dron y que tipo de software tenga este por detrás.

Así pues, este trabajo tiene como objetivo crear un simulador de vuelo de drones en el entorno gráfico de Unreal Engine 5 realizando una integración con la librería de comunicación de C, ROS2, para así crear un sistema de manejo automático de la trayectoria del dron. La implementación de la gran mayoría del proyecto se realizará en C++. Al mismo tiempo, al crear este simulador en UE5, lo que se quiere es evitar el uso de Gazebo como motor de físicas ya que este es un tanto limitado. En cambio, se pretende simular la física y colisiones del dron con el propio motor de físicas de UE5.

1.2. Unreal Engine 5

Como he mencionado previamente, el simulador se va a desarrollar para el motor de juego Unreal Engine 5 (UE5) desarrollado por la compañía Epic Games. Esta herramienta es muy reciente y cuenta con unos avances gráficos enormes, pudiendo llegar a generar entornos que luchen casi idénticos a los reales dando la impresión de ser grabaciones reales y no simulaciones generadas por ordenador. Asimismo cuenta con un sistema de físicas y colisiones integrado, lo que facilitará las tareas de implementación más adelante. Como añadido, este entorno también cuenta con herramientas de Inteligencia Artificial, que se pueden usar para controlar los actores, refiriendonos a los drones, que podamos llegar a tener en la escena.

El principal motivo para realizar el desarrollo en este motor, es con vistas a futuro, gracias a la gran capacidad gráfica que proporciona y la oportunidad de hacer uso de IA, hacer el entrenamiento de los drones dentro del simulador para luego poder transferirlo a máquinas reales y así no arriesgarse a dañar el equipo.

1.3. ROS 2

ROS 2, o también conocido como Robot Operating System 2, es un SDK (System Development Kit) open source, el cuál ofrece una plataforma estándar para desarrollar software de cualquier rama de la industria que implique el uso de robots. Este framework se desarrolló en 2007 por el Laboratorio de Inteligencia Artificial de Standford y su desarrollo se ha continuado desde entonces.

La versión de este framework con la que estamos trabajando es la versión humble, la última versión publicada a la fecha de realización de este trabajo. Entrando a describir más específicamente en que consiste este software, ROS se compone de 2 partes básicas, el sistema operativo ros, y ros-pkg, un conjunto de paquetes creados por la comunidad que implementan diversas funcionalidades como puede ser; localización, mapeo simultáneo, planificación, percepción y simulación...etc. Sin embargo, el uso principal de este conjunto de librerías es el paso de mensajes entre un controlador y la máquina en cuestión.

En este trabajo, el objetivo, además de poder tener un dron cuyo movimiento sea lo más fiel a la realidad posible, implementar ROS 2 para poder realizar el control del dron de forma “externa”, y así simular un vuelo real.

2. Title of next chapter

2.1. Overview

bla bla bla bla bla bla bla bla bla bla b la bla bla bla PPS bla bla bla bla bla bla
 bla
 bla
 bla
 bla
 bla bla bla bla bla bla, see [Ric21, Mar63].

2.2. The next section

La inserción de código fuente se puede hacer directamente desde el archivo¹:

Listing 2.1: Un programa en C

```
1
2 int main() {
3     char saludo[128] = "Hola mundo";
4     printf("1: %s\n", saludo);
5 }
```

O con insertando un flotante de tipo Algoritmo y luego insertando igual que antes el archivo fuente:

Algoritmo 2.1 Una clase de Java

```

1
2 public class UnaClase {
3
4     private static final SALUDO = "Hola Mundo";
5
6     public UnaClase() {
7         System.out.println(SALUDO);
8     }
9
10    public static void main(String[] args) {
11        new UnaClase();
12    }
13
14 }

```

¹Para insertar, hay que ir al menú insertar -> Archivo -> Documento hijo y seleccionar tipo de inclusión Listado de código fuente.

Se puede hacer referencia al flotante: Algoritmo 2.1 o a la referencia del listado: Listing 2.1.

Y se puede delimitar lo que se muestra utilizando las opciones del paquete *Listing*, mediante *firstline* y *lastline*, usando estas opciones en el recuadro de configuración.

Nota:

Como se puede ver si se introduce el título al insertar el documento hijo aparece *Listing*, se recomienda utilizar un flotante de tipo “Algoritmo” para mostrar código fuente.

3. Title of next chapter

3.1. Overview

bla bla bla bla bla bla bla bla bla b la bla bla bla PPS bla bla bla bla bla bla
bla
bla
bla
bla
bla bla bla bla bla bla, see [Ric21, Mar63].

3.2. The next section

4. Title of next chapter

4.1. Overview

bla bla bla bla bla bla bla bla bla b la bla bla bla PPS bla bla bla bla bla bla
bla
bla
bla
bla
bla bla bla bla bla bla, see [Ric21, Mar63].

4.2. The next section

A. Title of the first appendix chapter

A.1. Overview

bla bla bla bla bla bla bla bla bla bla bla bla bla bla bla bla b la bla bla bla bla bla bla
bla
bla
bla bla bla bla bla bla bla bla bla bla bla bla bla bla bla bla bla roughness parameter
 R_a bla
bla bla bla bla bla bla bla bla bla bla, see [ISOa].

A.2. The next section

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Nomenclatura

R_a arithmetic average roughness

PPS Polyphenylene sulfide

PPS Polyphenylene sulfide

PPS Polyphenylene sulfide