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Escuela Técnica Superior de Ingenieros Informáticos

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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

Índice general

1. Introducción

1.1. Descripción General

La simulación de drones es un campo relativamente nuevo, sin embargo, es un área en el que se han realizado numerosos desarrollos. En los recientes años se han realizado grandes avances e investigaciones con diversos fines, desde el estudio de la física del movimiento de los drones para su posterior simulación en entornos virtuales, hasta estudios para descubrir las posibles aplciaciones de estas versátiles máquinas. Como por ejemplo su uso en seguridad[2], mantenimiento de campos de placas solares[3] e incluso entretenimiento con enjambres de cientos de estos pequeños robots[1] .

Los drones son vehiculos 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. Por ello, simular el comportamiento de una máquina de este tipo se ha vuelto esencial, tanto para preveer que movimientos será capaz de realizar según en que condiciones se encuentre como para poder hacer pruebas sin el equipamiento real, evitando así posibles daños. Con esto en mente, se crean los simuladores, que sonentornos virtuales tridimensionales los cuales pueden recrear una gran variedad de situaciones.

Con respecto a los avances actuales en el campo de los simuladores, se han desarrollado una gran cantidad de los mismos, entre ellos, los que permiten aprender a controlar un dron, otros orientados a videojuegos de simulación de carreras de drones[4], etc. A nivel más profesional podemos encontrar algunos como AirSim[5], simulador de vuelo creado por Microsoft en el motor de juego de Unreal Engine (UE), o Flightmare[6], un simulador desarrollado para el motor de juego de Unity. Sin embargo, este simulador se basa en el simulador de físicas Gazebo, el cual para ciertas ocasiones es muy límitado.

La mayoría de los simuladores previamente descritos hacen uso de 2 SDK (Software Development Kit) externos, Gazebo y ROS/ROS2. El primero es un motor de físicas el cual gestiona todo lo relacionado con la física que interactua 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 sobre que tipo de software este construido.

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 trayectoría 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 límitado. 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 lucen casi idénticos a los reales dando la impresión de ser grabaciones del entorno natural y no simulaciones generadas por ordenador. Asimismo cuenta con un sistema de físicas y colisiones integrado, lo que fácilitará las tareas de implementación más adelante. Como añadido, este entorno también cuenta con herramientas de Inteligencia Artifical, 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 su gran proyección de futuro, gracias a la 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 ultima 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, es implementar ROS 2 para poder realizar

el control del dron de forma “externa”, y así simular un vuelo real.

2. Desarrollo

2.1. Descripción General

Como se mencionó en la introducción, el desarrollo de esta aplicación será principalmente en C++ dado que es el lenguaje en el que se escribe en Unreal Engine 5 y ROS2. La fase de desarrollo se basa en 2 partes principales. Una primera de puesta a punto, o de prototipado, donde se ha experimentado con el motor de juego para descubrir la mejor forma de implementar los requisitos pedidos. Y una segunda fase en la que, ya , en esta primera versión se desarrolla la aplicación al completo.

2.2. Fase de prototipado

Esta ha sido la primera fase del desarrollo del simulador, en la cual he realizado algunas pruebas para encontrar la mejor forma de implementar un dron y su movimiento en el sandbox proporcionado por Unreal. Las pruebas realizadas han sido un total de 3

La insertación de código fuente se puede hacer directamente desde el archivo[1]:

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:

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.

[1]Para insertar, hay que ir al menú insertar -> Archivo -> Documento hijo y seleccionar tipo de inclusión Listado de código 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 }
```

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, 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, 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 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 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 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 bla bla bla bla bla bla bla bla bla 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