A Multi-UAS Simulator for High Density Air Traffic Scenarios

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Presenter

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Resume

Telecommunications Engineer, 2000, at the Public University of Navarre.

Specialized in computer security and digital identity projects. I have developed my professional activities in different companies and sectors for more than 20 years.

My research work is focused on ontology-based autonomous systems and how to apply it to unmanned aircraft (UAS).

Introduction

- Unmanned Aerial Systems (UAS) traffic increase

- Safety risk

- Different Collision Avoidance Systems (CAS)

- Incidents with UAS, collisions.

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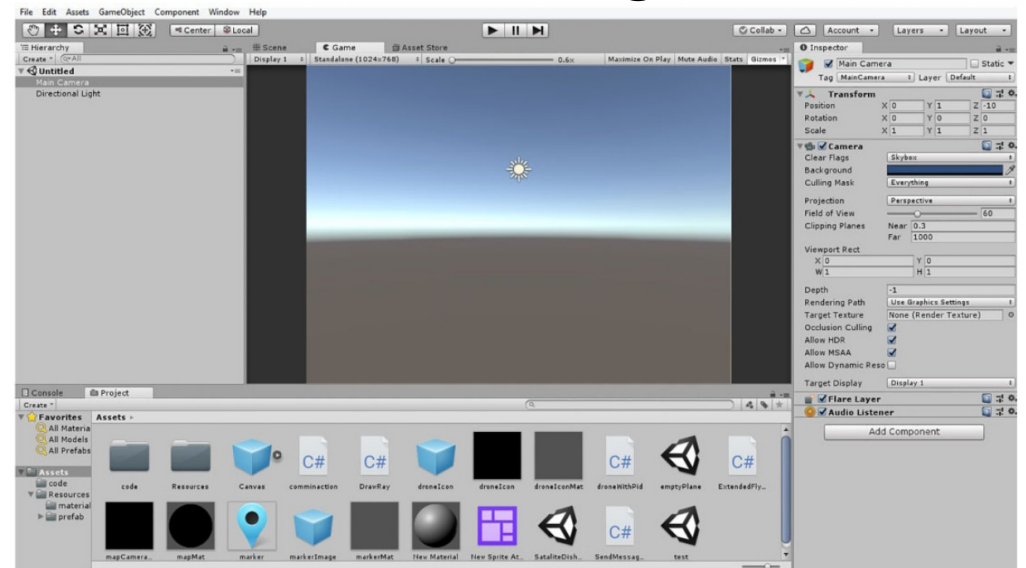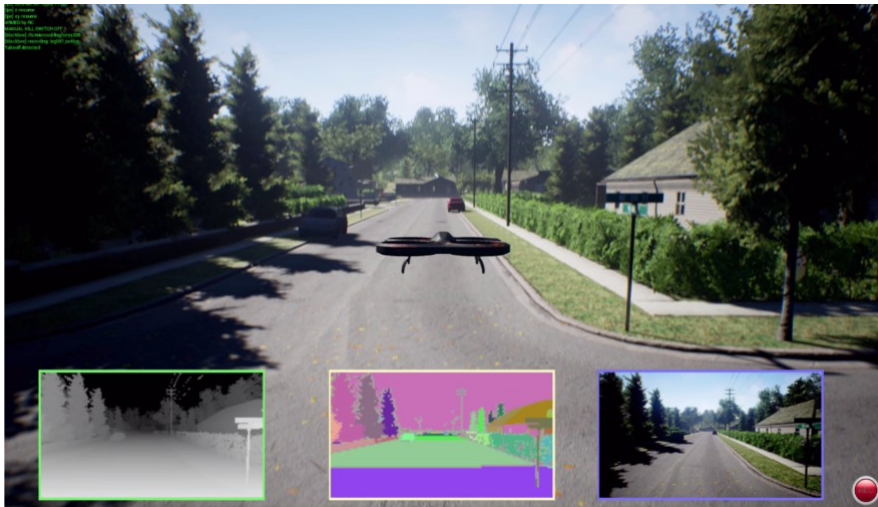Nafarroako Unibertsitate Publikoa

Challenges

- How to improve UASs flight security?

- How to verify CAS response time?

- How to simulate UAS traffic safely?

- How to reduce time-to-market of UAS sub-systems?

Related Work

- Aircraft and UAS simulators lacks configuration flexibility

- Limited conflict and scenario generation

- Hardware In the Loop simulation are a separate process, not integrated

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Related Work

Simulators of one UAS based on 3D engines

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Contribution

- A novel UAS simulator, *SIMUdrone,* for dense traffic areas.

- Conflict configuration flexibility

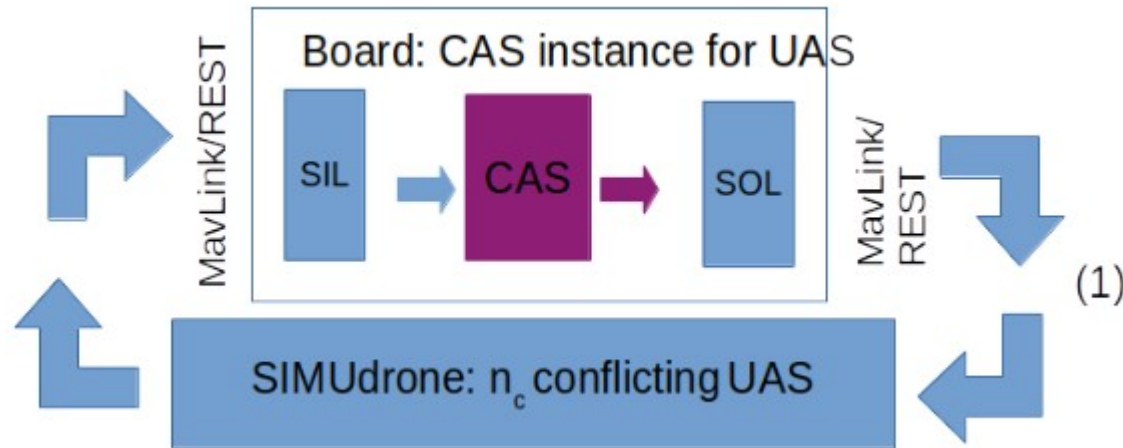- Reduce time to market, as *SIMUdrone* integrates HIL.

Simulator *SIMUdrone*

- *SIMUdrone* modes

  - HIL mode: an external connected embedded board runs an implementation of an UAS sub-system, like a CAS.

  - Integrated-conflict mode: multiple conflicting equipped UAS are modelled
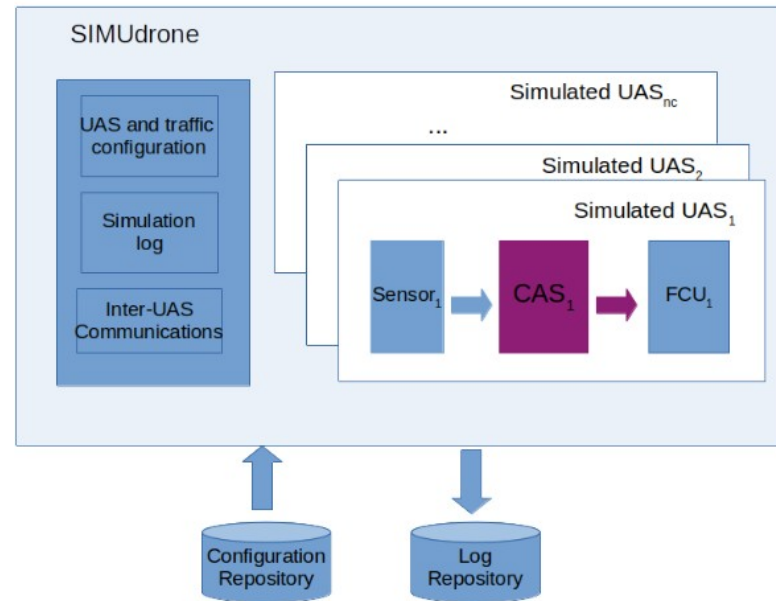
Simulator *SIMUdrone*

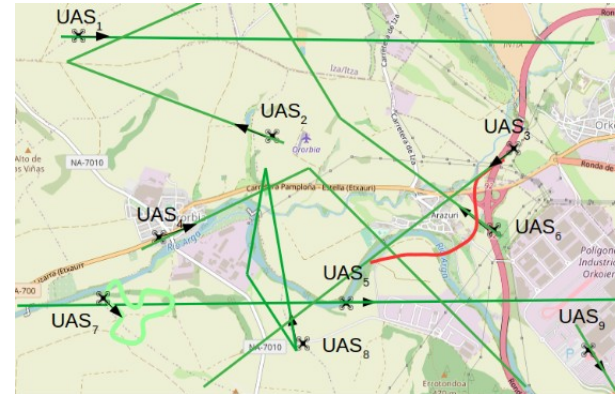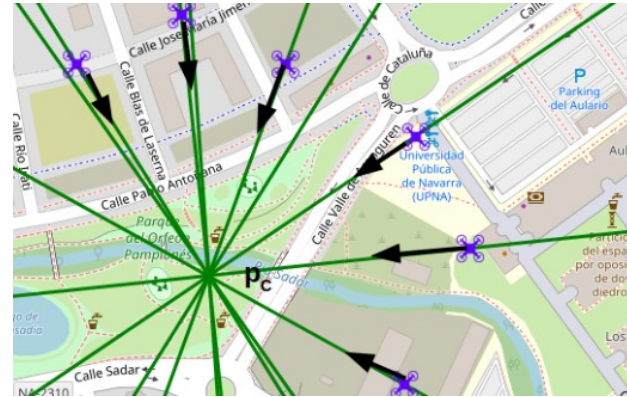- Architecture HIL mode:

Simulator *SIMUdrone*

- Architecture of the integrated-conflict mode

Simulator *SIMUdrone*

Conflict scenarios available:

- Conflicting point scenario

- Conflicting area scenario

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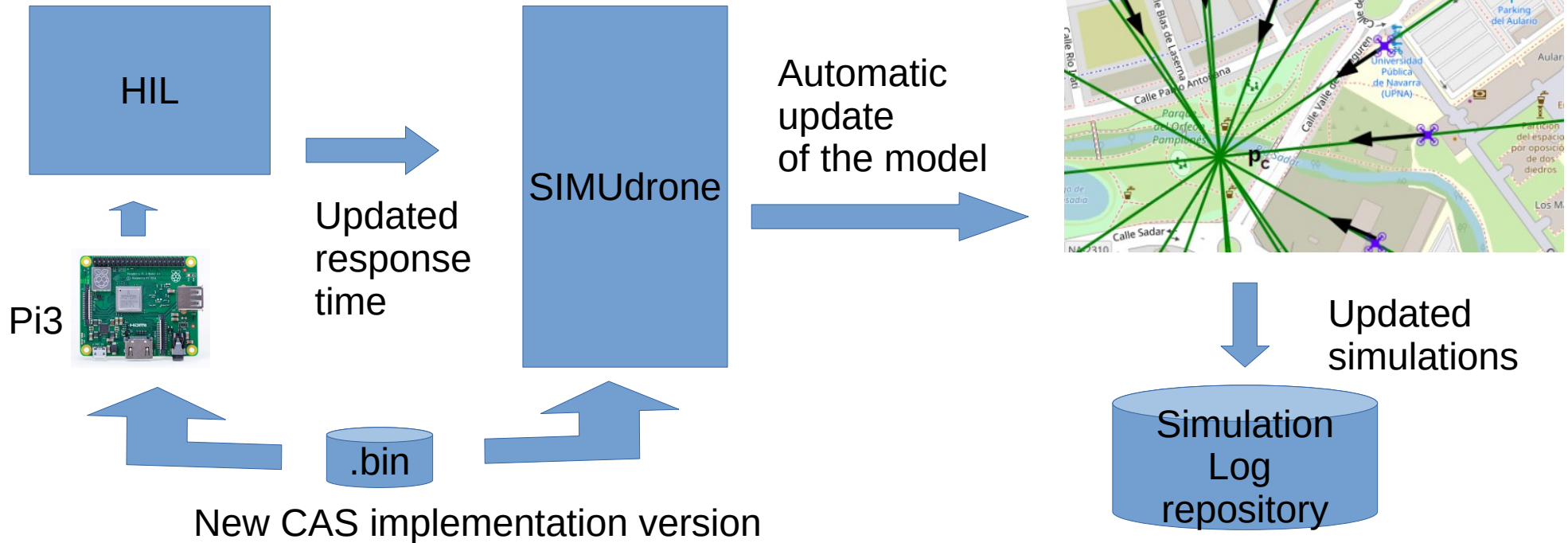
Simulator *SIMUdrone*

UAS types available:

– Autopilot UAS

– Autonomous UAS

– Remotely piloted UAS

Simulations results

- Automated integrated continuous simulation that combines an HIL simulation and a software model simulation

  - A CAS implementation is executed in an embedded board

  - The response time obtained updates the simulator model of the CAS

Continuous traffic simulation

A continuous simulation example:

HIL

Pi3

Updated
response
time

SIMUdrone

Automatic
update
of the model

Updated
simulations

.bin

New CAS implementation version

Simulation
Log
repository

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Simulation cycle

- CAS executes in a Pi3

- CAS implementation is integrated in *SIMUdrone* code base

- CAS integrated in *SIMUdrone* has the same response of the CAS running in a Pi3.

- *SIMUdrone* simulates a conflicting scenario

- New CAS versions are deployed to the Pi3 and *SIMUdrone*

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Simulation results

- Improvement of the CAS implementation can be verified in conflicting scenarios

- A historical simulation log allows to compare CAS implementation improvements over time

- A simulation without CAS is the reference as it is the worst-case for a defined scenario

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Conclusion

- *SIMUdrone* integrates simulations of virtual traffic scenarios with HIL simulations.

- Allows an automated simulation workflow to reduce time-to-market

Future Work

- Integration of external binaries of collision avoidance implementations.

- Integration of *SIMUdrone* with hardware implementations for UAS.

Future Work

- Implementation of models for more UAS components.

- HIL mode with more protocols available.

- Dataset of conflicts and avoidance maneuvers.

Thank you