VEC VIRTUAL ENGINEERING CENTRE / PRESAGIS MAKE IT REAL

Creating an AV **DIGITAL TEST-BED** allowing physical and virtual entities to be tested simultaneously

BACKGROUND

Recent technological advances have accelerated the development and application of increasingly autonomous systems in civil and military aviation, bringing benefits in efficiency, affordability and reliability. However, there are several challenges in proving the safety assurance of these systems due to their non-deterministic behaviour, the results of their interactions with humans and the busy nature of commercial airports, where multiple transport systems often co-exist.

The Virtual Engineering Centre (VEC) wanted to connect advanced robotics within the physical, synthetic and virtual worlds, using a simulation of the Liverpool John Lennon Airport terminal area, to assess the safety and reliability of autonomous systems testing within the highly regulated aerospace industry. The project was to act as a showcase for the work of its Robotics and Autonomous Systems Laboratory (RASL) and Virtual Engineering Systems Laboratory (VESL).

THE CHALLENGE

The VEC had to create a virtual test bed which allowed physical and virtual entities to be tested simultaneously on a true-to-life scale, to ensure realistic and effective testing and evaluation. It also had to be capable of testing a range of scenarios, including human interaction with autonomous systems, for example from a pilot or air traffic controller. The aim of the hardware and software-in-the-loop testing was to provide a showcase for all the VEC's capabilities and facilities, including distributed simulations.

THE SOLUTION

The VEC created a test bed to facilitate the testing and evaluation of the sensors on an unmanned airborne vehicle (UAV), or unpiloted aeroplane.

A high-fidelity 3D synthetic simulation of Liverpool John Lennon Airport (JLA) was created using Presagis software products; Vega Prime, Creator, and STAGE.

The simulation was complete with runways and buildings, based on existing data on the airport. This provided an immersive virtual environment for the testing. A remote flight simulator allowed a range of different landing and taxiing situations to be considered.

In the physical world, a motion tracking system area was built in the RASL, replicating the airport runway apron

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layout on a scale of 1:70, with an autonomous vehicle representing an airport passenger bus.

This was then immersed into the virtual environment. High Level Architecture (HLA) allowed for full interconnectivity between all physical and virtual elements of the test bed – the virtual air traffic control and cockpit, robotic vehicle, motion tracking, monitors and simulators. This meant that different weather conditions could also be factored in, making the virtual environment as realistic as on any given day at the actual airport.

The test bed allowed the VEC to simultaneously and intensively test the virtual and physical worlds for millions of 'what happens if' and collision avoidance scenarios.

The VEC's RASL and VESL collaborated on the project, with the RASL responsible for the motion tracking system, the autonomous ground vehicle and its surrogate in the virtual environment, and a 360 degree view, while the VESL developed the ground control station, vehicle system model and simulated vehicle view.

This highlights the potential challenges they may face within their day-to-day tasks. This allows operators to learn to 'drive' the nuclear waste retrieval crane before the full-scale training environment was available, ensuring greater levels of safety whilst increasing productivity.

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