Using 3D and information visualisation to improve perception and facilitate situation awareness

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INTRODUCTION

CSIR engineers are developing a 3D-viewer library called Sentience3D. The goal is to aid users and developers of simulations in building the visualisation tools they need to achieve the required level of situation awareness in their virtual environment simulations. The library makes use of open source building blocks and is itself moving towards a Lesser General Public License (LGPL). Online or offline simulation traces are used to populate a virtual environment similar to Google Earth with 3D representations of all the simulation entities. The virtual environment is then visually augmented with additional information such as entity relationships and model state.

Having an adequate level of situation awareness is very important for decision-makers in fields such as aviation, air traffic control and military command and control. It is, however, of equal importance to have a high level of situation awareness when attempting to make sense of and use complex simulation traces and results. This paper and accompanying poster describes the long-term vision for 3D visualisation; the use cases and design of Sentience3D and instances of impact in the domains of the current SANDF and international clients.

BACKGROUND

The 3D visualisation capability has been gaining momentum within the CSIR defence domain for many years. The possible utility of using 3D visualisation to present simulation outputs was realised during the early 2000s. The OpenSceneGraph project, which is a scene graph programming interface on top of OpenGL, was identified as a lively new open-source project that provided the needed tools to create a rich 3D environment.

A need to use the viewer component in external DPSS contracts emerged during early 2009. It was decided to create a new project from scratch with a clear licence and terms of use. Thus, the "Sentience3D" library was born. The growth of OpenSceneGraph, related geo-spatial libraries and new open-source building blocks greatly eased the design and implementation of the new viewer library.

Currently, Sentience3D provides an interactive virtual environment with real-world terrain and GIS support. Simulation traces may be used to populate this environment with representations of all the simulation entities. The environment is usually also augmented with additional information such as entity relationships and metadata.

VISUALISATION USE CASES

Three types of simulation will be differentiated; these are:

- Live simulation – real operators are using dummy or simulated equipment in the real world.
- Virtual simulation – real operators are using simulated equipment in a synthetic environment.
- Constructive simulation – simulated operators are using simulated equipment in a synthetic environment.

These simulations are usually run either for purposes of training or for doing controlled experiments during research and development. Regardless of the type of simulation being run, the equipment and environment can be instrumented to capture data that may be used during analysis. Visualisation is then used to augment the natural ability of the user, developer or client to follow the simulation traces and then analyse the results.

VISUALISING SIMULATION TRACES

The first use case is visualising simulation traces. This may be done offline or online, as the visualisation software does not interact with the simulation. Examples of offline visualisation of constructive simulations are shown in **Figure1** and **Figure2**.

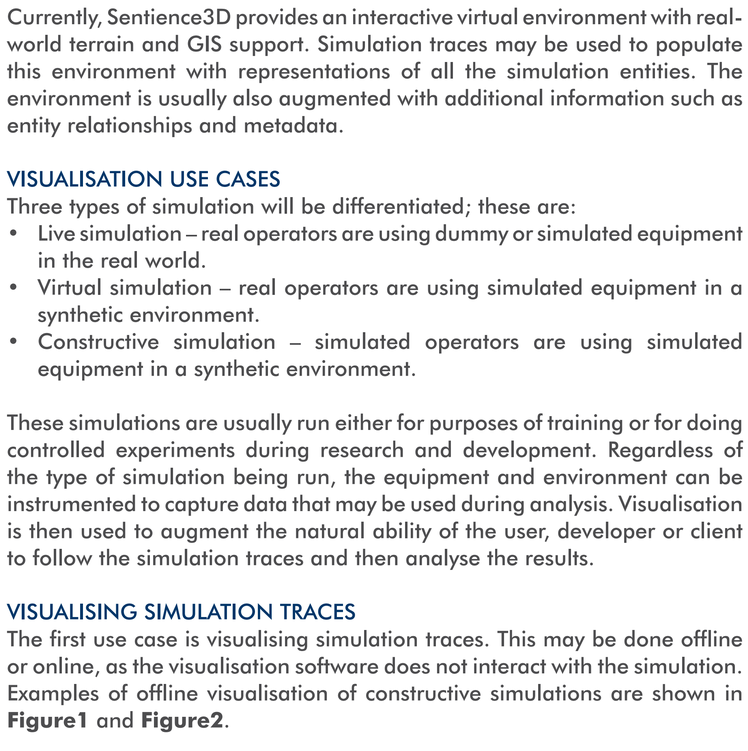

Figure 1: An overview of a GBADS battery [CCIW, GBADS simulation group]

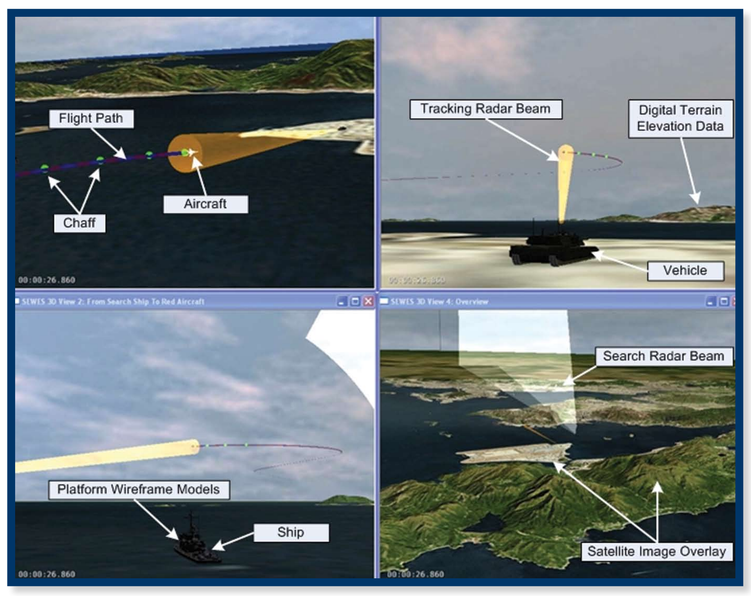

Figure 2: An overview of a electronic warfare simulation [RADAR&EW, SEWES simulation group]

INTERACTING WITH A LIVE OR VIRTUAL SIMULATION

The second use case of visualisation is an online visualisation tool that can manipulate and interact with the simulation. Examples of these are mock-ups of 2D equipment consoles and 2D/3D scenario planning tools. A 2D map view interface that is part of a virtual simulation is shown in **Figure 3**.

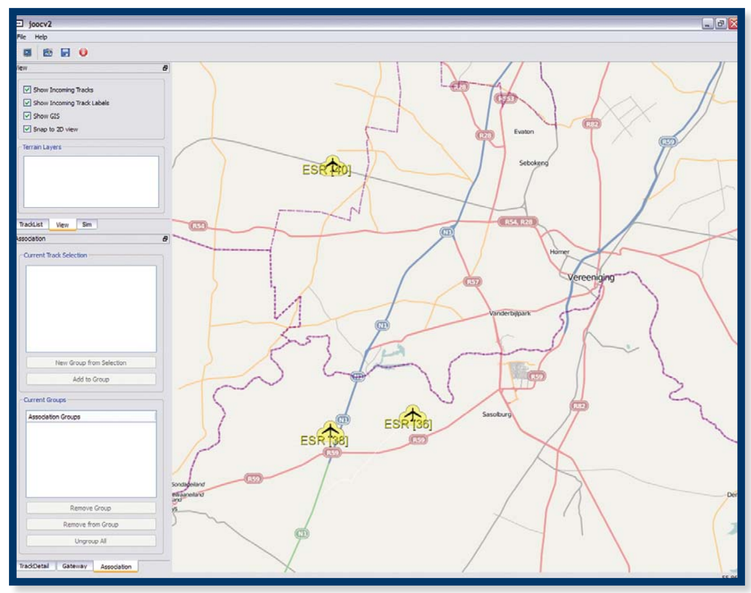

Figure 3: A 2D map view interface [CCIW, GBADS simulation group]

AUGMENTING LIVE AND VIRTUAL SIMULATION

The third use case is in augmenting the available information during a live scenario, such as a field exercise, with a 3D view of the situation. During a surveillance deployment, for example, 3D visualisation might be used to show a real-time overview of the situation indicating the state (e.g. position, orientation and FOV) of all systems on a realistic 3D terrain with the relevant GIS information. **Figure 4** shows a 3D overview of a sensor FOV in a live simulation during development of a pedestal pointing and tracking system. The pedestal's position and orientation is geo-aligned with the 3D terrain and a GIS layer.

Figure 4: An overview of a live simulation during the development of a pedestal sensor system[OSS, Image Processing group]

USING SENTIENCE3D

The Sentience3D library makes use of a layered design to separate the application from the underlying implementation. The inner most C++ interface provides a low-level object-oriented method for using the Sentience3D library which is built on top of Open Scene Graph. A high-level ANSI C interface wrapper is used to integrate Sentience with a variety of programming languages such as Matlab and Python.

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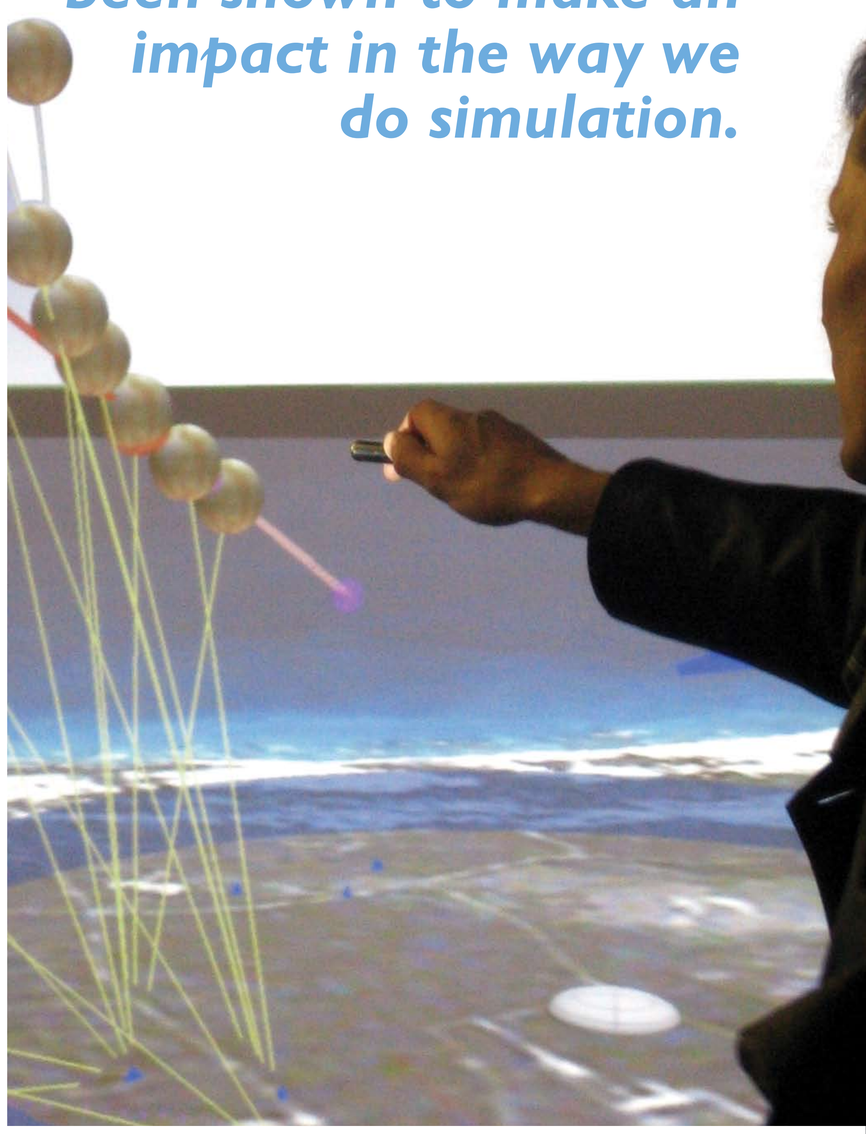

The extra level of indirection had some additional benefits. Two of these are streaming of commands and simplified synchronisation between the simulation and the visualisation.

FUTURE WORK

The long-term vision for the visualisation capability is to add more GIS functionality and improved support for live data and sensor displays. Improved GIS support adds visual cues and intuitive visualisation of geo-aligned information to aid in further improving situation awareness. Support for efficiently incorporating live information streams from sources such as cameras and search RADARs is cardinal to advanced 2D and 3D displays.

CONCLUSION

3D Visualisation has been shown to make an impact in the way we do simulation. More to the point:

- Visualisation is used during development to verify model implementations.
- The simulation results are presented to clients such as the SANDF using 3D visualisation.
- 3D and map view visualisation is used to improve situation awareness during live exercises.

Having Sentience3D open source allows the library to be used by a wider community and the community contributes the reciprocal of its gained expertise back into the library. The library makes use of open source building blocks and is itself moving towards a Lesser General Public Licence (LGPL). Users may therefore build commercial applications without having to pay licensing fees.

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