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NEW FEATURES OF VIRTUAL SIMULATION IN VBS3

Abstract: The paper presents new properties of VBS, which have been added in VBS3. The principal new features are the extended properties of the graphics engine, extended range and method of simulation and network communication. The paper also presents examples of visualization using the new graphics engine.

Keywords: simulation of combat operations, virtual simulation, VBS3, battlefield simulator

1. INTRODUCTION

Development in virtual simulators refers to both simulation algorithms (simulation engine) as well as the graphics engine. The VBS (Virtual Battle Space) simulation environment is being rapidly expanded to increase the efficiency of multiple station exercises, extend the range of available exercises and enable highly detailed imaging. The VBS environment is now the most widespread software for tactical simulation and the main simulator of tactical operations in the US Army, which chose to use it during the next five years.

2. GRAPHICS

VBS3 uses elements of the Real Virtuality 3 and 4 graphics engine. The new capabilities of the graphics engine enable visualisation of objects at a high level of detail. The lighting model and dynamic representation of reflections on water surface have been extended. Fig. 1 shows an example of terrain representation using the new lighting model. Dynamic streams and pipelines and simulation of underwater operations with sea bottom and water surface animation have also been added.

Fig. 1. Example of applying the new lighting module

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3. SIMULATION ENGINE AND NETWORK COMMUNICATION

The simulator is now furnished with improved network communication mechanisms for multiple station exercises. The new network communication mechanisms provide high performance imaging (50 FPS), even with several hundred scenario objects (AI or trainee). Exercises with two hundred or more participants and several hundred objects controlled by artificial intelligence are performed on a regular basis. Fig. 2 shows an example of the architecture.
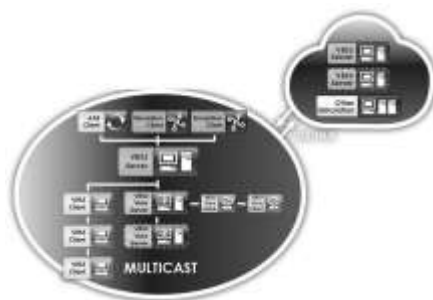
Fig. 1. Architecture of an example of exercise configuration

4. DYNAMICALLY RENDERED VEGETATION AND PROCEDURAL SNOW

The newest version of VBS3 provides mechanisms that enable generating procedural biotopes for a given map. Such a solution enables adapting the given map to the needs of trainees in terms of vegetation changing with the time of year or in accordance with the training scenario. Another advantage of such a solution is that special tools for generating maps are not required. The generated map also takes up much less memory space, as the position of every tree does not have to be permanently recorded in the map file − this is important because VBS generates maps that cover hundreds of square kilometres which can have millions of trees. Fig. 3 shows the same fragment of the map with dynamically generated biotopes.

Fig. 3. Dynamic generation of biotopes

A new property of the most recent VBS3 version is the ability to use snowfall algorithms (procedural snow layer). Snowfall algorithms are not constrained to visualise snow, they also represent the interaction of snow with moving objects. Fig. 4 shows an example of the representation. Snow is deposited in layers and affects the speed of simulated vehicles, thermal signature and fatigue.

Fig. 4. Rendering of procedural snow

5. MAPS

To handle large areas during exercises, VBS3 now supports building maps covering a terrain of up to 2200km x 2200km in size. Maps of this size enable representing vast areas. Fig. 5 shows an example of a large-sized map.

Fig. 5. Example of a large-sized map

6. OBJECTS

As regards objects, the vehicle condition properties have been expanded. Now it is possible to define several vehicle components that can break down and be repaired in real time. The simulation represents failures of the individual components, possibilities of repairing them and the duration of the repair. A new element is the ability to simulate systems that support vehicle driving, such as: ABS, hand brake. Independent suspension, front and rear wheel drives are simulated, which has an effect on the manner of driving under various conditions.

Human injury severities have also been expanded, which during simulation has a strong effect on the scope of possible actions, affecting also the AI algorithms. Treatment is also simulated, as are the effects of wrong actions.

Deep changes have been made in models of buildings to enable representation of partial demolition or damage. Building elements retain their basic physical properties when damaged and can also cause injuries (see Fig. 6).

Fig. 6. Examples of the representation of the new physics of building damage

New objects have been introduced to enable creating underground passages and tunnels adapted to land configuration.

A new element is the introduction of the aspect of object camouflage (see Fig. 7) for generating images in exercises with the use of augmented reality (AR) technology.

Fig. 7. An example of object camouflage

7. SUMMARY

New properties available in VBS3 enable construction of simulators and training devices that closely map the reality that surrounds the trainee. The increased number of available objects (vehicles, weapons, aeroplanes, helicopters) and additional maps enable the instructors to locate the trainees within new, previously unattainable scenarios.

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