ROBOT BASED DRIVING AND OPERATION SIMULATION WITH A SPHERICAL FIXED SCREEN

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Abstract – We present the latest development stage of the visualization system of RODOS®. The concept of this novel type of simulator was presented at the DSC-Conference 2012 [Kle1]. Currently the RODOS® system (Robot based Driving and Operation Simulator) is undergoing concluding stage of construction. This poster details the fixed screen visual system, the clustering of the rendering system and the multi-channel projection. Different application scenarios are highlighted to show the visualization system's capabilities.

Key words: Interactive Driving Simulation, Industrial Robot, Fixed Screen, Spherical projection, Multi-projector system.

1. Motivation

Most high end simulators are equipped with moving screens. To ensure an optimal use of the serial kinematics motion system, an uncommon screen concept was necessary. A 10-meter spherical screen maximizes the view area without affecting the payload of the motion system. Besides blending and warping the image, which is also necessary in most moving screens, the graphic engine has to support the synchronous position tracking of the test person. Additionally the scene should run on various devices in order to simulate assistance or information systems.

2. Visual simulation

2.1. Introduction and Current State.

At this moment the simulator features a seamless, synchronized and responsive image. The scenario can be a 3D model or a picture, as depicted in Fig 1 and Fig 5, respectively. The landmarks of this progress can be summarized as (a) solving the synchronization challenge, and (b) accurately warping and blending the projections in the spherical screen.

2.2. Synchronization

This point may be addressed through the tolerances of the human perception. Psychological studies show that subjects can tolerate up to 40 ms. delay between their actions and visual feedback [Diz1]. While it is possible to achieve almost perfect synchronization between the projections, this approach would force freezing the whole scene when one slave lags behind. Thus, we aim to achieve a smooth simulation while keeping the de-synchronizations sparse and below the human perception threshold. At this moment, a non-locking synchronization system is being tested, with encouraging results.

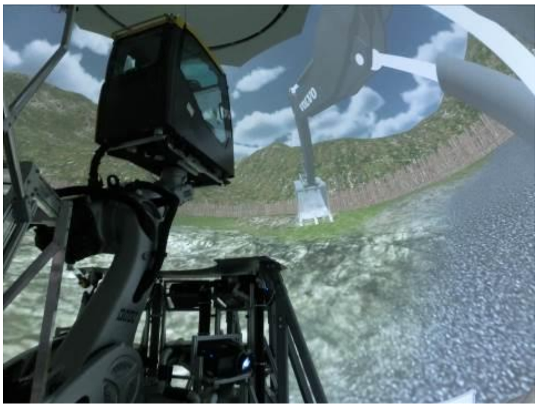

Fig 1. Interactive excavator simulation with RODOS®

2.3. Warping & Blending

Since the screen has an almost spherical shape, the projections must be warped to avoid a distorted image. Additionally, the projections are overlapping, thus brightness must be adjusted to achieve a seamless image (Fig 2.)

Fig 2. The projections are overlapping. In order to mask this effect, blending must be applied.

The automatic calibration of the projector system is an in-house solution developed at Fraunhofer FOKUS in Berlin [Hau1].

The image warping and edge blending are then carried out by in-house developed plugins for different graphic engines.

2.4. Integration of existing technologies

The visual system allows the integration of alternative display devices such as handhelds (Fig. 3), as well as head tracking devices, in order to maintain an optimal warping, or to accurately simulate rear-view mirrors depending on the driver's head position [Koo1].

Fig 3. Handheld devices can easily be adapted to enhance the experience.

In addition to hardware, we aim for integration with existing software technologies, such as panoramic videos (Fig 4), or even Google Street View (Fig 5).

Fig 4. Panoramic video in the dome [Air1]

Fig 5. Google Street-view® in the projection dome.

3. Future work

As on-going and future work, we present the following lines:

- Tire-terrain interaction: Updating the terrain at runtime with realistic reaction forces.
- Tool-soil interaction: Excavator simulation with physically correct material behavior
- Laser-scanned real environment: Point cloud visualization of real test tracks.
- Applying different vehicle cabins: Tractor cabin and passenger car chassis

4. References

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