
Using digital reality to visualize and facilitate the remote operations of a radioactive chamber

By Emil Boman and Lukas Smisovsky, 2016

Digital Reality: umbrella term for Augmented Reality and Virtual Reality

Can Digital Reality (DR) be used for effectively visualizing a radioactive chamber and the operations carried out within? What kind of DR can be used, and what kind of DR should not be used? By developing and testing a prototype, we were hoping to answer these questions and get a good indication of how to approach this problem using this kind of technology.

The Target Division at the European Spallation Source (ESS) is currently designing and leading the future construction of a hot cell (a radioactive chamber), known as the Active Cells Facility. ESS is currently under construction in Lund, Sweden, and will be the world's most powerful neutron source when finished in 2025.

Hot cells need to be operated from the outside because of the fatal levels of radiation inside during operation. Traditionally, this has been done using radiation shielding lead glass mounted in the walls of the chamber. However, as the chambers get bigger and the operations themselves get more advanced, other solutions need to be explored.

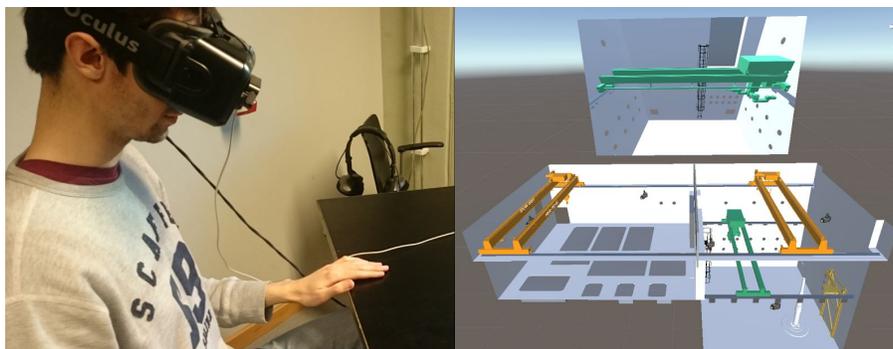
Because of the impracticality and cost of using and constructing radiation shielding windows, it has already been decided that the Active Cells Facility will not have windows. This means that other solutions need to be applied. As DR technologies are rapidly improving, the most promising solution seems to be involving this kind of technology.

So, is DR applicable on this problem? If so, what are the requirements on hardware and software? What kind of DR can be applied, and what kind of DR should not be applied?

This thesis set out to explore different ideas, and to prototype them using a combination of off-the-shelf products. The final prototype was then evaluated with 14 volunteers.

The results from these tests indicated that the application of DR techniques could indeed prove to be very useful. Users reported as feeling to be in control and having a good overview of the facility. This could mean that DR could indeed improve the visualization of the operations inside, and thus increase the situational awareness among operators. However, some of the techniques used were not positively received by the users. Using virtual controls for controlling equipment that required precision, for instance, was received with frustration and was for the most part too inaccurate for safe operation.

DR is therefore not necessarily useful in itself. It is important to identify the tasks to be performed and the difficulties in performing them, but also the capability and limitations of the hardware at hand. A comparison can then be made between DR and traditional methods. Once all this information has been obtained, an appropriate DR environment with complementing non-DR technology can be designed for efficiently performing the tasks in question.



Left: An operator watching the inside of a hot cell, using VR glasses.

Right: The hot cell with an accompanying monitor above it to show the camera streams.
