Radiation Dose Assessment in Nuclear Plants Through Virtual Simulations Using a Game Engine

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Abstract

This paper reports an R&D which has the purpose of performing dose assessment of workers in nuclear plants, through virtual simulations using a game engine. The main objective of this R&D is to support the planning of operational and maintenance routines in nuclear plants, aiming to reduce the dose received by workers.

Game engine is the core of a computer game, that is usually made independent of both the scenarios and the original applications, and thus can be adapted for any other purposes, including scientific or technological ones. Computer games have experienced a great development in the last years, regarding computer graphics, 3D image rendering and the representation of the physics needed for the virtual simulations, such as gravity effect and collision among virtual components within the games. Thus, researchers do not need to develop an entire platform for virtual simulations, what would be a hard work itself, but they can rather take advantage of such well developed platforms, adapting them for their own applications.

The game engine used in this R&D is part of a computer game widely used, Unreal, that has its source code partially open, and can be pursued for low cost.

A nuclear plant in our Institution, Argonauta research reactor, has been virtually modeled in 3D, and trainees can navigate virtually through it, with realistic walking velocity, and experiencing collision. The modified game engine computes and displays in real-time the dose received by a virtual person, the avatar, as it walks through the plant, from the radiation dose rate distribution assigned to the virtual environment.

In the beggining of this R&D, radiation dose rate measurements were previously collected by the radiological protection service, and input off-line to the game engine. Currently, on-line measurements can be also input to it, by taking advantage of the game's networking capabilities. A real radiation monitor has been used to collect real-time radiation dose rate measurement and input this data to the game engine through a TCP/IP network.

Another advantage of this approach is that radiation dose rate distribution can be mapped by any available method, from measurements or computation. We are planning to expand this application to consider a number of networked radiatioin dose monitors installed in the real plant, to map the dose rate and to perform the simulations in real-time. Any other nuclear plant can be simulated, depending on the availability of measured data, or radiation monitors installed in the real plant.

KEYWORDS: Radiation dose assessment; virtual reality; game engine.

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