Virtual reality and artificial intelligence for nuclear plants' environment simulation towards safety for personnel

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Introduction

Virtual reality (VR) techniques enable the design of virtual environments (VE) corresponding to real ones. In this R&D, VEs were developed by reusing a low-cost platform that is well suited to perform virtual modeling and simulation.

A nuclear plant was modeled and its VE counterpart may be used for personnel training and/or for supporting managers better plan activities to be executed in the real plant. The objective is to minimize radiation dose received by personnel.

Methodologies

The low-cost platform chosen has embedded the following characteristics: (i) the dynamic scene rendering; (ii) the physics representation (Gravity and collision); (ii) the multi-user interactive online participation; and (iv) the online data acquisition through computer networks. These characteristics enable researchers to concentrate in their own applications, instead of developing software from the very beginning, what would be a difficult (and unnecessary) task, and also instead of using a high cost commercial platform.

Results and Discussion

This research and development (R&D) was carried out through stages: (i) virtual modeling and simulation of a real nuclear plant, IEN's Argonauta research reactor, based on an offline dose rate database [1]; (ii) extending simulation for online acquisition and use of dose rate from the real plant, through computer network [2]; and (iii) interpolation of dose rate data using artificial intelligence (AI) techniques [3].

This system enables multi-user navigation within the VE, and displays either dose rate value or dose integrated at each user's position (Fig. 1). The dose rate may consist of previously collected offline data, or online data collected from the real nuclear plant, via computer network (Fig. 2). Planners may use it for personnel training, for better planning activities towards minimization of dose received by personnel, or for inspection of actual online dose rates before anyone enters the real nuclear plant. This R&D also resulted into two M.Sc. dissertations, referenced in [1] and [3].

Fig. 1- A simulations' screenshot.

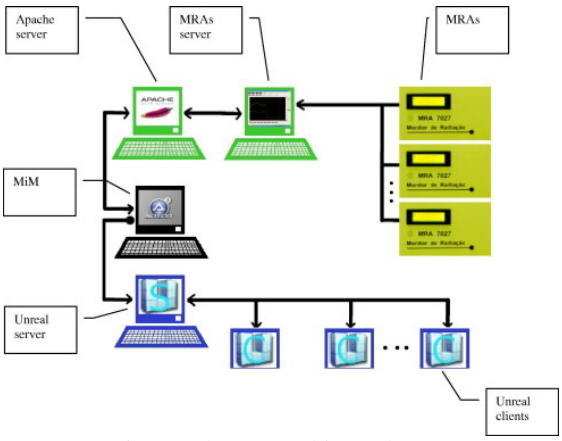

Fig. 2- The networking scheme.

References

[1] Mól, A.C.A.; Jorge, C.A.F.; Couto, P.M.; *et al.*; "Virtual environments simulation for dose assessment in nuclear plants", *Progress in Nuclear Energy*, 51 (2): 382-387, 2009.

[2] Mól, A.C.A.; Aghina, M.A.C.; Jorge, C.A.F.; *et al.*; "Nuclear plant's virtual simulation for on-line radioactive environment monitoring and dose assessment for personnel", *Annals of Nuclear Energy*, 36 (11-12): 1747-1752, 2009.

[3] Mól, A.C.A.; Pereira, C.M.N.A.; Freitas, V.G.G.; *et al.*; "Radiation dose rate map interpolation in nuclear plants using neural networks and virtual reality techniques". *Annals of Nuclear Energy*, 38 (2-3): 705-712, 2010.