

Virtual control rooms for nuclear power plants' ergonomics evaluation

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Introduction

This research and development (R&D) comprises the design of virtual control rooms (VCR) for nuclear power plants (NPP), aiming ergonomics evaluation. A VCR was designed by reusing a low-cost platform for virtual simulation. The NPP's control room was virtually modeled, considering all of its dimensions and control desks' locations.

The designed virtual environment (VE) was used for ergonomics evaluation, for comparative analysis with existing real data. Results were encouraging. This system can be used for ergonomics evaluation of new or existing NPPs' control rooms.

Methodologies

The low-cost platform used comprises some important characteristics for VE development, as: (i) multi-user simulation capability; (ii) physics representation (Gravity and collision); among others. The first mentioned characteristic is very important for this simulation, since a number of operators have to move across the control room, while executing their operational tasks. Then, it follows that the second characteristic is also important, because collision or crowded regions have to be considered, if a number of operators move across the control room.

An operational script was considered, based on real operations that are carried out in NPP control rooms. As each user controls his or her own avatar, each one can follow their individual tasks, interacting among themselves.

Results and Discussion

A virtual NPP control room was developed (Fig. 1), similar to a real one, based on available data. Users follow, in this VE, the mentioned script, and different situations that may occur may then be evaluated. Managers may use this type of simulation for ergonomics evaluation of new or existing NPPs' control rooms.

Once developed the NPP virtual control room, experiments were carried out. Users followed an operational script, for which previous ergonomics evaluation results were available. The comparative analysis was performed, for script actions, and

results agreed between the current virtual and the former real simulation and analyses (Table 1). This thus encourages its use for such ergonomics evaluation. This R&D resulted in a M.Sc. dissertation, referenced in [1].



Fig. 1- NPP control room's virtual model.

Table 1- Comparative analysis.

Action	Script time (s)	Avg. simul. time (s)	Relative error (%)
1	805,4	810	0,57
2	28,5	28,9	1,4
3	12,9	14,8	14,73
4	41,8	43,4	3,83
5	31,2	28,5	8,65
6	27,9	25,2	9,68
7	15,8	16,2	2,53
8	211,2	198,6	5,97
9	146	135,8	6,99
10	113,7	109,1	4,05
11	264,2	247,1	6,47
12	93,9	74,8	20,34
13	38,4	38,7	0,78
14	47,6	39,4	17,23
15	464,5	464,3	0,04
16	467,1	443,3	5,1
17	452,4	251,4	0,4
18	463,8	453,3	2,26
19	362,4	356,7	1,57
20	193,3	187,3	3,1
Total	4082	3966,8	-

References

- [1] Gatto, L.B.S.; Mól, A.C.A.; Santos, I.J.A.L.; *et al.*; "Virtual simulation of a nuclear power plant's control room as a tool for ergonomic evaluation", *Progress in Nuclear Energy*, 64: 8-15, 2013.