GAMES: Virtual Worlds and Reality

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CONTENTS

Combining concepts from Modeling and Simulation and Game research: Realismic Virtual Environments

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Abstract

Virtual environments (VEs) are increasingly being used for training and experimentation. In the field of Modeling and Simulation questions concerning fidelity and validity of virtual environments are addressed. The research field of Gaming focuses on visual style and gameplay in virtual environments. We bring concepts of both fields together in a valid and low cost virtual environment for scientific experimentation we call a realismic virtual environment. We propose research questions that help further explore this field in order to develop sound environments where research can be conducted and people can be trained.

Keywords: virtual environments, games, realism, gameplay, fidelity, validity.

Introduction

Virtual environments (VEs) are increasingly being used for training and experimentation. In the realm of Modeling and Simulation a lot of work has been done which has lead to sophisticated virtual environments for soldiers, car driving, space missions, et cetera. In recent years, serious games have entered this domain as well. Using game technology, impressive yet low cost virtual environments have been created that have been used for a variety of scientific and other applications. When the scientific literature behind games is considered, it is easily noticeable that the focus is on different subjects. Where 'traditional' Modeling and Simulation is about fidelity and validity, game research is about *gameplay*, immersion, representation and realism. However, although the vocabulary is rather different, often similar problems are addressed.

In this paper, we use knowledge from both the field of Modeling and Simulation and from the field of Gaming to create a task-oriented, behavior realistic, and valid VE we call *realismic*. This low cost VE has been used successfully in a number of experiments. In the next section, a brief introduction of the important concepts form the field of Modeling and Simulation is given. Terms such as validity and fidelity are introduced and explained. Next, important concepts from the field of Gaming are presented. After that we propose the idea of a *realismic* virtual environment. Finally, we draw some conclusions by giving an example and we pose some important questions that needs answers.

Modeling and Simulation

In the engineering field two concepts are utilized to describe how real a simulator mimics a task: fidelity and validity. The concept *fidelity* stands for how exact the environment is with regard to the real world. When a simulator has 100% fidelity it represents the real world in a one-on-one matter. It is needless to say that this 100% fidelity does not occur and that the fabricating of a simulator towards 100% fidelity is expensive. The question that fidelity addresses is: How does it look and how does it feel? Did we design the simulator right?

The concept of *validity* stands for whether the simulator actually represents the task where it is designed for and if that is experienced by the person who executes that task in the simulator. The question that validity addresses is: did we design the right simulator? When a simulator has high validity, the goal of the simulator resembles the task that people are asked to perform in real life.

One can say that fidelity serves the validity: fidelity can increase the validity of a simulator but that is not the only factor for high validity. For the purpose of our paper we have to look into fidelity and validity a bit deeper. There are many ways to examine these two concepts closer; we are going to use the distinction between what you can see: the physical or perceptible perspective and what you can feel or experience: a functional perspective (see Table 1)

Table 1: Further segmentation of fidelity and validity

	Fidelity	**Validity**
What you see	Physical fidelity	Face validity (physical validity)
What you experience	Functional fidelity	Functional validity

- *Physical fidelity* refers to the similarity between the operational system and the simulator. This physical aspect is measured by taking the overall look and feel of the simulator and compare it to the real world.[1] The question addressed is: How does the simulator look in relation to the 'real' task.
- *Functional fidelity* is the degree of similarity between trainee behavior on the simulator and on the real system (Emmerik 2004, p. 34). The question that is addressed here is: How is the performance of the task in the simulator compared to the 'real' task. The central point in this is that the representation of the system is centered around the task. Therefore, the world that is offered is only 'available' for the task at hand. Other 'realistic' aspects of that world that don't have a function are not necessarily included in the simulation.
- *Face validity (physical validity)* on the other hand, says something about the *representation* of the task in the simulator according to the *subjective perception* of the person who uses the simulated world (for training or research). When the person experiences that the task in the simulated world looks like the task in the real world, the face validity is high. Does the simulator looks like it represents the task that is asked of the person in the simulator?
- *Functional validity* is the measure in which the conducting of the task that is represented in the simulated world resembles the conducting of the task in the real world. When people are able to perform this task, a transfer between the task in the simulator and the task in the real world takes place. This is the named *transfer of training* where learning takes place.

Gaming

The field of games and gaming focuses on realism and representation. With realism we mean the techniques that can be used to create a high (relevant) resemblance to our own reality. Concerning realism, the question that needs addressing is: how real is a game environment in comparison with the real world?

Representation on the other hand is a mechanism where real objects or tasks are represented in the virtual world in a way so that the gamer understands what it is about. Representation is a way of communicating, a language of its own. It is in this representation where a lot of 'manipulating' is possible. The question that representation addresses is: How is the real world represented in the game world?

Although both concepts are described apart from each other, they share the same ground because realism is an enabler of representation. With more realism the representation improves, but high representation doesn't have to come with high realism per se.

Again we can further distinguish these two concepts by introducing two different perspectives:

- What does the world look like (visual style) and how does it feel (*gameplay*).
- Who looks at the world: the game designer (how is it built?) and the player (what is the experience?).

[1] The term 'real world' is problematic in itself. We chose to not enter that discussion in the scope of this article because we think the emphasis is not on whether we live in a 'real world'.

In
Table ***2*** different parameters are introduced that can be variables where the designing of the game and the experience can take place. For more details, see de Greef et al (2006).

Table 2: Schematic visualization of two different perspectives regarding the reality needed in a game environment for research purposes

	Perspective	
Realism and Representation	Game designer *[to build]*	Gamer *[to experience]*

Visual Style
[what you see]
	• Realism
	  ○ Photorealism
	  ○ Caricaturism,
	  ○ Abstractionism
	• Techniques like shading, colour, reflection
	• Technology
	• Remediation and Interface design (transparent immediacy, hypermediacy)
		•Cognitive observation
		  ○ Stereotyping
		  ○ Narrative comprehension/ making sense

Gameplay *[what you feel]*	• Storytelling • Immersion • Chaos • Willing suspension of disbelief / Magic circle / To forget ones surroundings	• Emotive reaction • Instinctive reaction

Synthesis: realismic virtual environments

The fields of games and the modeling and simulation have different foci, culture, researchers, and vocabulary, but they address many similar issues and have a lot to offer each other. It is obvious that despite the different terminology, considerable overlap exists between the games world and the world of Modeling and Simulation. In this section, we bring ideas from both fields to yield environments useful for experimentation and training that we call *realismic* environments.

An environment is *realistic* when it resembles our own reality. The visual style of this world represents the look and feel of the real world in a more or less exact way. Therefore the physical and functional fidelity of the world is high: the world is persistent, logical, continuous and respects the user or gamer in a meaningful matter. The face and functional validity can either be high or low. Because of the emphasis on the visual style of the environment (and therefore the fidelity of a realistic world), the validity of the task and the subjective experience of the gamer may be overlooked or overestimated. What remains important is that in whatever actions the user or gamer develops, the world reacts in a logical way and thus triggers the normal reactions users or gamers would give if they would interact with the real world.

A *realismic* environment is also a world that is persistent, logical, continuous and respects the user or gamer in a meaningful matter. The difference however is that in a *realismic* environment *a* reality is presented that doesn't necessarily has to be *our* reality. Therefore the physical and functional fidelity can be low. Both the validities are high on the other hand: the task that is chosen corresponds in what way or another with the task in the real world. The representation of the task is high. So the visual style can differ, the inhabitants of the world can differ, other artifacts of that world can differ, the underlying model of the world can differ (think for example about gravity, use

of speech or social interactions). One thing that is not different is that this world is logical and makes sense. Therefore the same 'mental model' of the users or gamers is triggered and they therefore react in an authentic way. The transfer can take place in a normal way. When a world is thus *realismic* the hypothesis is that the mental model of the person engaging in this world is triggered and that he is making sense of the cues that are offered in the world. This is called 'narrative comprehension': the user or gamer fills in the gaps that are between the simulated world and the real world. The imagination of people gets more drawn on, and therefore people are more immersed. When the environment ask the users to make sense themselves, a slight problem in for example the visual style is not a big issue there. The experience of the *realismic* environment takes place in the heads of the gamers themselves instead of only on the screen.
Summarizing: by using the essential characteristics of the medium of games, namely the strength of representation, visual style, *gameplay* and the act of sense making, environments can be build with an emphasis on the validity or on the representation of the task of the real world and therefore triggering behavioral realism. In a realismic world one can use the strengths of game environments (motivation and immersion) and at the same time ensure the validity of a task.

Conclusion and research questions

Modeling and Simulation hand us useful concepts to describe how to design and test virtual (research) environments. Fidelity says something about how the environment looks and feels, validity says something about the realism of the task. There seems to be two different styles of simulators: on one hand high fidelity simulators like flight simulators, on the other hand training simulators (for example lost cost drive simulators) where validity is leading instead of fidelity.
In the game world, concepts like visual style, representation, immersion and *gameplay* tell us something about how a game looks and feels like. These topics are analogous, but different words are used, different perspectives are taken and therefore different answers are generated. Here again we see a difference in emphasis which is today well apparent: Microsoft Xbox 360 and Sony Playstation 3 are focusing on the visual style and fidelity; Nintendo's Wii and DS on *gameplay* and validity.
Both fields can contribute to each other (games: immersion, attractiveness, *gameplay*; Modeling en Simulation: fidelity and validity, transfer of training,). Issues that must be addressed in future research are:

1. With the rise of a new medium often characteristics of the old medium are exactly translated into the new medium without acknowledging the strength of the new medium itself, the so-called 'horseless carriage syndrome' or 'rear-view mirror syndrome' mistakes (McLuhan 1967, 75). Games may be a new medium with new laws and possibilities. If concepts from gaming are transferred to serious applications, it is tempting to develop virtual environments in a similar manner as the traditional simulators looked. The lesson we can learn from this 'horseless carriage syndrome' is that we have to think about the essential characteristics of a new medium and based upon that create the new usage of that medium. Which way should gaming concepts be included in training and experimental simulators? Are new didactics required?
2. Little has been published about fidelity and realism of virtual environments that can be used for experimentation or training purposes. The question that follows the first is: how unrealistic (or unrealismic) a virtual environment is allowed to be without reducing the transfer of training.
3. What happens when 'next generation' users, who are much used to graphical eye candy game environments are exposed to visual 'poor' environments? Perhaps that their 'visual literacy' is thus overruling their experience that they cannot or do not want to interact with a low fidelity environment.
4. Next to that: when you lay emphasis on the task, different users have a different perception of the task realism. Domain experts attribute more realism on their task than naïve layman (such as students) who are often participants in experiments.

5. A twofold distinction can be made for tasks: there are cognitive tasks and procedural / operational tasks. Planning which victims to rescue first is a more cognitive task, the real rescuing (walking to a victim and offering medical assistance) are more procedural / operational tasks. The latter requires a more realistic environment with high fidelity and high validity. The first can also be executed in a *realismic* environment with low fidelity but high validity. In environments used for serious purposes fidelity can be varied according to task and participants, but the validity must always be high in order to create a good transfer between the environment and the real world.
6. Not only the virtual *realismic* environment can be designed, also the 'big game' around playing the virtual environment can be designed and therefore can generate specific behaviour. Playing a game is in other words not only the activity behind the screen, but moves in a broader context of roles, feelings, expectations and mental models. These can also be designed so that desired behaviour is shown. How are we going to design the behavior of the gamers according to what we want to see?

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