Towards a Virtual Reality Tool for Lighting
Communication and Analysis in Urban Environments

TAHRANI Souha¹, JALLOULI Jihen¹, MOREAU Guillaume² and WOLOSZYN Philippe¹
¹CERMA UMR CNRS 1563, ²Ecole d’Architecture de Nantes, Nantes, France

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Abstract: The objective of this paper is to evaluate the use of virtual reality as a potential decision-making tool to cognitively evaluate urban daylighting ambiances. This paper evaluates the solar effects visual perception in a real urban path in comparison to a virtual urban path in order to extract the characteristics of these effects and use them to figure out the necessary conditions for generating a physical and sensitive phenomena simulation. The comparison is based on questionnaires and interviews with participants on their judgements on sunlight during their walk through the chosen path. Our results highlight the relation between perception and the context of the urban environment, and prove that -in spite of its limits- virtual reality is able to simulate a large part of real solar effects.

1 INTRODUCTION

Studying the urban environment is a complex procedure that is heavily influenced by the multi-layered interaction and dynamics between the built environment (the mixture of volumes, shapes and materials that form the cities), the physical factors (wind, light, sound, pollution etc.), and their physical and cognitive representation by the human sense, what we might call the architectural and urban ambiance. The study of this multi-layered interaction is processed through an interdisciplinary approach, that complements classical ones with the use of Virtual Reality (VR) technologies as study tools.

There are many urban studies that primarily focus on visual perception analysis and its relation to movement in the urban space. These studies generally show a sensitive examination of the city (Lynch 1960, Cullen 1971), but don’t look into the physical factors that play a very important role in controlling the urban pedestrian movement. A few studies focus on the interaction between the physical and psychological factors in immersive environments (Woloszyn 2003).

Our aim is to develop a dynamic immersive tool that uses visual perception as an analysis method to study the impact of the solar effect on space acknowledgement.
Towards a Virtual Reality Tool for Lighting

To do that, the following questions are asked: How can the spatial factors influence our visual perception? Is it possible to measure the perceptive impact? What are the requirements for representing this impact?

In this paper, we will present an experimental study that compares the perception of solar effects in real and virtual environment. The first part will be devoted to a theoretical study. The two later sections will concentrate on describing the experimental study, the adopted methods and the obtained results.

2 BACKGROUND

Our study is based on two tools: solar effects and VR technology. This part will focus on a study of “solar effects” concept, as well as an overview of VR and its applications in the architectural and urban field.

2.1 Solar Effects

Human vision is conditioned by the existence of light, producing physical and psychological effects. In this logic, the concept of lighting ambience is defined by the position of human beings in the space and their visual perception of environmental daylight.

Several studies described the “effect of light” on architecture (Jungman 1995) by studying the way to visualize light in the architectural image. Other studies treated the notion of “ambiance effects” by using these effects as an ambiance analysis and design tool. This concept was initiated by the “sonic effects” - effets sonores- proposed by J.F. Augoyard and H. Torgue who defined this notion as: “the interaction between the transmitting source, the elements of built space and the perception of the receiver” (Augoyard 1998). Furthermore, some studies attend the notion of “effect of light” leading to “visual and luminous effect” (Thibaud 2001a). Although this work is not yet complete, there are several experiments that are based on this double sided concept “visual and luminous effects” and “sonic effects” (Follut 2000).

This perspective introduces the interaction between light and space through “solar effects” concept that is generated by combining the three following factors: observer (visual perception), space (architectural and urban forms), and daylight. In our work, we approach the “solar effect” as a tool for phenomenal interpretation of the public space. It is an essential component in building the urban scene (Figure 1). Figure 2 shows an example of some “solar effects” used in this paper, such as the effect of “Attraction”: an effect that attracts the attention in an uncontrolled or conscious way. “Repulsion”: an effect implying a solar phenomenon into a rejection attitude and “Opening”: effect highlights the opening of space, related to the position of the observer.