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USE OF CIE 171:2006 TEST CASES TO ASSESS THE SCOPE OF LIGHTING SIMULATION PROGRAMS

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Lighting simulation programs are being used widely in research and engineering areas including lighting design, architecture, and lighting quality subjective assessment. In order to use lighting simulation programs efficiently and make the users confident in them, it is required that the results of the simulation are physically accurate. For instance, light transport simulation is a key tool allowing to determine the correct size of windows or the total power of artificial lighting in a building prior to its realization. Other fields of applications require also physical accuracy. For example, computer-generated images are being used widely for research purposes in the field of subjective lighting assessment. Their validity depends on how closely they reflect the light behaviour in the virtual environments used as models for image synthesis.

Lighting simulation programs may be used efficiently for some applications, and not for others. In this paper, we show how CIE 171:2006 tests cases (Test Cases to Assess the Accuracy of Lighting Computer Programs) can be used to assess the scope of lighting simulation programs. CIE 171:2006 test methodology is based on the conception of testing separately the different aspects of the light propagation, and by making comparisons between the simulation results and analytical references.

The proposed method is illustrated by assessing the scope of Mental Ray 3.5 for applications that require physical accuracy. Mental Ray is a lighting simulation software widely used for visualization purposes, but that can be used in a way claimed to be physically accurate. The last release of the software is Mental Ray 3.5. Its new features include light measurement tools (light meter and lighting analysis image overlay, shown on Figure 1) as well as new materials called Pro materials. Combined together, these tools could make the software suitable for engineering purposes, and become an efficient alternative to engineer-based lighting simulation programs. Dialux and Radiance, for instance, are lighting computer programs popular to the lighting design and scientific communities. If Mental Ray 3.5, traditionally used by the visualization and artistic communities, reveals to be physically accurate, the scientific and artistic communities could be encouraged to work together which could result in new, global, and promising approaches for lighting design, architecture and other applications.

The paper is organised as follows. The light measurement tools of Mental Ray 3.5 are presented in section 2. Section 3 presents the results of the CIE test cases (the 3D scenes modelled for the assessment are illustrated on Figure 2 and examples of test results are given in tables 1-3). The scope of the software for applications requiring physical accuracy is determined in Section 4.

The analysis of test results leads to the following conclusions. Some aspects of light transport are accurately simulated by the software, whereas other are not simulated with a good accuracy. In particular, point and area light sources, light reflection, luminous flux conservation and glazed windows are accurately simulated; on the contrary, small obstructions and clear sky are inaccurately simulated. Nevertheless, these results show the fundamentals of light transport simulation are correctly handled by Mental Ray 3.5 and are promising for future releases. Yet, the scope of Mental Ray 3.5 for applications requiring physical accuracy is limited to scenes that do not include little geometric details, and lightened by identified sky types. These conclusions are discussed further in the full paper.

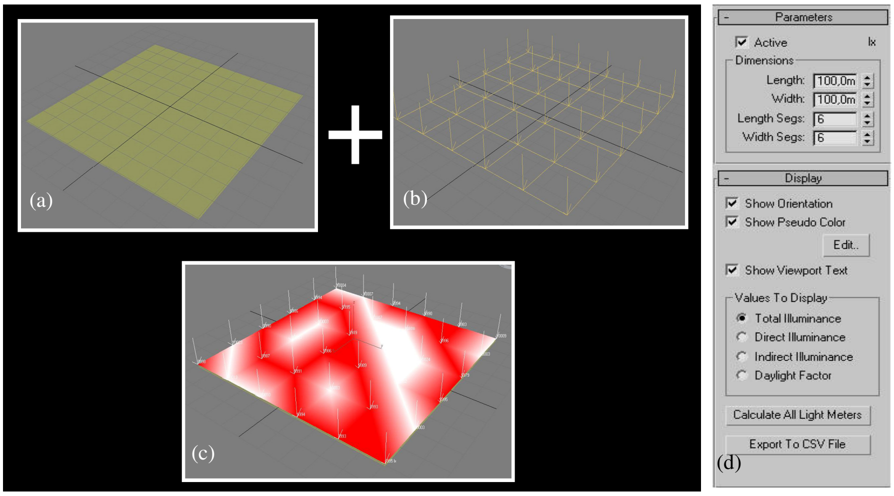

Figure 1: The light meter. (a): example of a surface where illumination must be measured on. (b): measurement grid defined. (c): visualization of the illumination variations on the surface and of the illumination values on the measurement points. (d): settings of the light meter parameters.