Assessing the Fidelity of Illuminating Engineering Society (IES) Profiles in Rendered Lighting Simulations: A Comparative Analysis

(Student Name)

I. Project overview and objectives

Enscape 3d and Lumion are Architecture, Engineering, and Design (AEC) industry-standard 3-D rendering software programs used to create photorealistic presentation images of proposed buildings and interiors for clients. Both programs offer the option to upload Illuminating Engineering Society (IES) lighting profile data, which allows designers to achieve more realistic simulations of the precise characteristics – color temperature, luminous intensity, distribution, and beam spread – of the actual specified light sources on a project. However, because design renderings tend to be completed in the early schematic stages of a design before light sources are specified, the IES profile upload feature is significantly underutilized, and as a result, Enscape and Lumion remain untapped as powerful lighting performance evaluation tools that could aid lighting designers in the evaluation and adjustment of lighting throughout the entire course of the project. While previous studies have compared the accuracy of a project's Enscape-rendered lighting design presentation images with final built condition (Chen and Cui (2021)) and compared the accuracy of a project's VR lighting simulations with the final built conditions (Belazzi, Bella, and Chinazzo (2022)), there has not yet been a study to compare how Enscape and Lumion uniquely render IES profiles, which impact their potential utility as assessment and evaluation tools during the design process. For lighting designers especially, the perceived accuracy of these renderings is crucial, as small changes in the rendering of a light source can impact the perception and success of the project. Therefore, the proposed project will be of value to design practitioners who are considering Enscape or Lumion as a tool to assist in the selection, evaluation, and adjustment of lighting over a project's entire course.

To analyze the performance of Enscape and Lumion in simulating lighting, the following criteria will

be used:

a) *Interface Design:* In each program, IES profiles are uploaded within an existing lighting type category that is unique to each program. Enscape offers four base lighting types: point, spot, linear, rectangular; whereas Lumion offers three: omni, spotlight, and spherical. *What impact could the software's existing lighting type options have on the way it renders identical IES profile data?*

b) *Lighting Fidelity:* A series of eight IES profiles representing a range of commonly-specified light sources with a variety of distributions, beam spreads, and luminous intensities will be chosen. *With identical IES profiles and values for light size, beam spread, and luminous intensity, what might the differences be in how the lights are rendered in each program?*

c) *Material Fidelity:* Materials cannot be perceived separately from the light that falls on them. The 3d model created for this project will include a range of five material samples that consist of a range of colors (both warm and cool) and finishes/textures (rough, matte, semi-specular, and specular). *Considering that both programs use ray-tracing to render light in the model, what variances exist in the presentation of materials and what may account for these differences?*

II. ***Description of duties/responsibilities***

My responsibilities will include modeling the lighting configurations in the virtual study environment and assigning materials to floor, ceiling, wall, and table surfaces. I will render the same 3d model having identical IES profiles and interior materials in each program per the criteria described above, and will render and export all configurations discussed and arrange them for analysis.

III. ***Significance of the project to academic development in the field***

The idea for this project came after a speaker in my Lighting Design class mentioned that there is not currently one program that meets the needs for both the presentation and the analytical parts of his

lighting design practice. By undertaking this research, I am responding to an immediate need in the lighting design field to identify a rendering program that balances accuracy with artistry.

IV. ***Description of how this project differs from previous URECA projects***

Based on my initial survey of past URECA projects, I do not believe that there has ever been a project to study lighting design. This could be due to the fact that only two programs on campus offer lighting design coursework – theatre and interior design. I think that one of the strengths of this project is that it combines both creative and research-driven aspects of design.

I. ***Role of the mentor to the project***

After an initial meeting to discuss the planned course of the project, I will meet with Professor Pavel bi-weekly in LRC 109 to verify that the rendered environments are set up correctly, review value inputs, and assist with troubleshooting if problems arise. Once the renderings are complete, we will discuss the results and repeat the rendering process if needed. She will then review my final report, which will inform a Scholar's Week submission. Danny Streit, Certified Lighting Designer and principal of DHS Lighting Design, will serve as a second reviewer.

References:

Bellazzi, A., Bellia, L., & Chinazzo, G. (2022). Virtual Reality for Assessing Visual Quality and Lighting Perception: A Systematic Review. *Building and Environment*, 18-38.

Chen Y, Cui Z, Hao L. (2021). Virtual reality in lighting research: Comparing physical and virtual lighting environments. Lighting Research & Technology. 2019;51(6):820-837. doi:10.1177/1477153518825387

Kreutzberg, A. (2018). Visualizing Architectural Lighting Design Concepts with 360 Panoramas. *eCAAD Computing for a Better Tomorrow Volume 2* (pp. 745-752). Lodz: Lodz University of Technology.

Mahdavi, A., & Eissa, H. (2013). Subjective Evaluation of Architectural Lighting via Computationally Rendered Images. *Journal of the Illuminating Engineering Society*, 11-20.

Pasinski, M., & Chwesiuk, M. (2007). Towards Interactive Rendering for Lighting Design. *Proceedings of CESCG 2017: The 21st Central European Seminar on Computer Graphics* , (p. 8). Warsaw.

Roy, G. (2000). *A Comparative Study of Lighting Simulation Packages Suitable for Use in Architectural Design.* Rockingham, UK: Murdoch University Press.

Project Timeline:

October 1-15, 2023:

- 3d model created
- material samples created and applied to the model
- IES profiles downloaded.
- Excel spreadsheet of value inputs created

October 15-31:

- Physical light simulations modeled and placed.
- IES profiles imported.
- Describe differences in interface design for IES inputs
- Survey of all value inputs before first renderings
- Render each of the lighting types on each material sample (40 render samples)

November 1-15

- Export and arrange renderings, add figure captions to key with text
- Discuss results with Prof. Pavel and Danny Streit
- Create final report for the project for Scholar's Week and IES conference submission