

Toon-shading - Perception of glossiness

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Project specification for Computer Graphics and Interaction (DH2323)

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Aiming for grade A.

Github, with the source code:

<https://github.com/malinjam/DH2323-Toon-Shader>

Blog:

<https://malinjam.github.io/DH2323-Toon-Shader/>

1 Background

1.1 Toon-shading

Rendering in computer graphics refers to the process of generating an image using software programs from a model. In this project, our focus is on toon-shading (or cel-shading), a non-photorealistic rendering technique that gives a mesh a cartoonish appearance, resembling a hand-drawn illustration in the final render. We will then use this toon-shader to conduct a perceptual study to find out how participants' perception of glossiness varies depending on various factors, such as shape or material [1].

The idea of creating a toon-shader for experimenting with different values of gloss originated from a previous study done in 2009 by Vangorp [4], where he conducted a perceptual study on different materials and shapes. A realistic shader is used in that study; however, as perceptual data related to toon-shaders is scarce, we decide to conduct a similar study, this time using the toon-shader instead, and see if its results match the ones found by Vangorp.

1.2 Previous work

Toon-shader made using Unity engine 2018.3 [3]:

<https://roystan.net/articles/toon-shader/>

Cel Shading/Toon Shading on Glass and Metal Objects [2]:

https://github.com/Unchained112/CelShadingProject_ComputerGraphics-Interaction https://www.cs.rpi.edu/~cutler/classes/advancedgraphics/S12/final_projects/hutchins_kim.pdf

Vangorp's perceptual study about perceived gloss dependent on object shape:

https://graphics.cs.kuleuven.be/publications/VangorpPhD/VangorpPhD_paper.pdf [4]

2 Problem

The main problem is to create our own toon-shader for a 3D object in Unity where we could test to see how different materials are rendered and how people perceive the gloss of them. This also means that the toon-shader must have easily adjustable specular gloss properties. To conform with the Vangorp study, this will need to be in accordance with Ward's BRDF [4].

3 Implementation

To begin, our focus will be on implementing a basic toon-shader on a simple shape, such as a sphere, with a single material applied.

Once we have a functioning toon-shader, we may explore applying it to spheres with diverse materials.

To visualize the project, we will use Unity for rendering, lighting, and loading models into a scene. We will create Unity scripts to implement the toon-shader and spheres with varying materials.

To evaluate our work, we will conduct a perceptual study where participants evaluate our results using a survey (probably through Google Forms).

3.1 Specification ideas

These will change over time but initially we suggest these specifications:

- glossiness;
- specular and diffuse reflectance;
- contrast;
- sharpness;
- perceptual distance;
- object shape.

4 Extensions

Some possible extensions could be:

- Parameter adjustments: Allowing users to customize shader parameters to explore their impact on gloss perception.
- Diverse 3D objects: Applying the toon-shader to a wider range of objects to understand how different shapes and materials affect gloss perception.
- Expanded material variation: Incorporating a broader range of materials to investigate their influence on gloss perception in toon-shaded objects.
- Database development: Creating a comprehensive database of toon-shading materials to facilitate standardized experiments and further research.
- Enhanced perceptual study: Conducting a more comprehensive study with a larger sample size and refined methodologies.

References

- [1] Pascal Barla, Joëlle Thollot, and Lee Markosian. “X-Toon: An Extended Toon Shader.” In: *Proceedings of the 4th International Symposium on Non-Photorealistic Animation and Rendering*. NPAR ’06. Annecy, France: Association for Computing Machinery, 2006, 127–132. ISBN: 1595933573. DOI: 10.1145/1124728.1124749. URL: <https://doi.org/10.1145/1124728.1124749>.
- [2] Bosen Cheng. *Cel Shading / Toon Shading on Glass and Metal Objects*. https://github.com/Unchained112/CelShadingProject_ComputerGraphics-Interaction. [Online; accessed 24-April-2023]. 2021.
- [3] Erik Roystan. *Unity Toon Shader Tutorial at Roystan*. URL: <https://roystan.net/articles/toon-shader/>.
- [4] Peter Vangorp. “Human visual perception of materials in realistic computer graphics.” PhD thesis. PhD thesis, Department of Computer Science, KU Leuven Celestijnenlaan, 2009.