CS348B Project Proposal

Pearlescence and Translucence in Betta fish

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Project Overview

We were inspired by how iridescence and pearlescence manifests in biology. As we researched animals with such properties, we were struck by this picture of a betta fish. In particular, the betta demonstrates pearlescence in the reflection of its scales and tail, as well as translucence in its tail, making for a striking image.

Figure 1: Pearlescent Betta fish

Modeling scene

We will use a rigged model of a betta fish from sketchfab. Referencing the experience of a project from previous years (http://graphics.stanford.edu/courses/cs348b-competition/cs348b-19/grand_report.pdf, Summertime Iridescence), we anticipate implementing bump maps, texture maps, and height maps uv mapped to the surface of the fish to improve our result and render scales. Depending on what we want our composition to look like, we have also discussed modeling a tank and/or bubbles in blender, then export the

whole scene as a ply file for pbrt.

Implementing pearlescence

(Kayla will be working on this part of the project.)

To mimic the lustrous metallic-like soft glossy sheen of the betta fish scales, we wish to implement a BSDF shader for pearlescence using PBRT framework applied to an underwater scene modeled in Blender. Our model will take into account the oriented microscopic platelets with a layered structure of nanostructure thickness, which produce interference effects given their scale and planar geometry as light scatters within the platelets.

The simulation model will also consider the light transport inside the hosting medium, or container, as well as volumetric scattering and the anisotropic, interference-based light scattering occurring within the pearlescent platelet structures. The macroscopic structure, orientation, and distribution of platelets within the material will also affect the final image appearance with our material, so we hope experiment with modifying various parameters for the model to produce desired visual results.

Additionally, we intend to study existing proposed models for car paints and metallic surfaces that feature pearlescent properties to help with creating our model. However, it is important to note that these models are rather limited in the range of surface appearances they may produce due to a reduced parameter set. We may also look to implement the model described in an article regarding general framework for pearlescent materials (include citation number/superscript: http://giga.cps.unizar.es/ iguillen/publications/Guillen_TOG2020_Pearlescence.pdf. For our image subject, we selected a betta fish, given the vast array of surface properties they exhibit in the wild and their captivating and colorful personalities.

Implementing translucence

(Vivian will be implementing this part of the project.)

The tail and fins of the fish are a great example of translucence in nature - consisting of a translucent membrane moved by short bony spines near the peduncle. There are also many folds and ridges in the fish tail, and it can be observed that these ridges allow less light to pass through, and reflect more light. The pearlescence is overlaid on top of this membrane, which makes for an interesting effect.

Referencing this paper on subsurface scattering (https://graphics.stanford.edu/papers/bssrdf/bssrdf.pdf), we intend to implement a BSSRDF to model how light interacts with the membrane of the tail. This will involve determining parameters for absorption, scattering, and diffuse reflectance.

References

https://sketchfab.com/tags/betta-fish
http://graphics.stanford.edu/courses/cs348b-competition/cs348b-19/grand_report.pdf
http://giga.cps.unizar.es/ iguillen/publications/Guillen_TOG2020_Pearlescence.pdf
https://graphics.stanford.edu/papers/bssrdf/bssrdf.pdf