CGRA 408 Computer Graphics Rendering T1/2021

Project #2: **PBRT Extension (20 pts)**
Assigned: **Tuesday, 23rd March 2021**
Presentation: **Tuesday, 27th April 2021 14:10 pm**

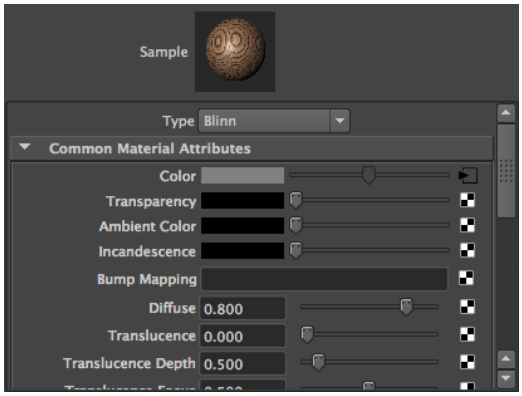

Figure 1. Sample texture editor

1. Objective

The objective of this project is to improve and extend PBRT. Tasks include implementing ray-primitive intersection routines, a new solid texture, and a Maya/Blender plug-in program to provide a user interface to edit PBRT materials and textures.

1. Understand ray-primitive intersection and accelerator
2. Understand materials and textures
3. Understand Maya/Blender API
4. Improve PBRT bounding box routines to properly account for a partial sphere object
5. Implement a new PBRT solid texture
6. Implement a Maya/Blender plug-in program (or Python script) to edit materials and solid textures of PBRT
7. Implement a new PBRT accelerator (e.g. BIH, Octree, etc.) and analyze the performance of the new accelerator compared with the current PBRT accelerators such as BVH, and KD-Tree.

2. Important Dates

1. Project presentation due: **27th April (lecture time)**
2. Source code and project report due: **23:59**, **30th April**

3. Project Core (60%)

3.1. Bounding Box for Partial Sphere (25%)

Improve the object space bounding box routines to properly account for partial spheres ($\phi_{\max} \leq 2\pi$) and compute tighter bounding boxes when possible. How much does this improve performance when rendering scenes with partial spheres?

3.2. Create Your Own Solid Texture (35%)

Create your own solid procedural textures for PBRT. Your texture should be related to meaningful real-world materials (e.g. mahogany wood, leather, etc.) with meaningful attribute parameters (e.g. filler color, vein color, number of age rings in case of mahogany wood). The new solid texture can be defined and called using a PBRT scene description file. Your mark will be based on the complexity of the algorithm (e.g. noise, turbulence, perturb, and etc.) and visual quality of the material at the final rendering.

4. Project Extension (25%) and Challenge (15%)

You will choose one of the following tasks as the extension of your project. The other will be your challenge. Please indicate which of these you choose for the extension and challenge in your project presentation and report.

- New accelerator
- PBRT material and texture editor (Maya/Blender script/plug-in program)

4.1. New Accelerator

Implement a new accelerator that the current PBRT does not support; you need to specify it in your report and presentation. The new accelerator can be defined and called using the PBRT scene description file. Compare its performance against the BVH and KD-Tree accelerators. The details of your experimental results should be clearly noted (e.g. tables and graphs) and analyzed in the project report. They should also be presented and discussed during your presentation.

4.2. PBRT Material and Texture Editor

Create a material and texture editor; a Maya/Blender plug-in program (or Python script) to create and edit a material and solid texture of PBRT. The material editor/script will be opened from the Maya/Blender interface and the changed parameters will be interactively applied to a sample display menu (a sphere-shaped thumbnail as shown in the Figure 1), which will be rendered from PBRT.

Attempt to create a user-friendly interface connecting these two different programs. You need to provide interfaces/scripts for at least two materials / solid textures (including your solid texture created in the core part). The created materials and textures as well as the edited attributes will be exported into PBRT scene description file, which can be read and run from PBRT.

5. Presentation and submission

The details of your implementation should be clearly noted in the project report. Especially, if you modify/add any part of the PBRT source code, please specify it clearly. You will show your implementation working (e.g. live demo or recorded video) during your presentation.

5.1 Project Presentation

You will prepare a live demo and presentation of your project. The presentation will be limited to 10 minutes for setup, presenting, and taking questions. You need to prepare 5 - 6 slides as visual aids and submit them into to ECS submission system. You can use your own laptop (Mac or Windows) or ECS Linux system.

5.2 Project Report

You need to submit a project report using the ECS submission system. The report should be about two to three (maximum four) A4 pages, in 10-point font, PDF format. It should detail your solutions and results including screen capture of the important outputs. Providing a supporting video (e.g. mov, avi, mpeg) is recommended.

5.3 Source Code

Submit the complete source code using the ECS submission system. It should include all source code files, data files, makefiles, and a README file describing how to compile and run the program.

6. Marking

- Total Marks: **100**

    1. Presentation: **30**

    2. System and Project Report: **70**

Marking of the system will be done on the ECS system. There is no guarantee of what the underlying operating system will be for marking, so be careful with any OS specific commands used.