Holidays in Dream

COSC187 RENDERING COMPETITION

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Theme & Motivation

Something A LITTLE OFF?

Source: Mirror City, photo by LU WENPENG

Theme & Motivation

Theme & Motivation

Source: recettes-cocktails.fr

Rendered by me

Techniques

- Emitter

- BRDF

- Texture

- Medium

- Integrator

Emitter

- Spotlight
  - Falloff angle
- Environment light
  - Environment Map
  - Importance Sampling: $p(\theta, \varphi) \propto L_{env}(\theta, \varphi) sin\theta$

Challenges	Solutions
Env maps are sometimes of low resolution	Blur: 1. Bilinear Interpolation 2. Depth of field 3. Others, e.g. add a rough glass window

Emitter: Environment Map

▶ Envmap Verification

Blender Ref

My implementation

Emitter: Environment Map

- Blur

baseline · Bilinear Interpolation · Depth of Field

BRDF

- Update all previous BRDF implementations to include UV texture mapping
  - Diffuse, Blinn-phong, etc
- Transparent
  - Used for volumetric path tracing debug
- Microfacet
  - Fresnel * Beckmann Distribution * Shading
  - reflection only, weighted with diffuse term
  - With refraction, used for rough glass

BRDF: Microfacet

- Microfacet BRDF
  - reflection only, weighted with diffuse term
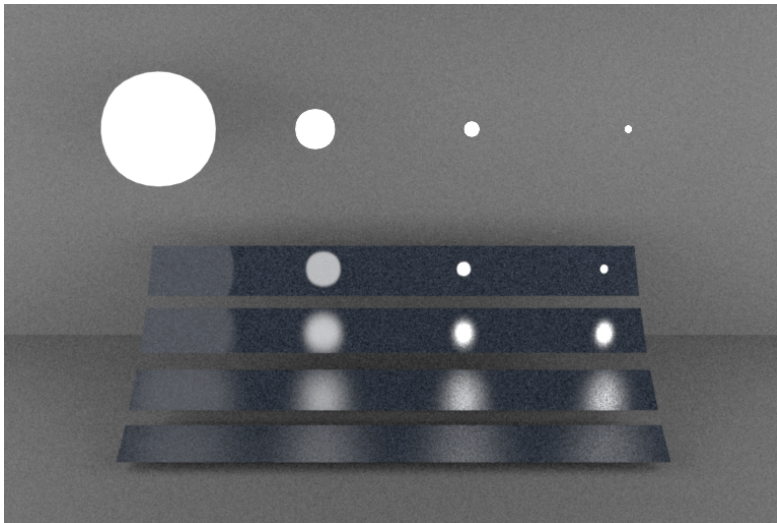 - Verification:

Reference

My results

Setting:
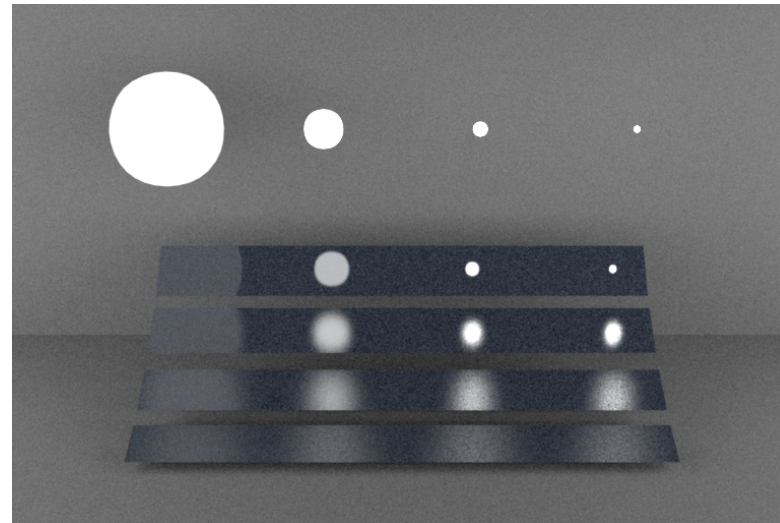Path tracing using MIS
(Emitter sampling +
BRDF sampling)

Objects:
Microfacet bowl
Dielectric glass
Dielectric water

BRDF: Microfacet

- Microfacet BRDF
  - reflection only, weighted with diffuse term
  - Verify:

Reference   My results

Setting:
Direct Illumination
using MIS (Emitter
sampling + BRDF
sampling)

Objects:
4 microfacet planes
4 sphere emitters

BRDF: Microfacet

- Microfacet with Refraction
  - Ref: Walter, Bruce, et al. "Microfacet models for refraction through rough surfaces." *Proceedings of the 18th Eurographics conference on Rendering Techniques*. Eurographics Association, 2007.
  - Given wi & wo, evaluate BRDF
    - Calculate Half-vector wh
    - Calculate pdf of wh, and convert to pdf of wo
  - Given wi, sampling wo
    - Importance sample half-vector wh, $p(\theta h, \varphi h) \propto BeckmannD(\theta h, \varphi h) sin\theta h cos\theta h$
    - Calculate Fresnel Term to decide: refract or reflect
    - Calculate refracted / reflected wo based on wh


Surface Refraction
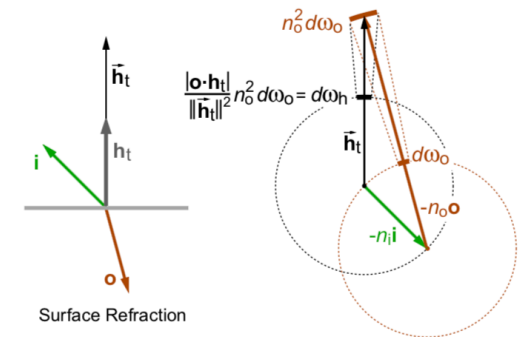
BRDF: Microfacet

- Microfacet with Refraction (con't)

Challenges	Solutions
Beckmann Distribution only samples in upper hemisphere in local coordinate, but with transmission, wi can comes from both sides	Always make sure wi and sampled wh in the same hemisphere. If wi.z() < 0, flip sampled wh to force wh.z() < 0 as well
For refraction, a given wi is not guaranteed to have a refracted wo, since total internal reflection may happen	Always make sure wo is valid

BRDF: Microfacet

- Microfacet with Refraction (con't)
  - Verify
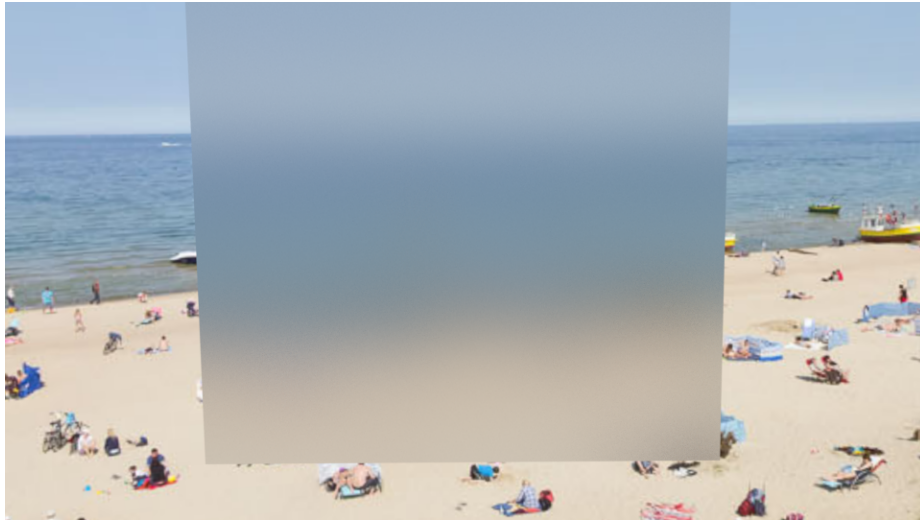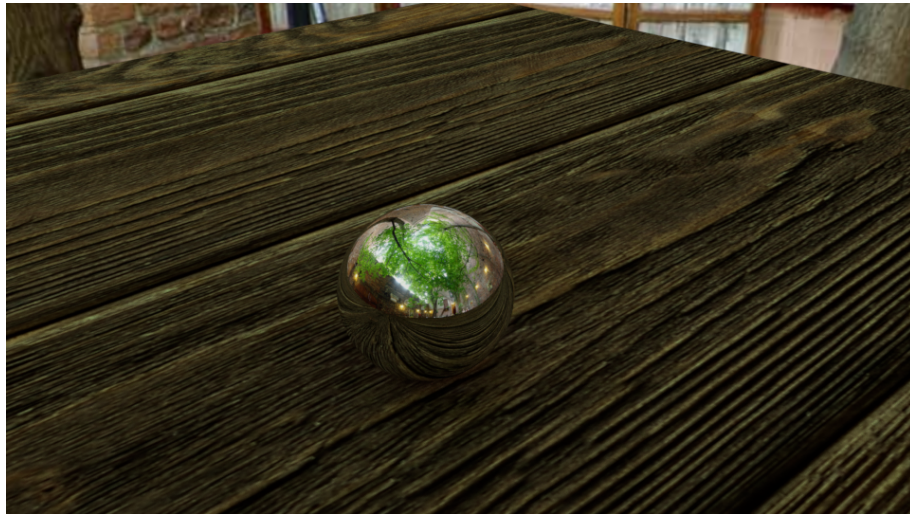

Blender Ref

My Implementation

Setting:
Alpha = 0.1

(In Blender,
Roughness is
set to 0.1)

Texture

- UV Mapping
  - Clamping
    - "Take the nearest pixel that is in the image"
    - Used for non-repeating textures, such as texturing a painting / magazine cover / wine labels
  - Wrapping
    - "Treat the texture as periodic, so that falling off the right side causes the look up to come in the left"
    - Used for repeating seamless textures, such as wall paper / sofa leather

Texture: UV mapping

- Verify
  - Simple UV texture mapping

Blender Ref
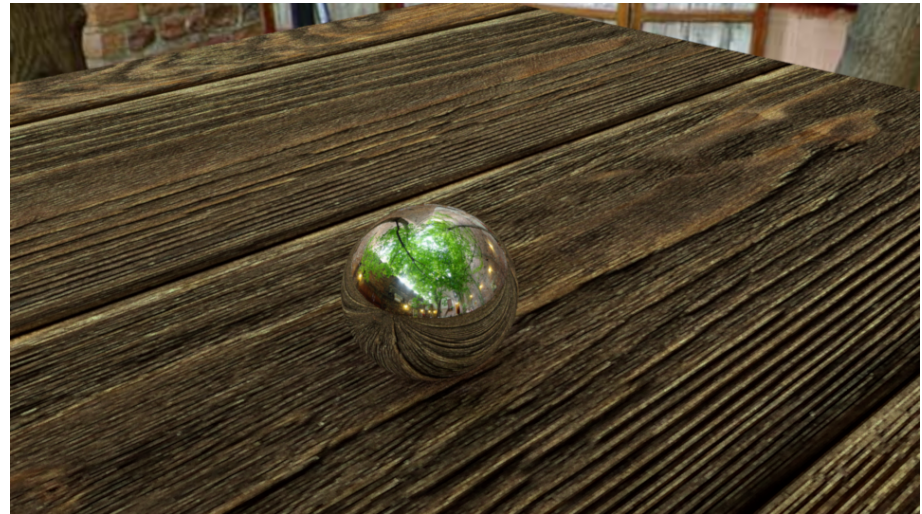
My Implementation

Texture: UV Mapping

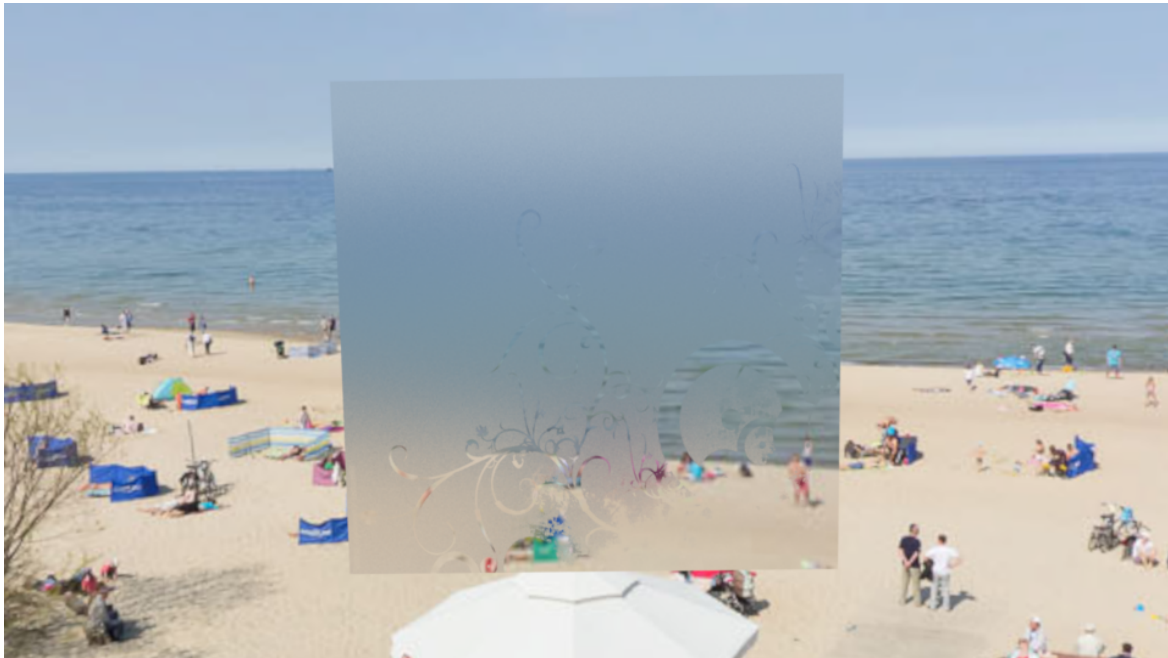

- Verification
  - Add texture to magazine

Blender Ref

My Implementation

Texture: UV Mapping

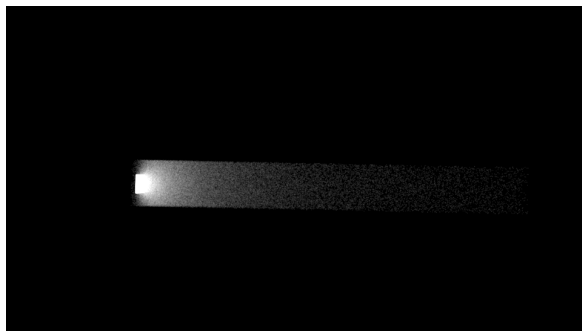- Add texture as roughness in Microfacet

Medium

- Homogenous Medium
  - Absorption
  - Scattering
    - Phase functions:
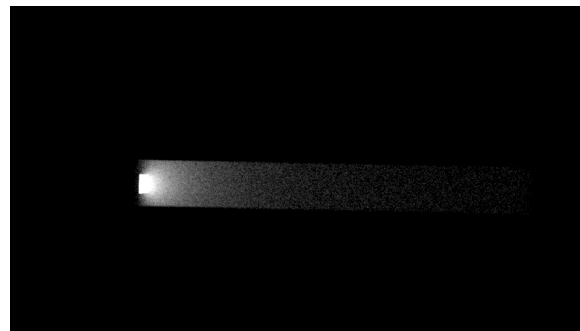   - Isotropic Phase Function: $1/4\pi$
      - HG Phase Function: based on g

Medium: HG Phase

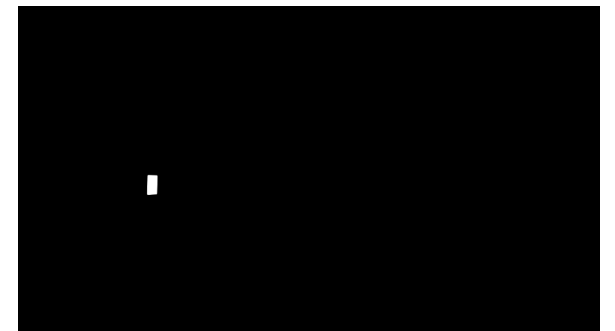▶ Verification

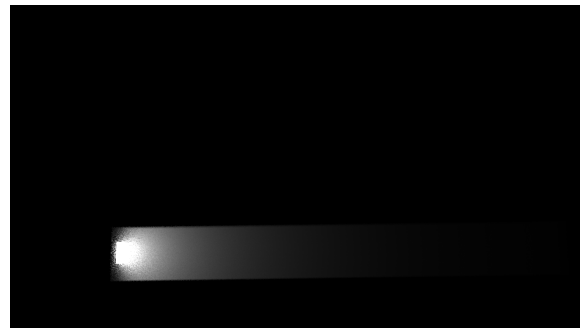

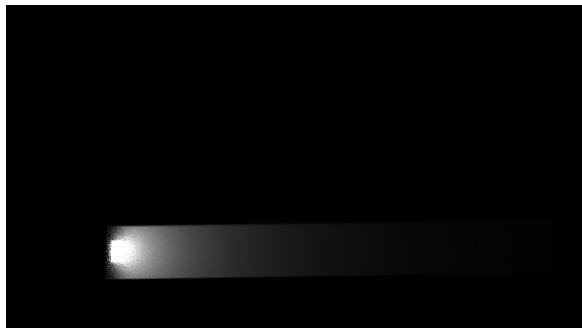|	g = 0	g = 0.2	g = 1
Mine			
blender			

Medium

My Implementation
Absorption only

My Implementation
Scattering only

Integrator

- Volumetric Path Tracing with MIS (emitter sampling + BRDF sampling)
  - Free-path sampling:
    - Before hit surface & have medium: volumetric path tracing, sample next path based on phase function
    - Hit surface: regular path tracing, with MIS

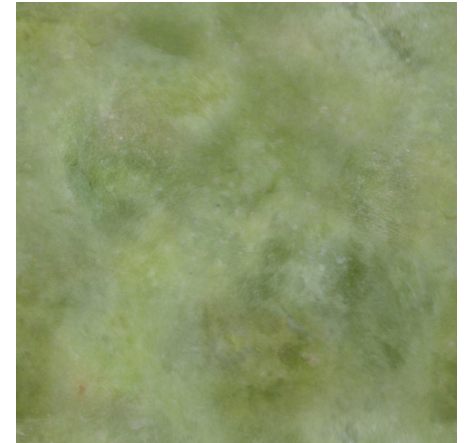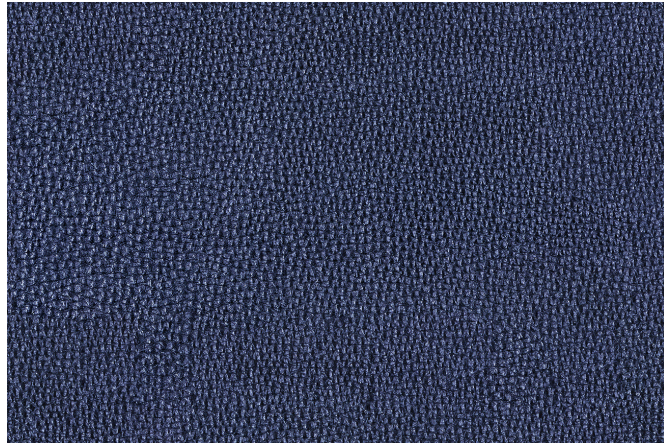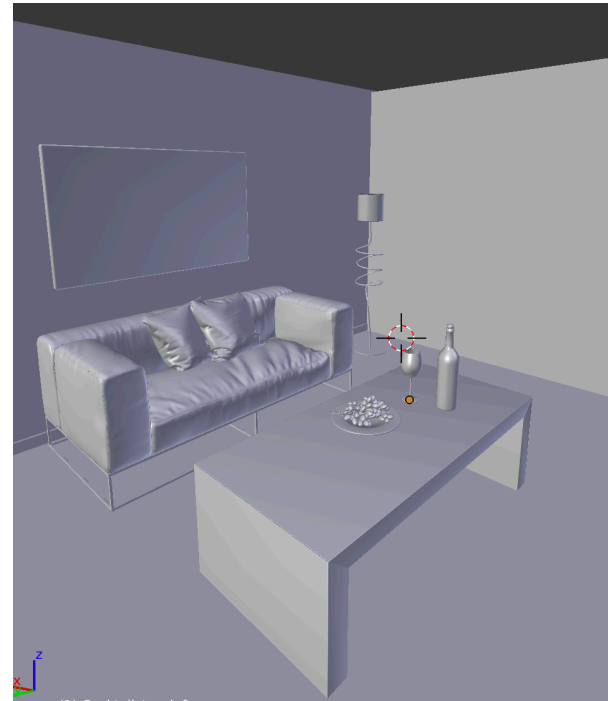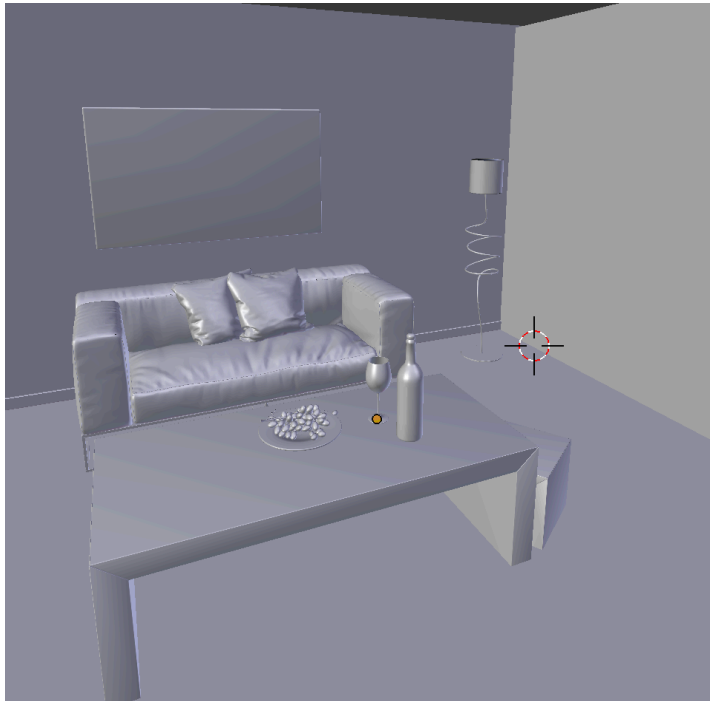| Challenge	Solution
Free-path sampling when $\sigma s, \sigma t$ have different values in different color channel	First randomly sample a color channel; Then sample free-path based on the coeffi of that channel; Finally compute channel-weighted pdf

Final Image

EnvMap

Textures

Positions

Setting:

Painting: clamping texturing

Sofa: wrapping texturing

Rough glass wall: microfacet with refraction, textured with alpha (roughness)

Cocktail: scattering and absorbing medium

Blue wine: absorption only

Wine bottle: clamping texturing

Marble table: clamping texturing

Grapes: blinn-phong, weighted with diffuse term, textured with green grape texture

Thank You for Listening!