CS580:
Related Problems to Rendering

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Course URL:
http://sglab.kaist.ac.kr/~sungeui/GCG

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Applications of Rendering

- Virtual and augmented reality
- Artistic controls

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Augmented Reality (AR) and Virtual Reality (VR)

- **Head-Mounted Display (HMD) for VR**
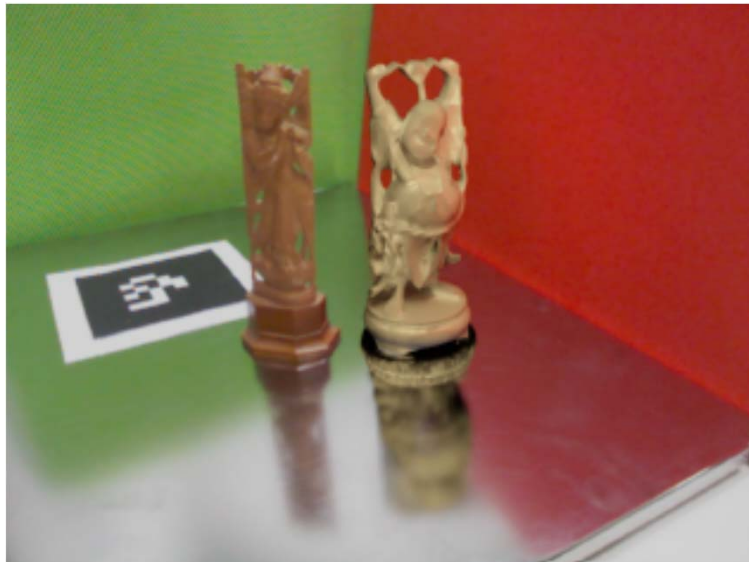

MS

- **HoloLens for Augmented Reality (AR) and Mixed Reality (AR)**

Rendering Synthetic Objects into Real Scenes

Soft shadows, diffuse indirect bounce, and glossy reflection

Franke et al., ISMAR 14

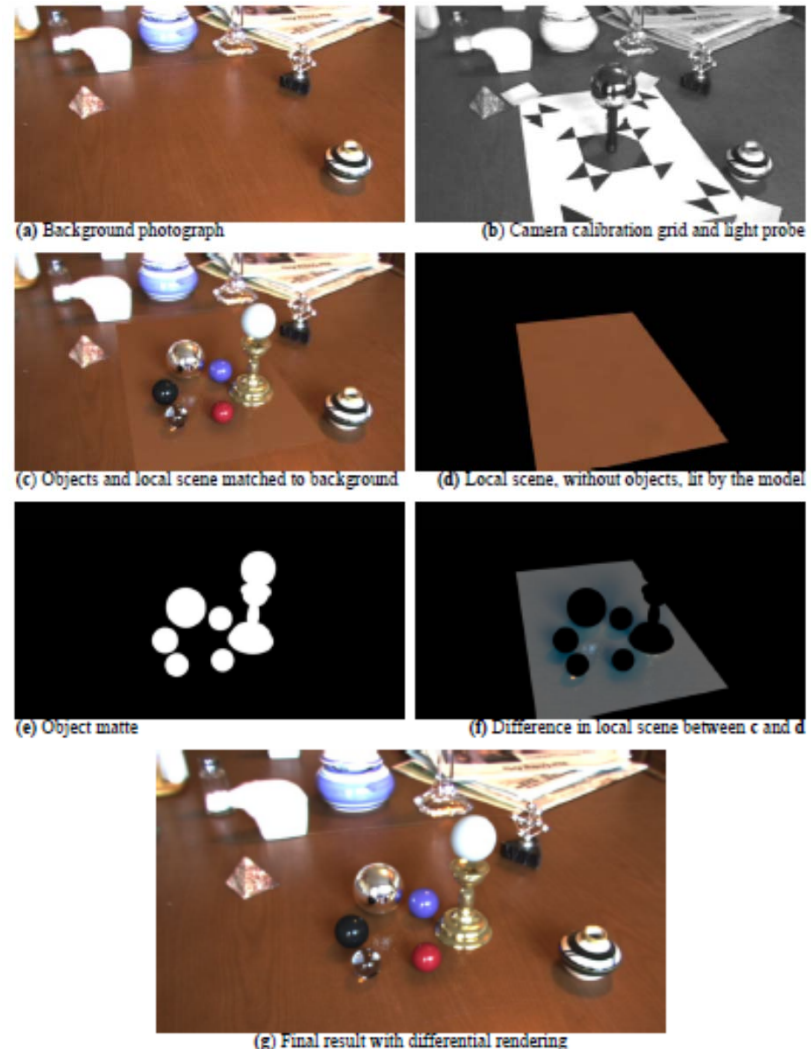# Rendering Synthetic Objects into Real Scenes

- **Overall process**
  - Acquire geometric and light information: use depth/RGB sensors with metallic balls
  - Acquire material information: specialized sensors or iterative method
  - Track the camera: a marker based approach
  - Apply differential rendering
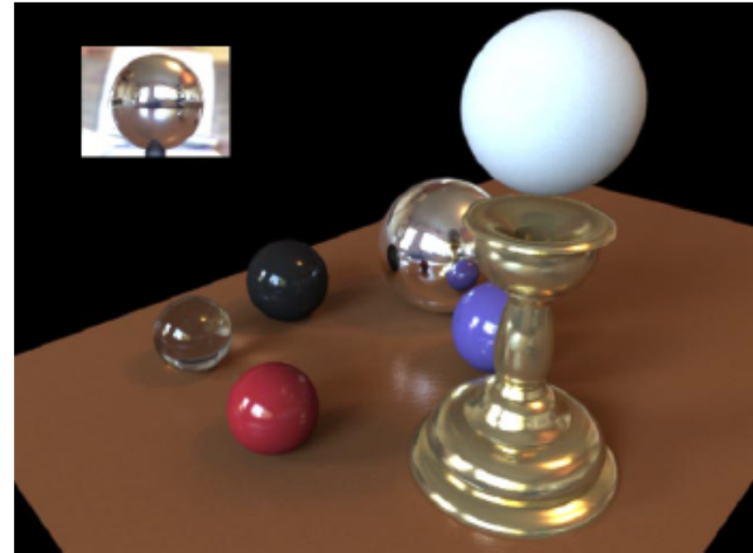
Rendering with an environment mapping [Debevec]

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Differential Rendering

- **Use global illumination two times**
  - One with the estimated real scene
  - Measure its error
  - Apply the error to the global illumination with real and virtual objects

(a) Background photograph

(b) Camera calibration grid and light probe

(c) Objects and local scene matched to background

(d) Local scene, without objects, lit by the model

(e) Object matte

(f) Difference in local scene between c and d

(g) Final result with differential rendering

Iterative Approach

- Rely upon global illumination
- Start with approximate values for materials of real objects
- Measure their errors with the ground-truth (the captured scene image)
- Adjust the values until their error is small

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Shadow Manipulation: Freeform Shadow Boundary Editing

example:
emphasize
Paolo's
nose and fists

From EG14 slides   **KAIST**

Artistic Controls for Various Scene Designs

- Require various controls for content creation **[STAR, Schmidt, EG14]**
  - Scene setting (object locations)
  - Light setting (light direction)
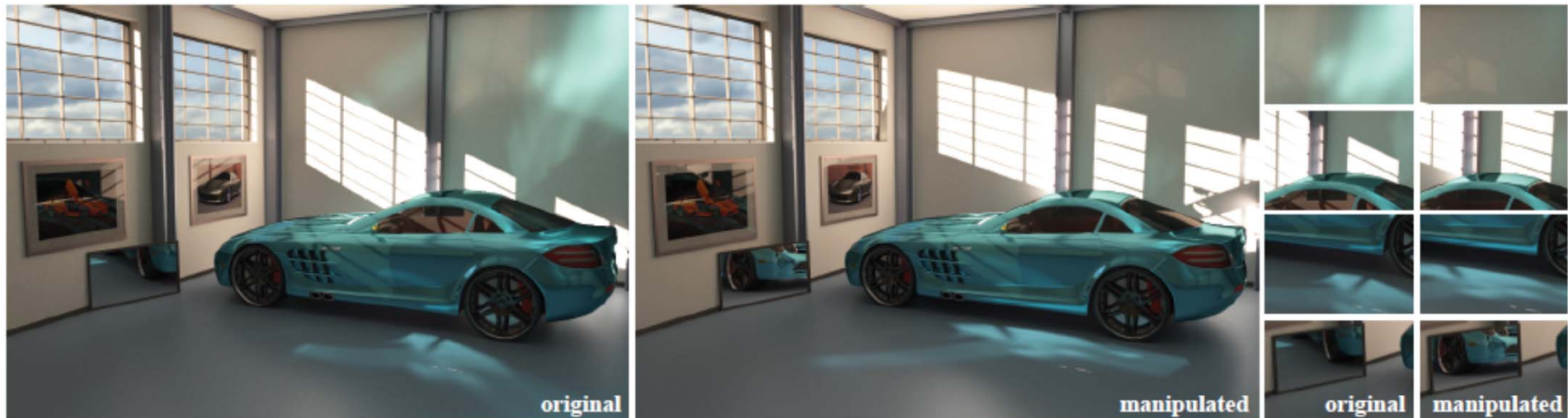 - Material setting (reflectance), etc.

Tangled, Disney, 2010

- Technically, a search problem for right parameters

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Another Example

- **Path-Space Manipulation of Physically-Based Light Transport [Schmidt, SIG 13]**
  - **Allows light paths for artistic controls within global illumination**

original · manipulated · original · manipulated

Key Components

- Interaction (UI)

- Lighting design

- Material design

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Key Components

- **Interaction (UI)**
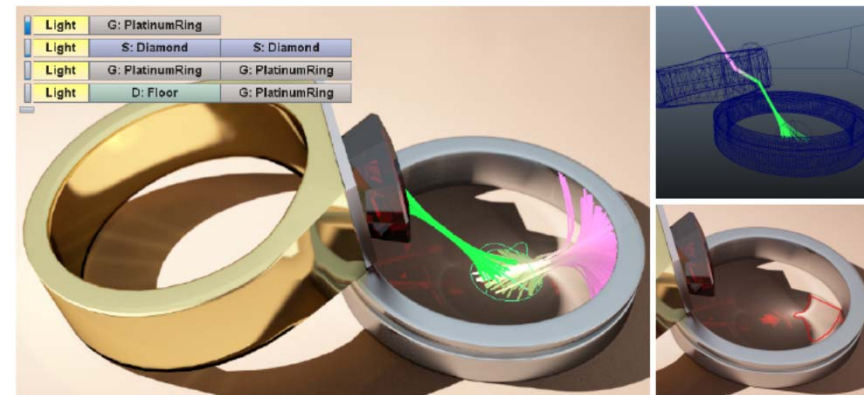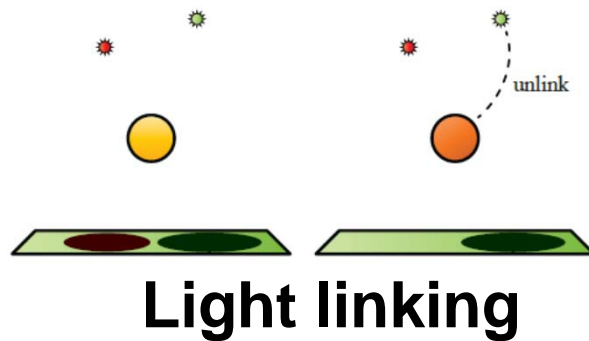 - **Direct, indirect, and goal-based**

Direct

Indirect [EG 14]

Artistic design process: refine sketch before the final rendering [Nowrouzezahrai, SIG 11]

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Key Components

- **Lighting design**
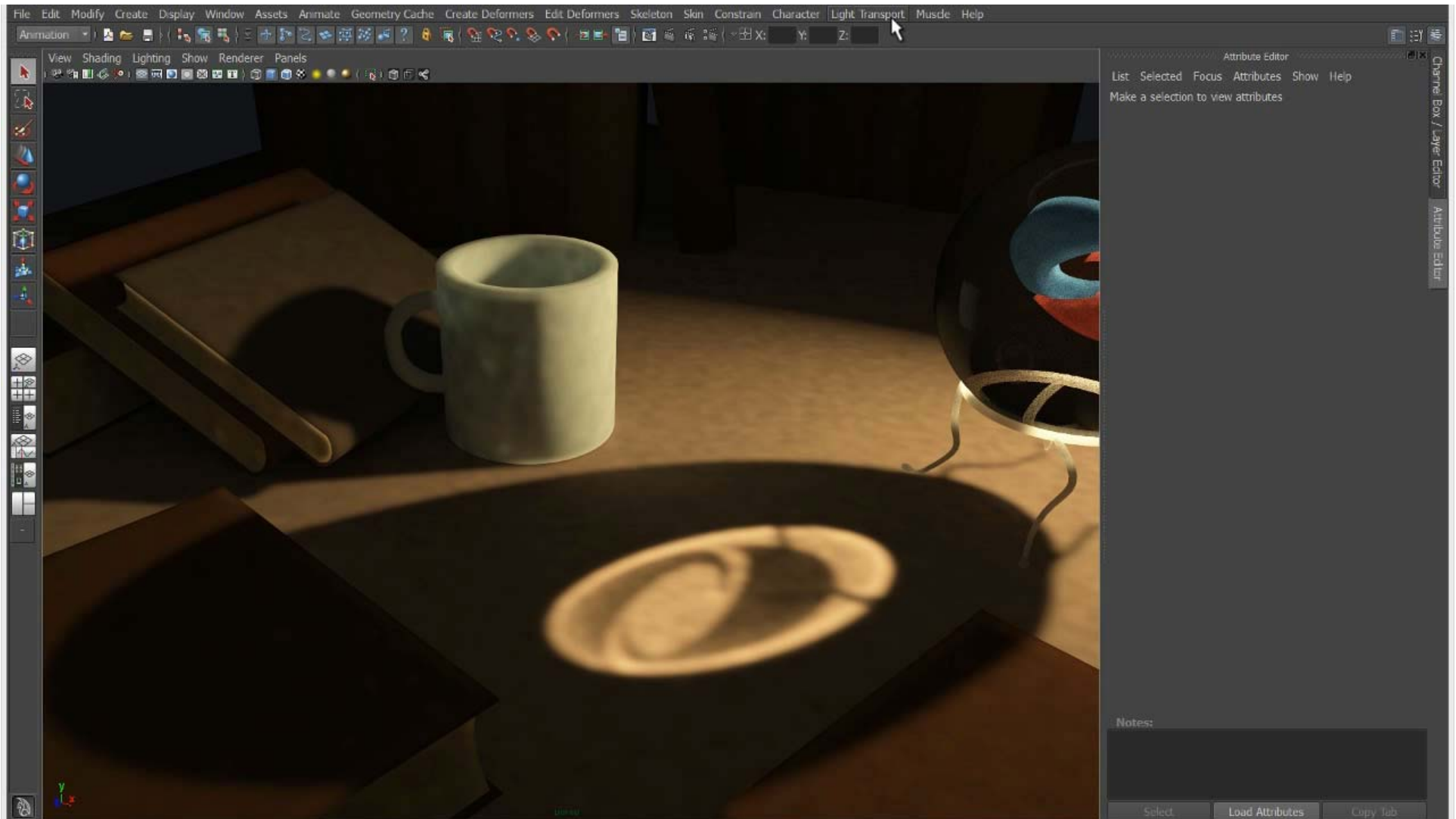 - **Directly or indirectly controlled lighting**

Light linking

Path space manipulation [Schmidt, SIG 13

Find various rendering parameters related to volumetric effects given sketchy
Tangled, Disney, 2010

Path Space Manipulation

From EG14 slides

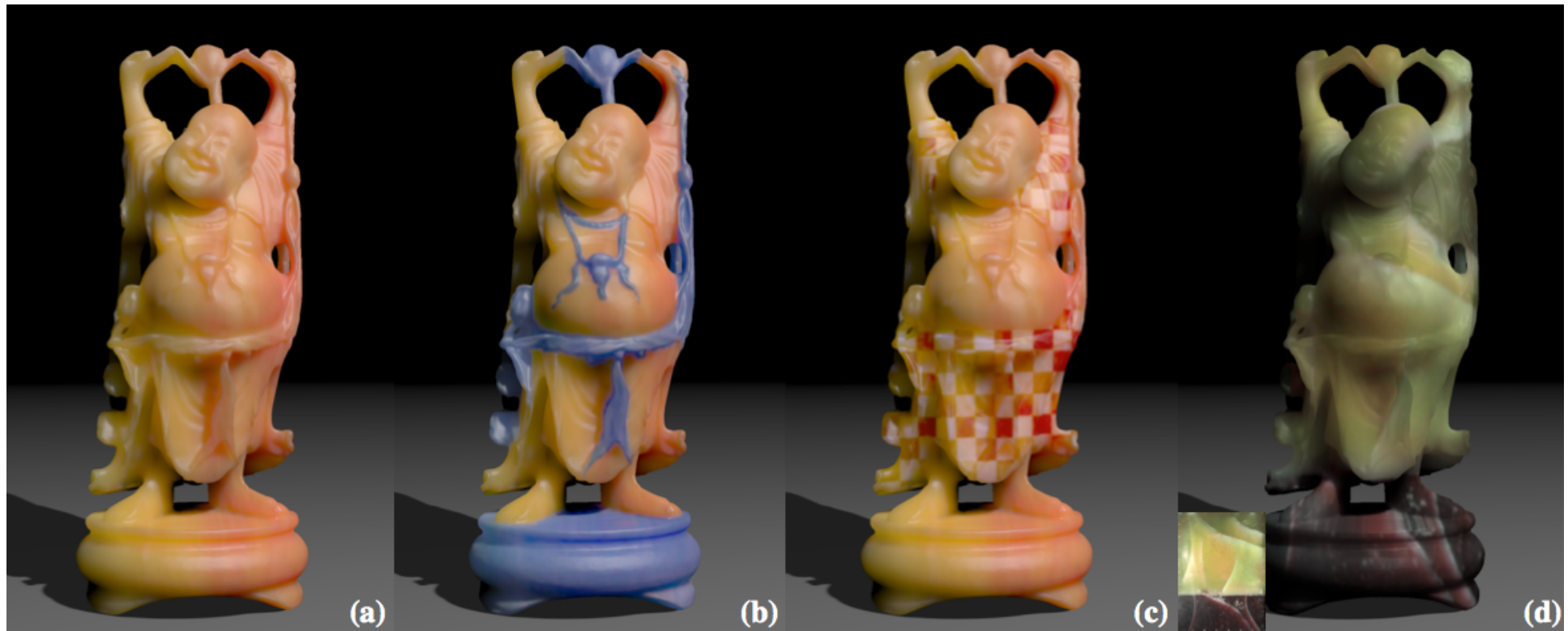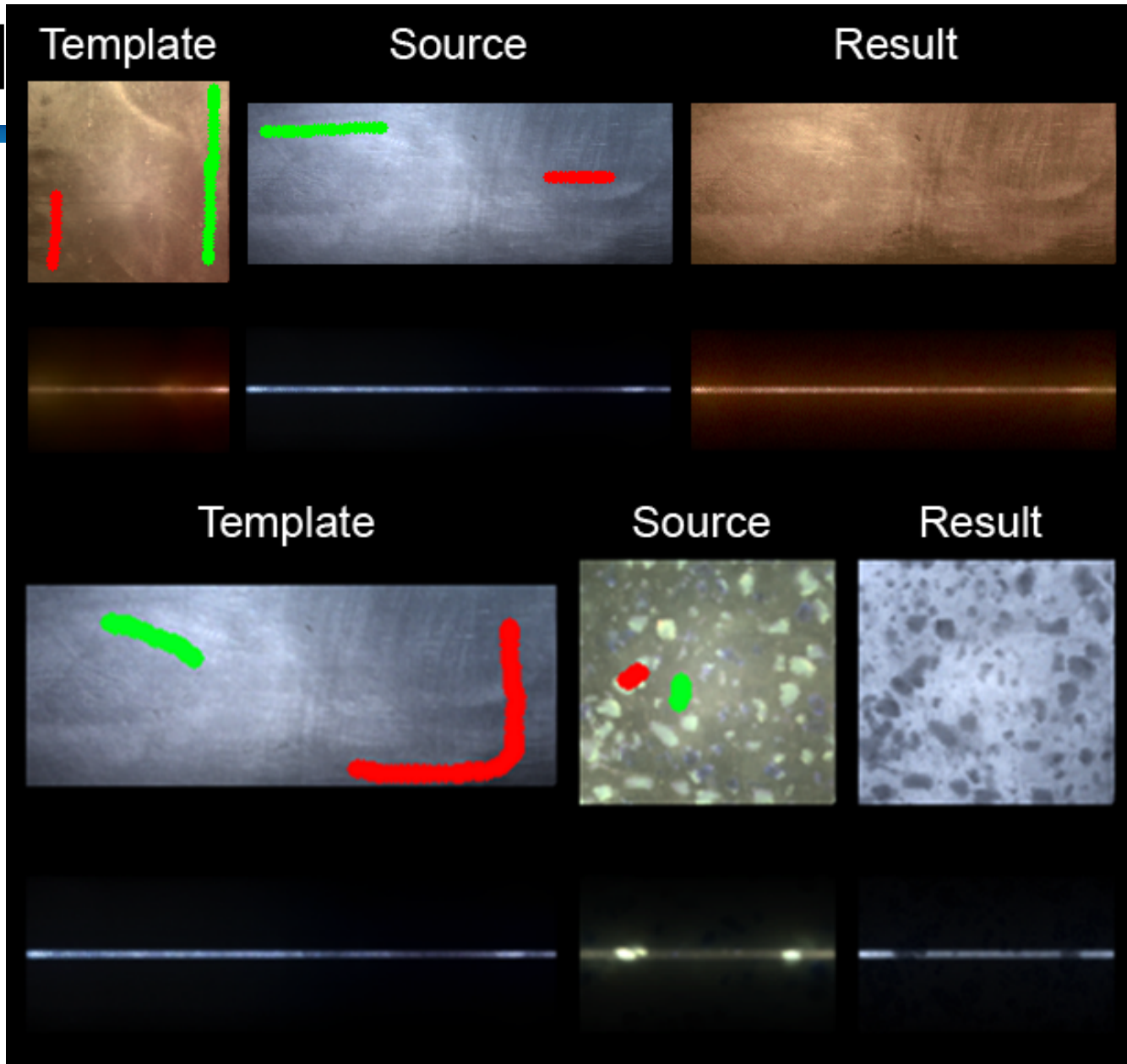# Key Components

- **Material design**
  - Much less studied, mainly because different material representations have been proposed steadily

Editing Subsurface Scattering

- ## SubEdit [STPP09]
  - ### decouple BSSRDFs into product of per-point scattering profile

(a) (b) (c) (d)

From EG14 slides

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Editing g

From EG14 slides

[STPP09]

Different Perspective

- **Performance**
  - Reducing running time of rendering algorithms

- **Productivity**
  - Look at work process!
  - Better performance
  - Flexible controls
  - Intuitive feedback and informative visualization

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