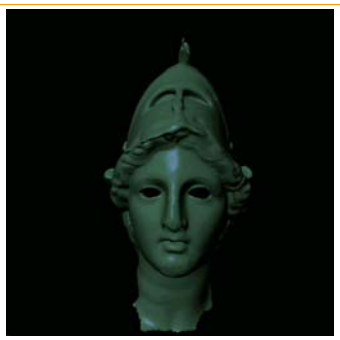
Realistic Materials

BRDF Measurement

Homogeneous BRDF



Spatially Varying BRDF

Approaches - Sampling

- dense sampling for each texel
  - Reflectance Fields, BTF
- sparse sampling
  - image-based BRDF Measurement
  - combining samples from different surface points
- spatial variation
  - constant specular part vs. clustered BRDFs

Approaches - Illumination

- point light
  - controlled condition
  - interreflections most often neglected
- environment maps
  - still direct illumination only
- global inverse illumination

BRDF Measurement

- Gonioreflectometer

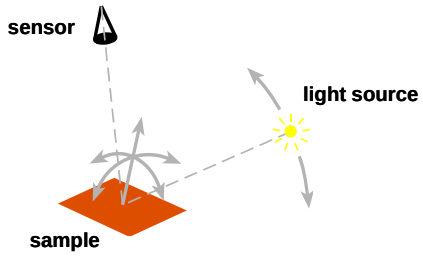
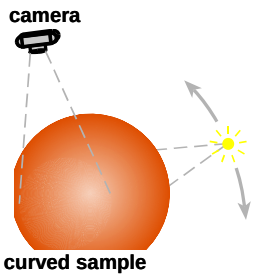


Image-Based BRDF Measurement

- [Marschner 1999, Lu & Koenderink 1998, …]
  - capture lots of BRDF samples at one shot by a sensor array / camera.
  - homogeneous, isotropic materials only



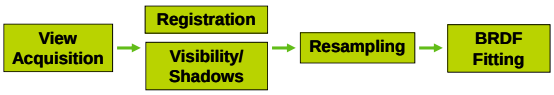
Example Acquistion Setup

- The following demonstrates and image-spaced acquisition setup [Lensch 2002,2003]
- There are other possible variants

Acquisition Setup

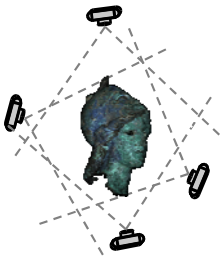
- Camera and light source are moved manually around the object.
- Positions are calibrated with respect to the object.
- The dark room reduces reflections from the environment.

BRDF Fitting



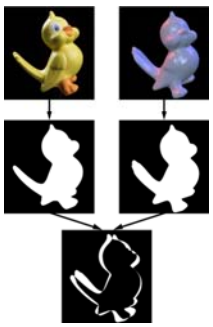
BRDF Acquisition

- Capture HDR-images from various viewpoints with different light source positions.



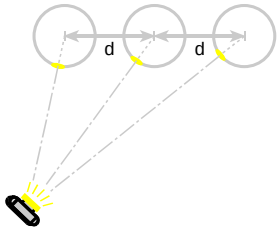
3D-2D Registration

- calibrated gantry
- corresponding points
- silhouette-based method



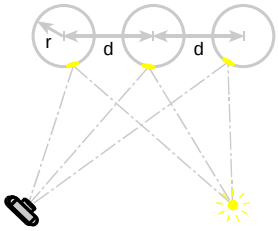
Light Source Position

- detect highlights of ring flash reflections
- determine the position of the spheres



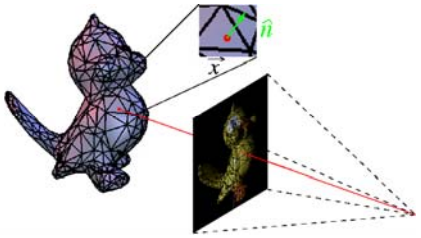
Light Source Position

- detect highlights of light source reflections
- reconstruct light source position



Light Source Position

Resampling

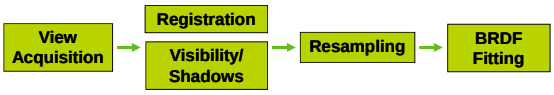


- for each point on the surface:
  - find all images where the point is visible and lit
  - take sample at corresponding pixel position

Resampling

- Now at every location on the object:
  - Have several samples
    - For different view/light combinations
    - Number depends on number of images!
  - Using these samples, fit a BRDF now

BRDF Fitting



Fitting a BRDF to the data

- Fitting a separate BRDF at every texel
  - Choose a BRDF model (say Cook-Torrance)
  - BRDF model has several “free” parameters
  - Perform non-linear fitting (Levenberg-Marquart for instance) of model to measured data
    - Can be done in Matlab
  - Yields parameters per pixel

Results

Results

Results

Photograph Rendering

Results