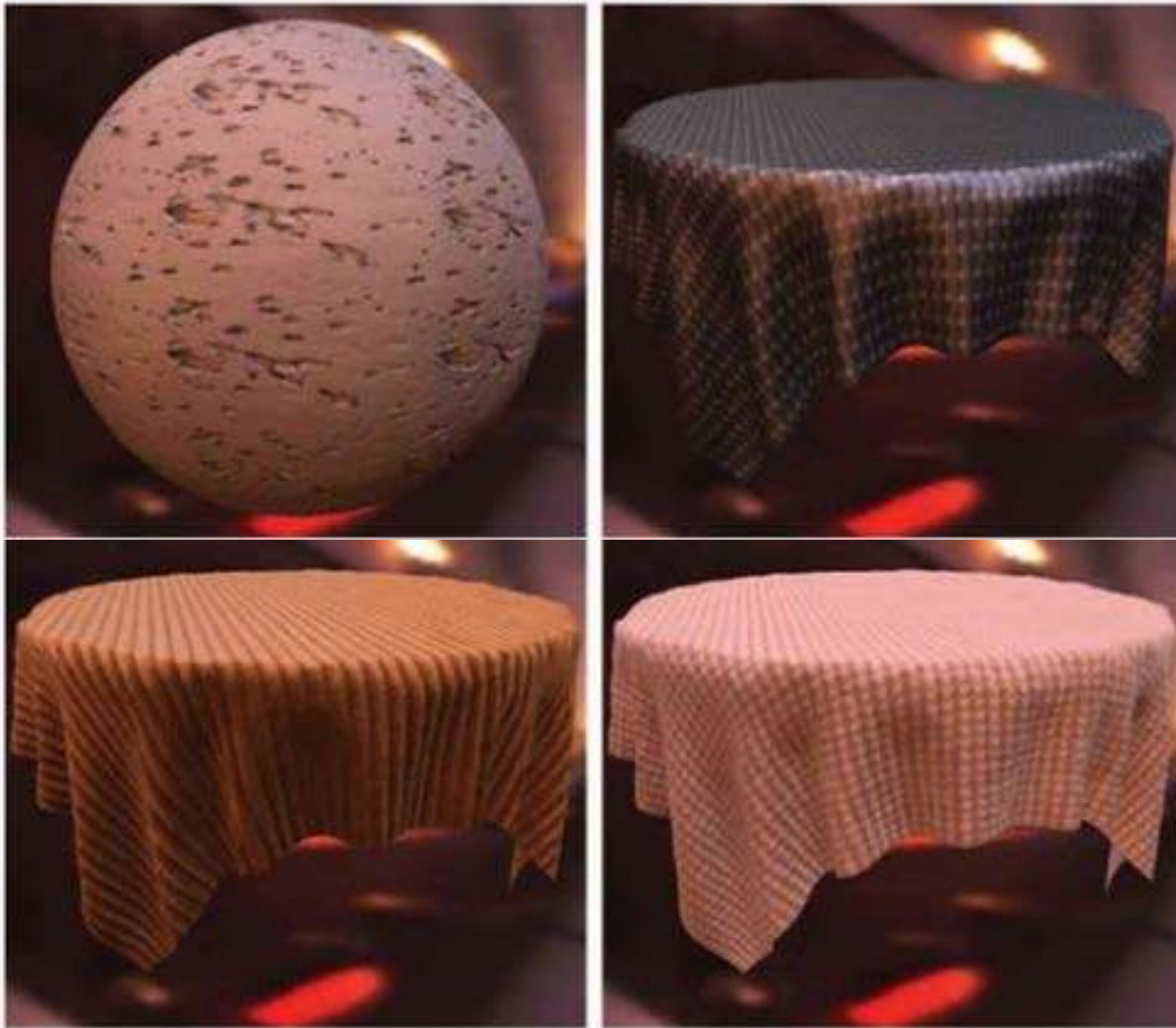


# Effects of Approximate Filtering on the Appearance of Bidirectional Texture Functions

Adrian Jarabo, Hongzhi Wu, Julie Dorsey,  
Holly Rushmeier, Diego Gutierrez



# Bidirectional Texture Function



[Filip et al.11]

# Bidirectional Texture Function



[Settler et al. 05]

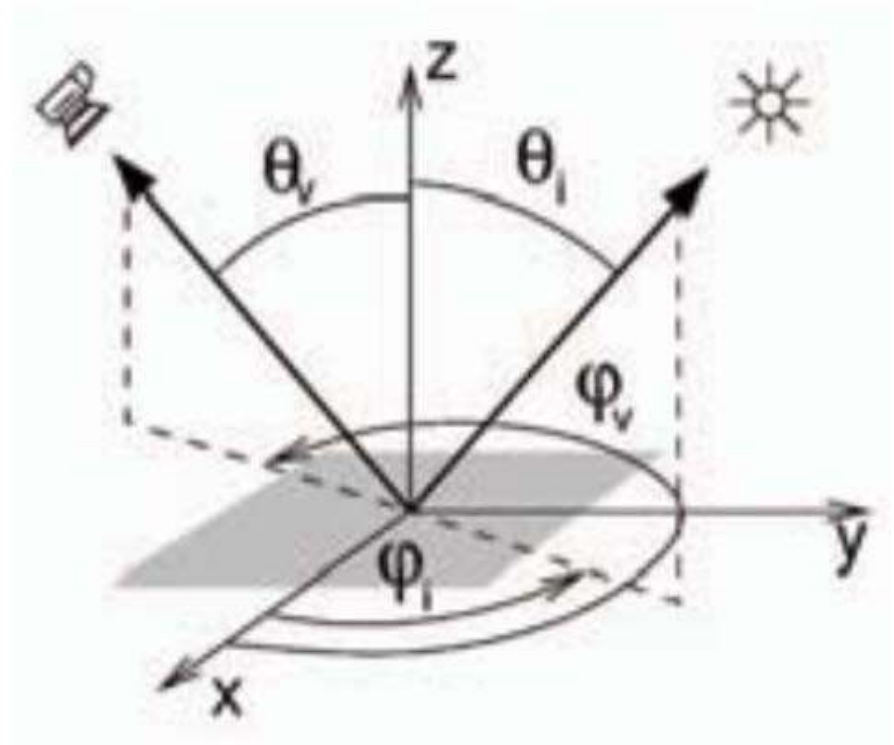
# Bidirectional Texture Function



[Schwartz et al.11]

# Bidirectional Texture Function

- View- and light-dependent textures
- Encoding:
  - Complex reflectances
  - Parallax
  - Shadows
  - GI + local SSS



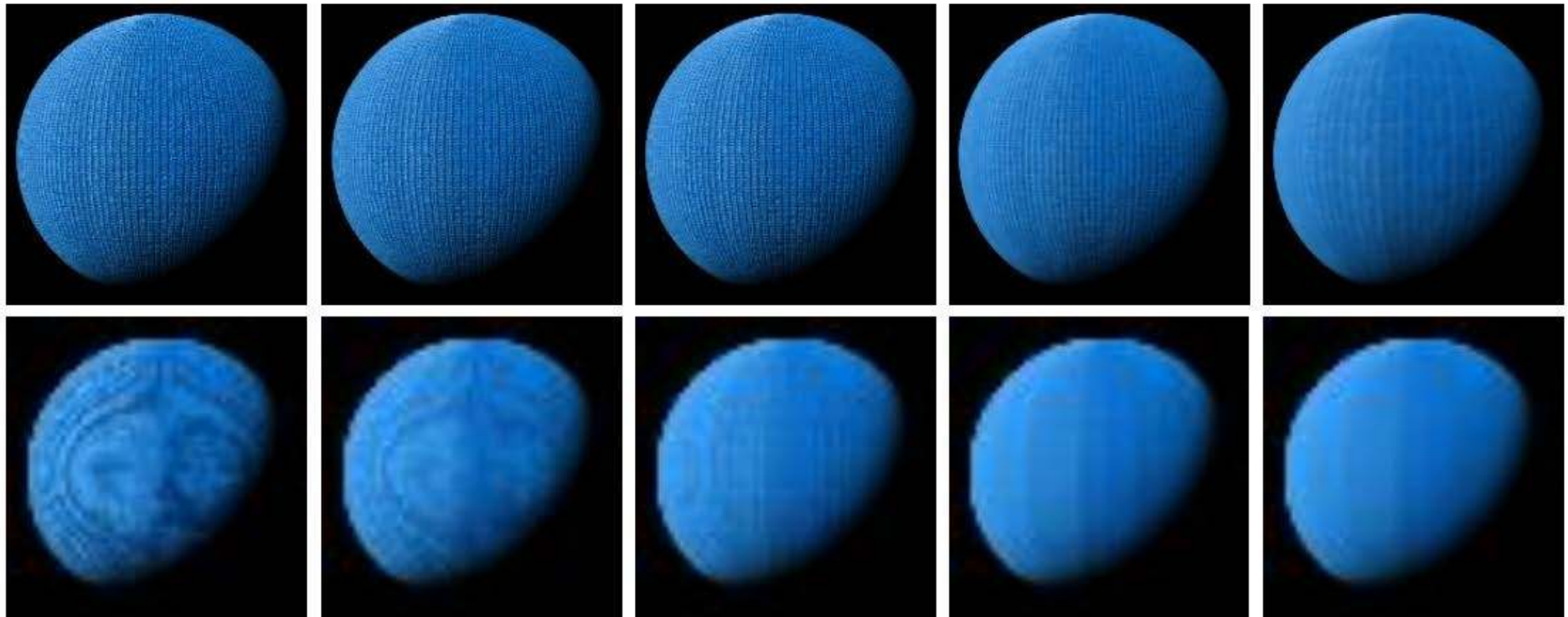
[Filip et al.11]

# Bidirectional Texture Function



[Schwartz et al.11]

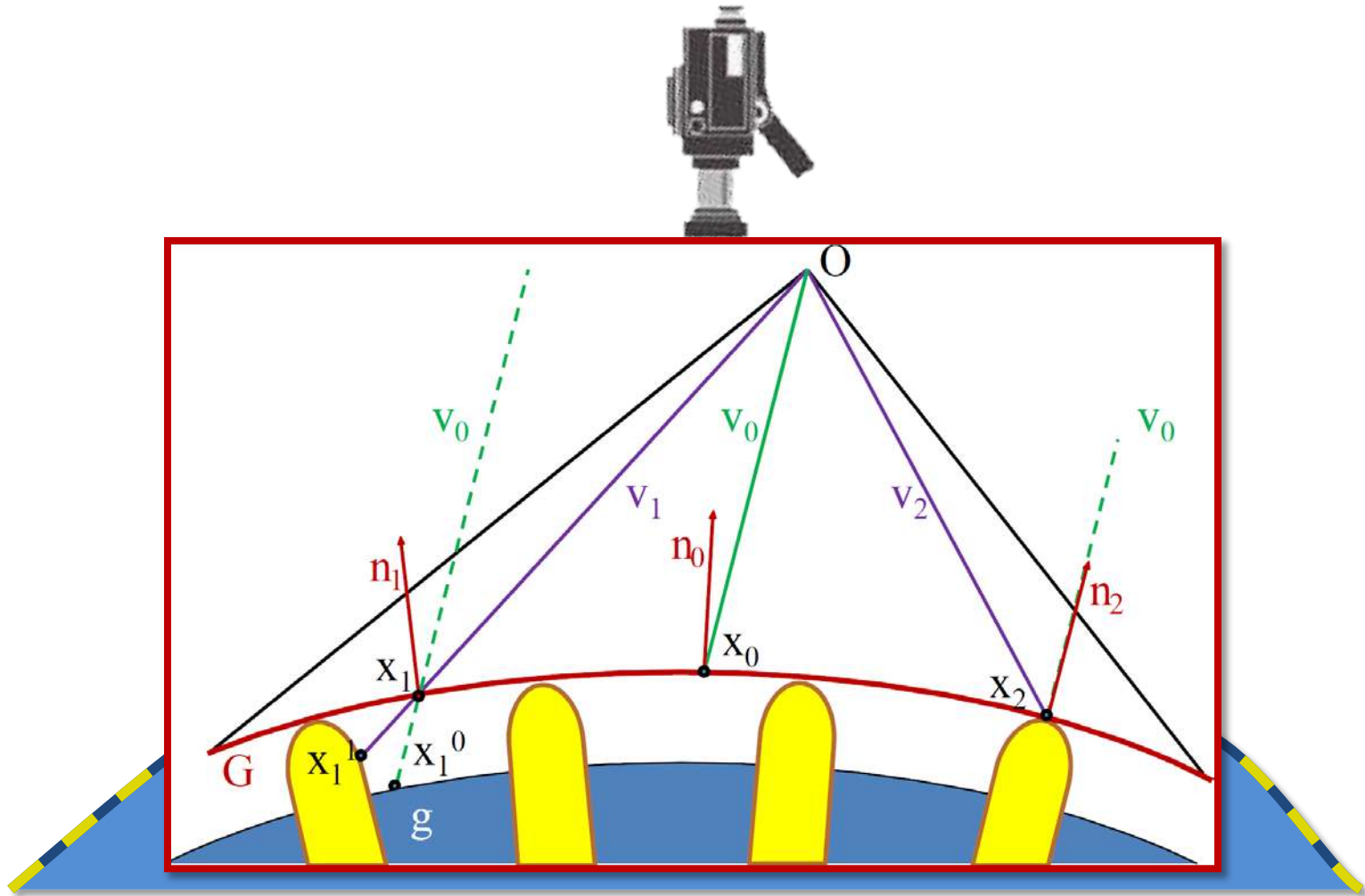
# BTF – The problem of filtering



Undersampling (Aliasing)

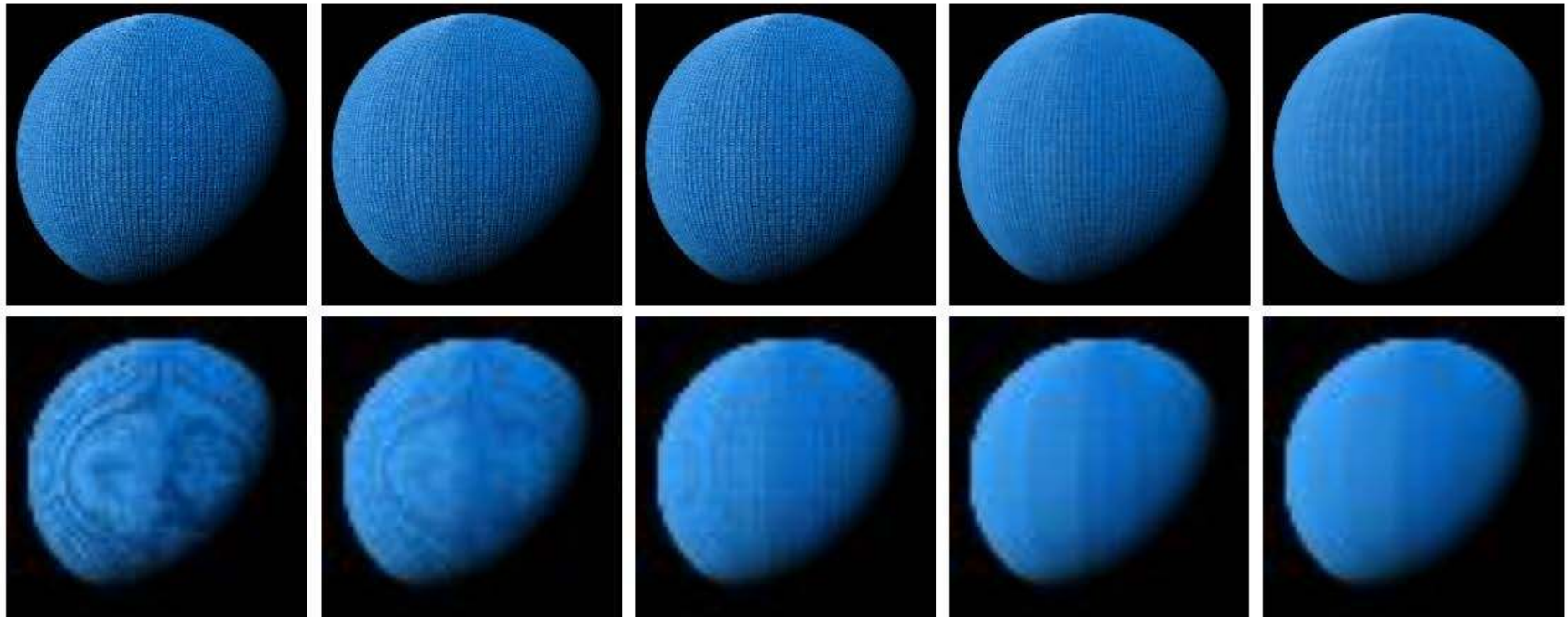
Over-smooth (Blur)

# BTF – The problem of filtering





# BTF – The problem of filtering

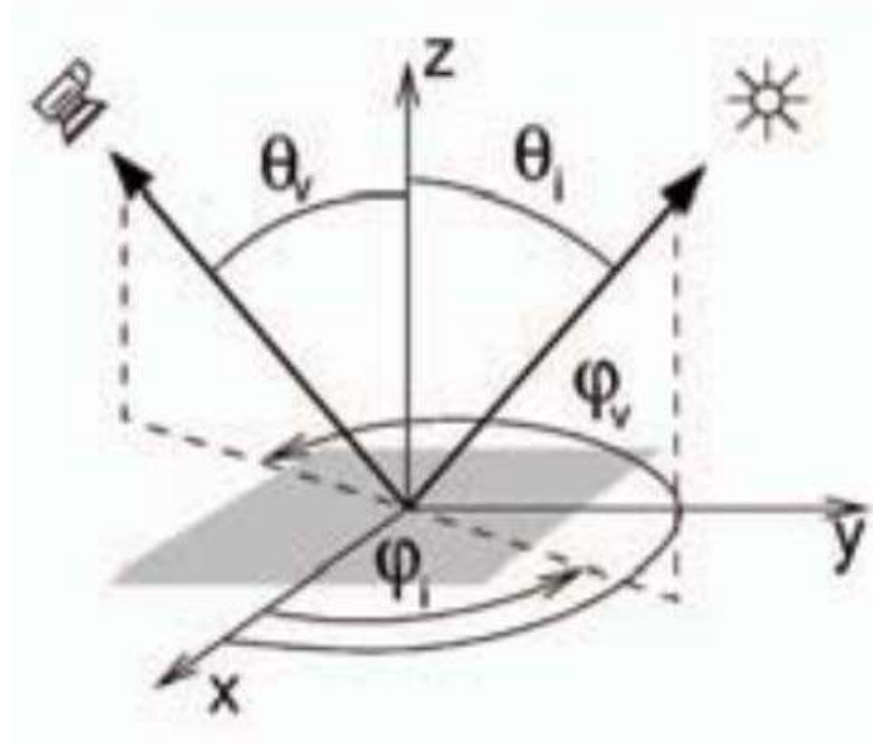


Undersampling (Aliasing)

Over-smooth (Blur)

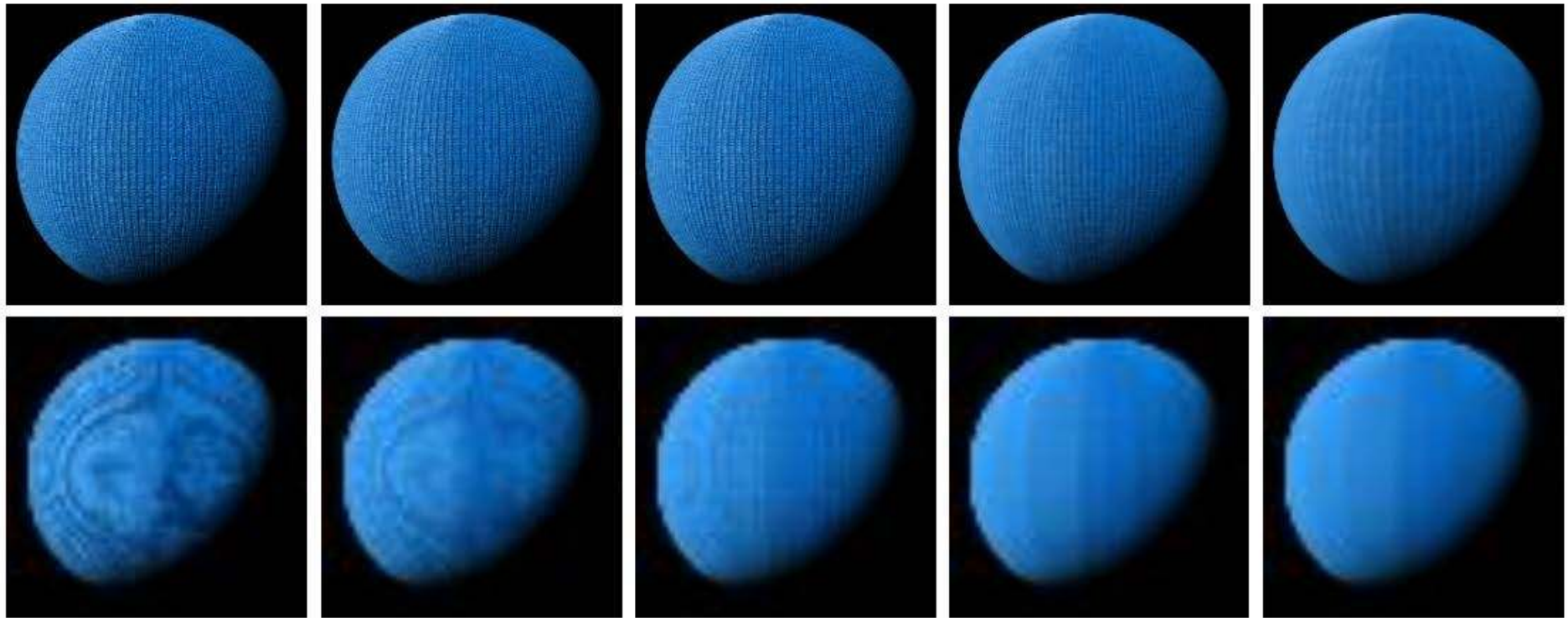
# Bidirectional Texture Function

- **Angular-dependent textures**



[Filip et al.11]

# BTF – The problem of filtering



← Undersampling (Aliasing)

→ Over-smooth (Blur)

# BTF – The problem of filtering

So you can:

- a) Throw many rays to sample accurately the BTF (expensive)
- b) Or prefilter the BTF, and then only throw one sample



Undersampling (Aliasing)

Over-smooth (Blur)

# Our goal

Evaluate under which conditions an approximately pre-filtered **BTF** is considered **visually equivalent** to the ground truth.

# Our goal

1. Is it possible to pre-filter BTFs maintaining **visual equivalence** to the reference solution?
2. What kind of **artifacts** (e.g. aliasing, blur) are more easily accepted? Under which conditions?
3. Does **distance or motion affect visual equivalence?**
4. Is this visual equivalence **correlated with high-level visual properties** of the surface?

# Perceptual Experiments

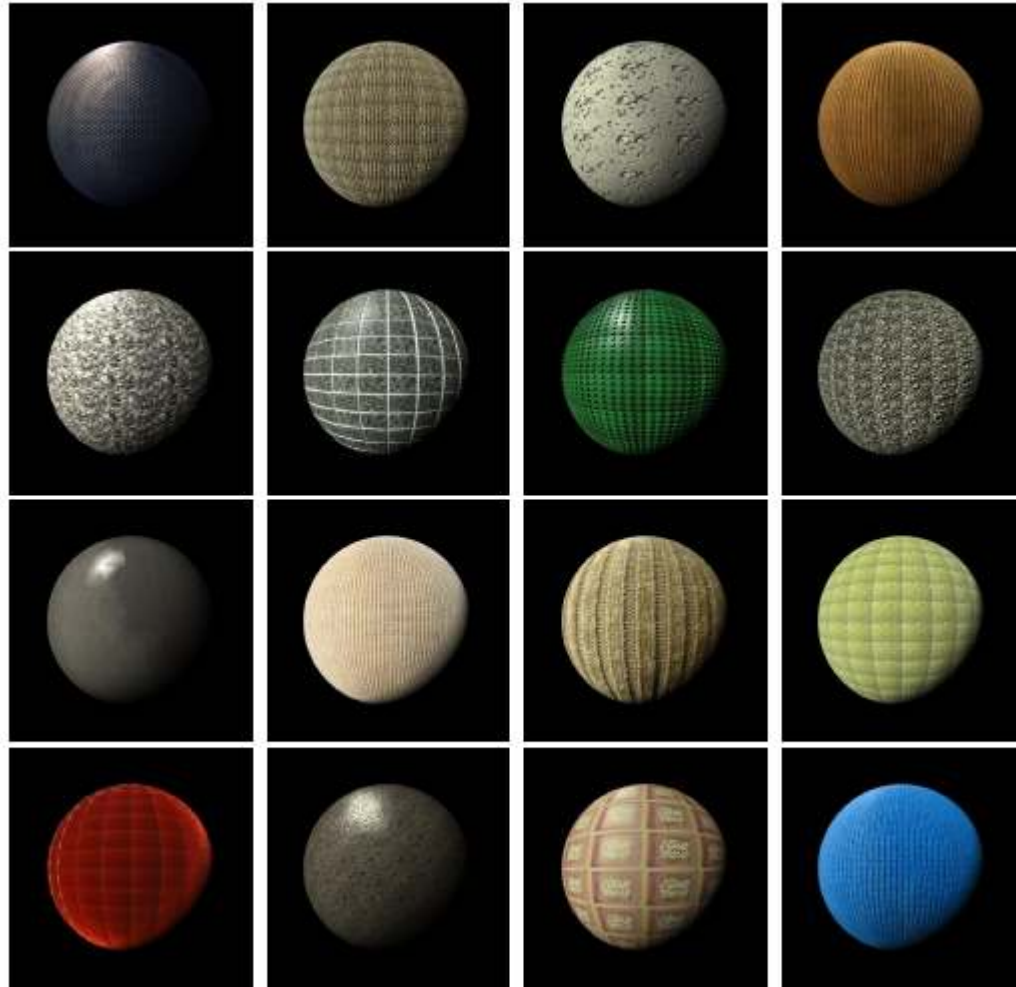
- **Static** and **dynamic** experiments
  - *Static light and camera, moving light & moving camera*

# Perceptual Experiments

- **Static** and **dynamic** experiments
- **Several BTFs** representing different materials
  - *Each BTF has assigned a set of high-level visual properties: e.g. glossy, structured, relief*



# Perceptual Experiments



# Perceptual Experiments

- **Static** and **dynamic** experiments
- **Several BTFs** representing different materials
- Analysis of filtering **angular** and **spatial** domains separately

# Perceptual Experiments

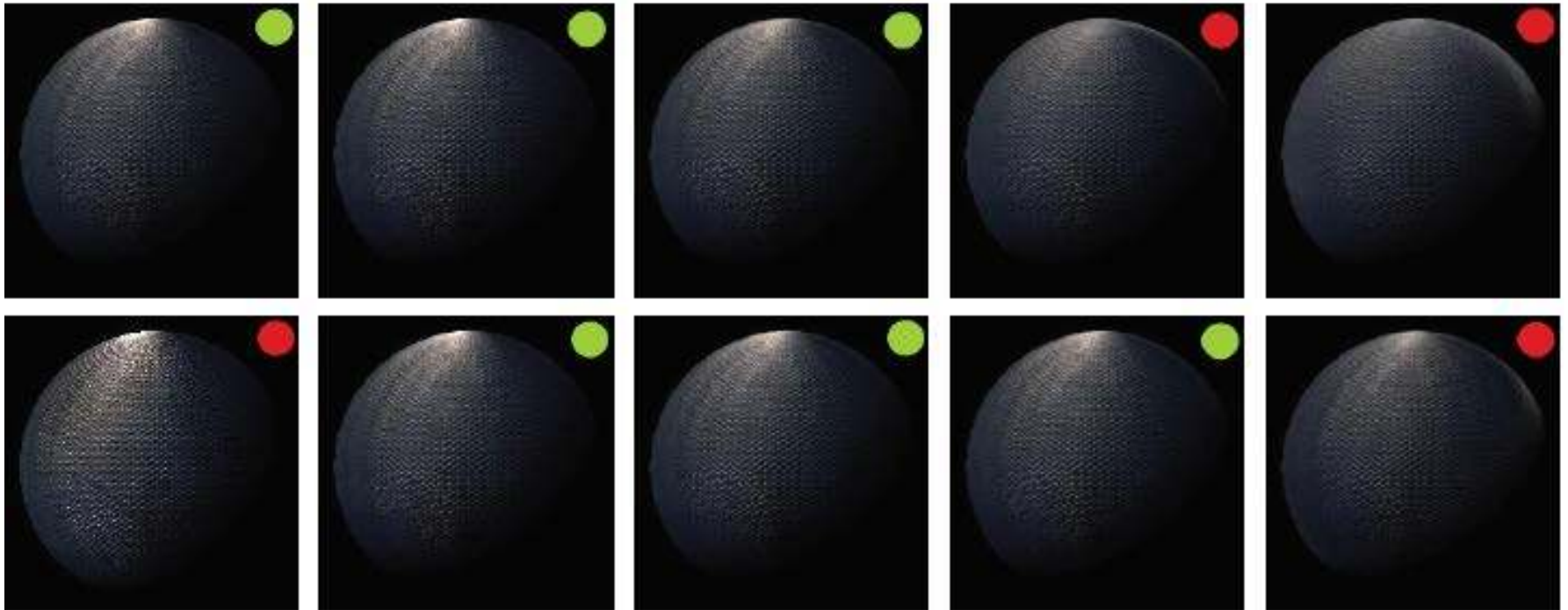
Spatial domain



← Undersampling (Aliasing) Over-smooth (Blur) →

# Perceptual Experiments

Angular domain

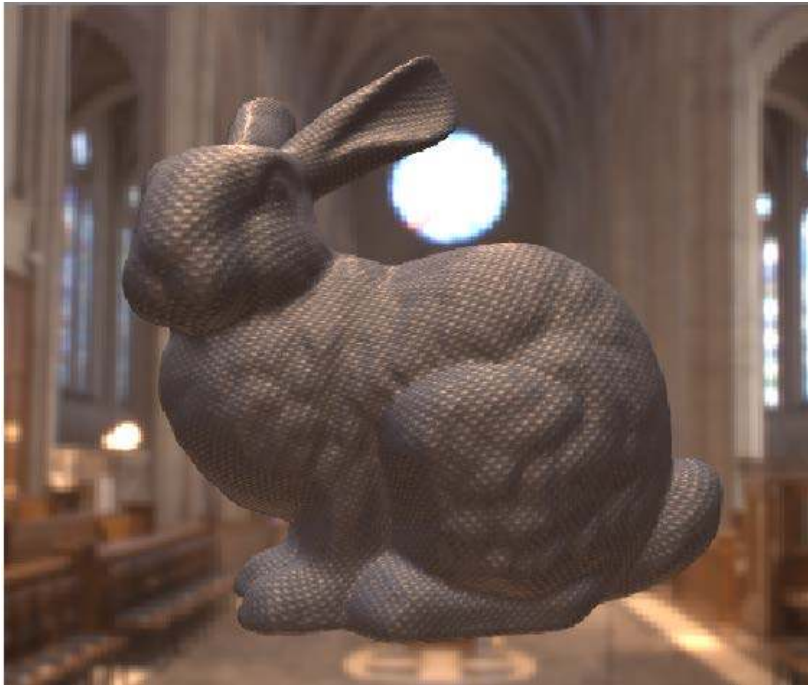


← Undersampling (Aliasing) Over-smooth (Blur) →

# Perceptual Experiments

- **Static** and **dynamic** experiments
- **Several BTFs** representing different materials
- Analysis of filtering **angular** and **spatial** domains separately
- Test **different geometries** and **illumination**

# Perceptual Experiments



# Perceptual Experiments

- **Static** and **dynamic** experiments
- **Several BTFs** representing different materials
- Analysis of filtering **angular** and **spatial** domains separately
- Test **different geometries** and **illumination**
- Use **MTurk** to get participants (~3000)

# Analysis

- Check consistency between results on Mturk and controlled in-situ experiments.
- N-Ways ANOVA seeking for main and interaction effects.
- Tukey-Kramer post-hoc analysis.



# Experiments Results (I)

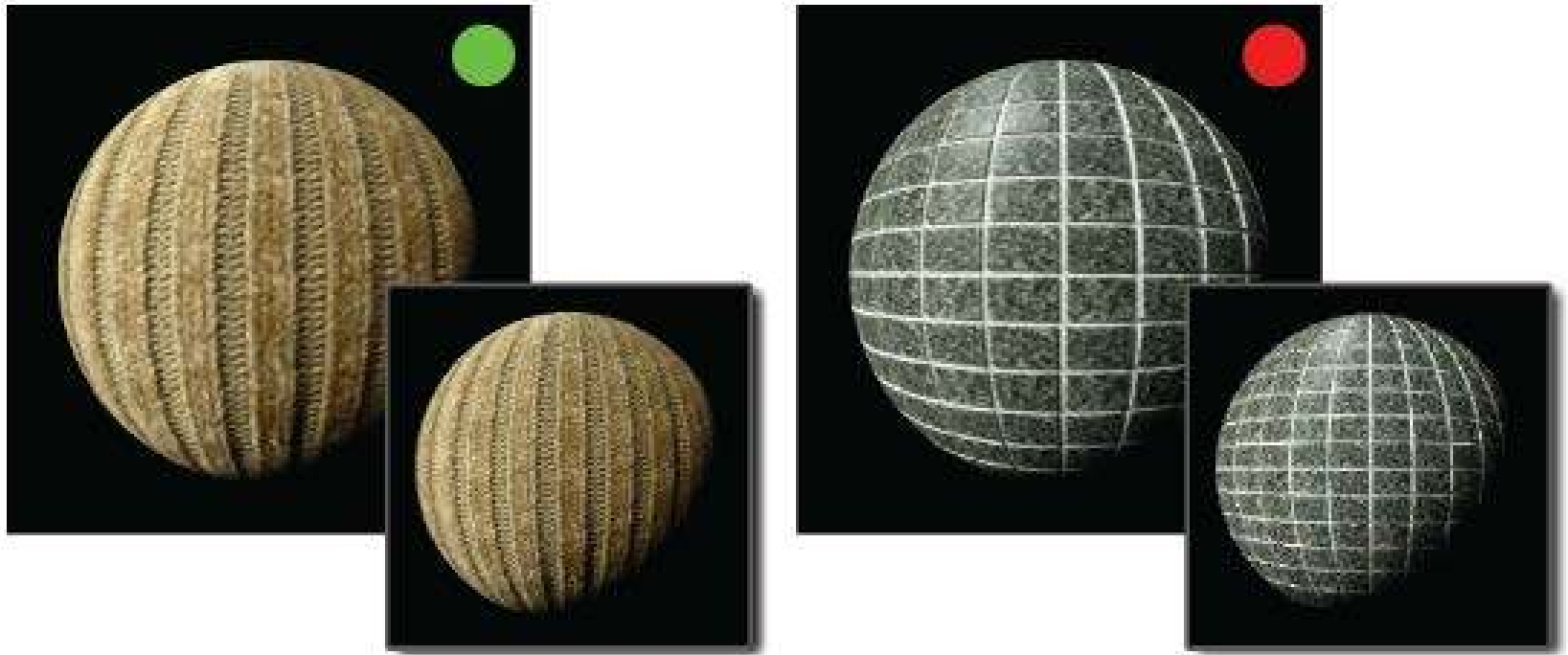
- **Aliasing** (contrast) is preferred in **static** scenes...
- ... in contrast, **oversmooth** appearance is preferred for **dynamic** scenes.
- The **angular** domain supports for **more aggressively pre-filter** than the spatial domain.

# Experiments Results (II)

- **High-level descriptors** of the surfaces relate with the results: their visual properties affect the level of blur or aliasing accepted.
- **Low-level BTF statistics** correlate with high-level visual descriptors.
- Our **results generalize** to geometries and illumination with several levels of complexity.

# Applications

- In **rendering**, BTF compression or filtering:
  - When a prefiltered approximation can be used for BTFs?



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- In **rendering**, BTF compression or filtering:
  - When a prefiltered approximation can be used for BTFs?

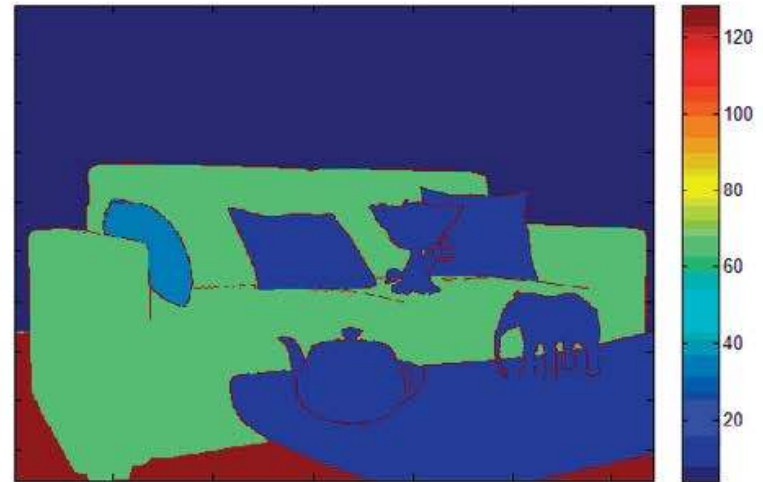


# Applications

- In **rendering**, BTF compression or filtering:
  - Adaptive rendering based on material props.



**Speed-up: x2.5**



# Conclusions

- **Approximate pre-filtering** can be applied to BTF without sacrificing visual quality.
  - We can filter the **angular domain** more aggressively than the spatial domain.
  - **High-level features** can be used to determine optimal parameters for BTF filtering. **And they correlate with low-level statistics!**

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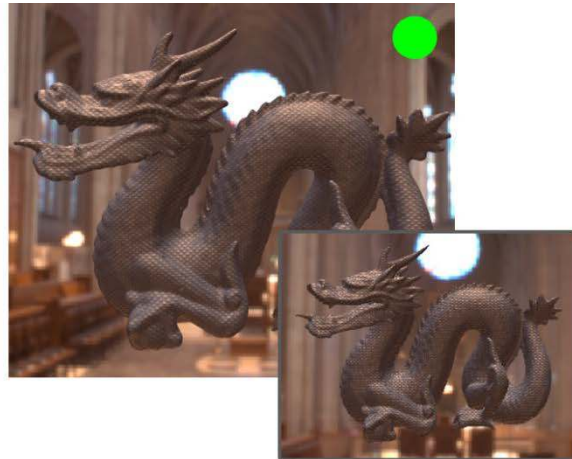
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- Shown **several applications** for BTF rendering, filtering and compression.



# Conclusions

- **Approximate pre-filtering** can be applied to BTF without sacrificing visual quality.
- Shown **several applications** for BTF rendering, filtering and compression.
- Future work: **extrapolate** findings and procedure to other material **models?**
  - e.g. SV-BRDFs

# Thanks!



Data at:

<http://giga.cps.unizar.es/~ajarabo/pubs/btfTVCG14/>