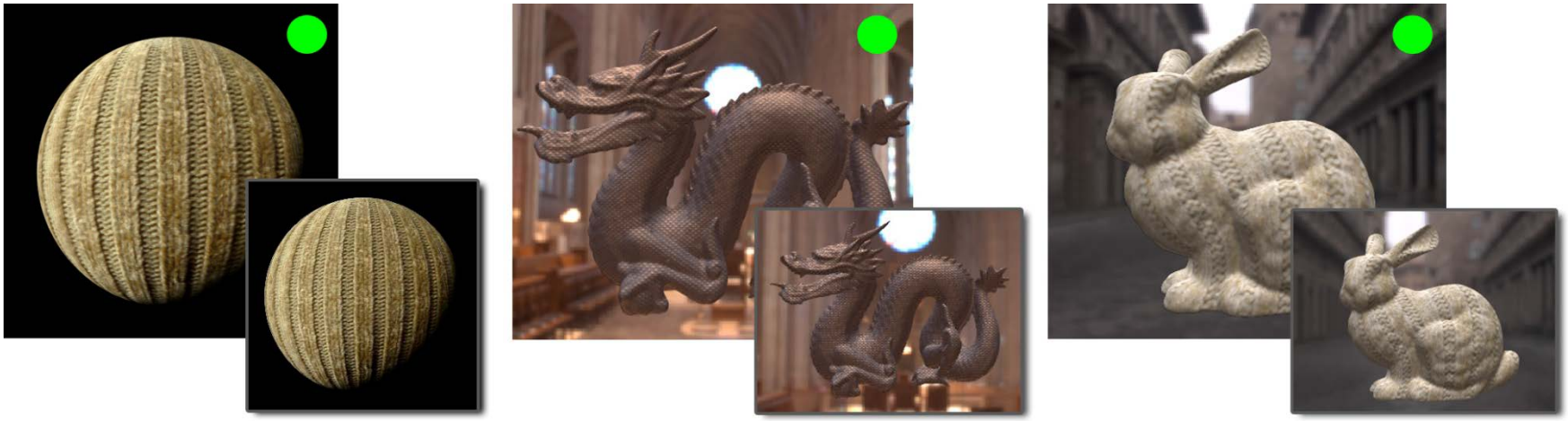

Effects of Approximate Filtering on the Appearance of Bidirectional Texture Functions

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

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LUX ET VERITAS

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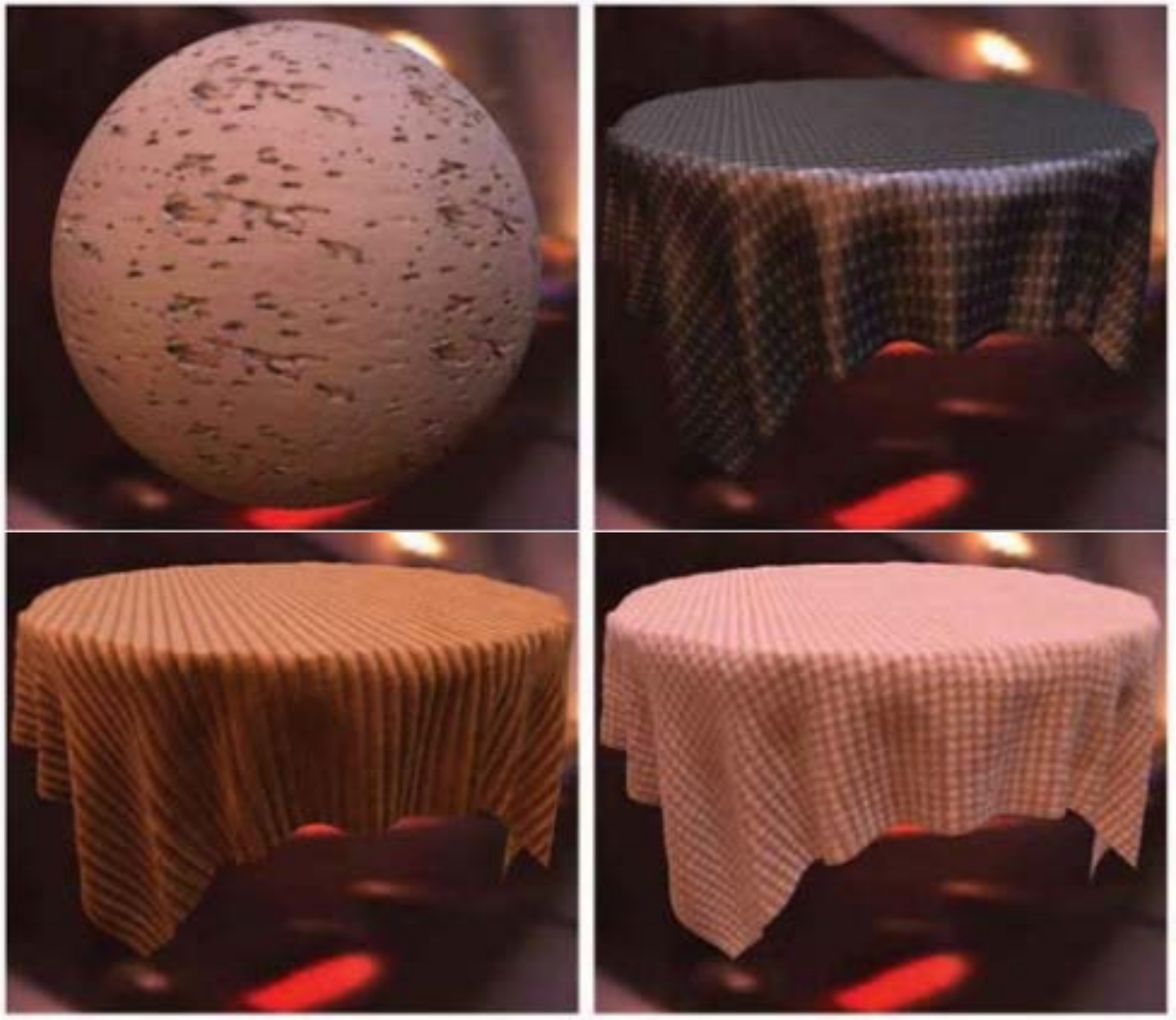
Bidirectional Texture Function



[Filip et al.11]

Bidirectional Texture Function

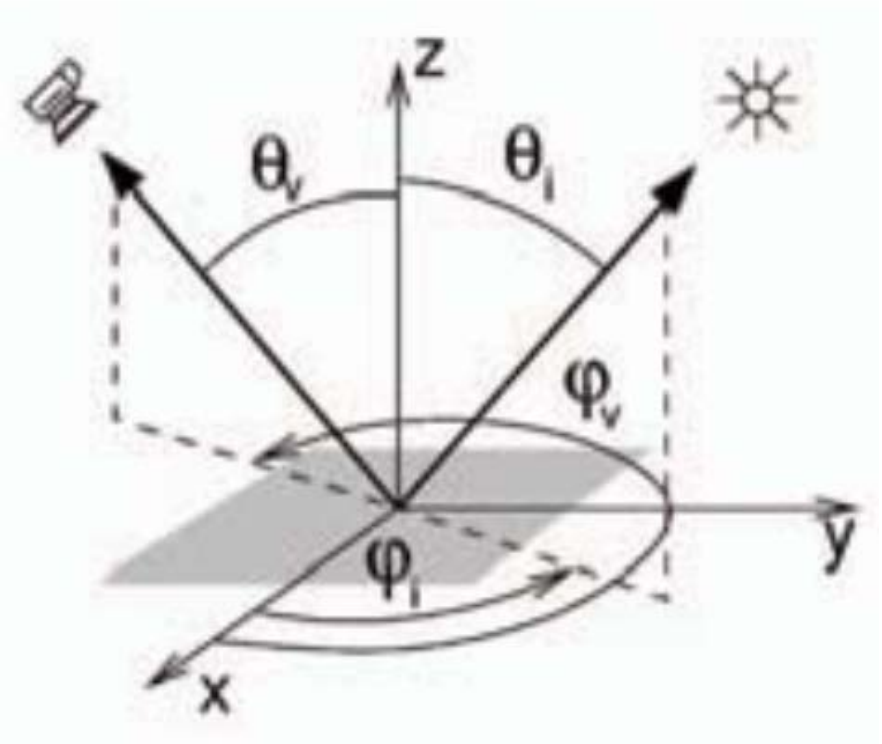
[Settler et al. 05]

Bidirectional Texture Function

[Schwartz et al.11]

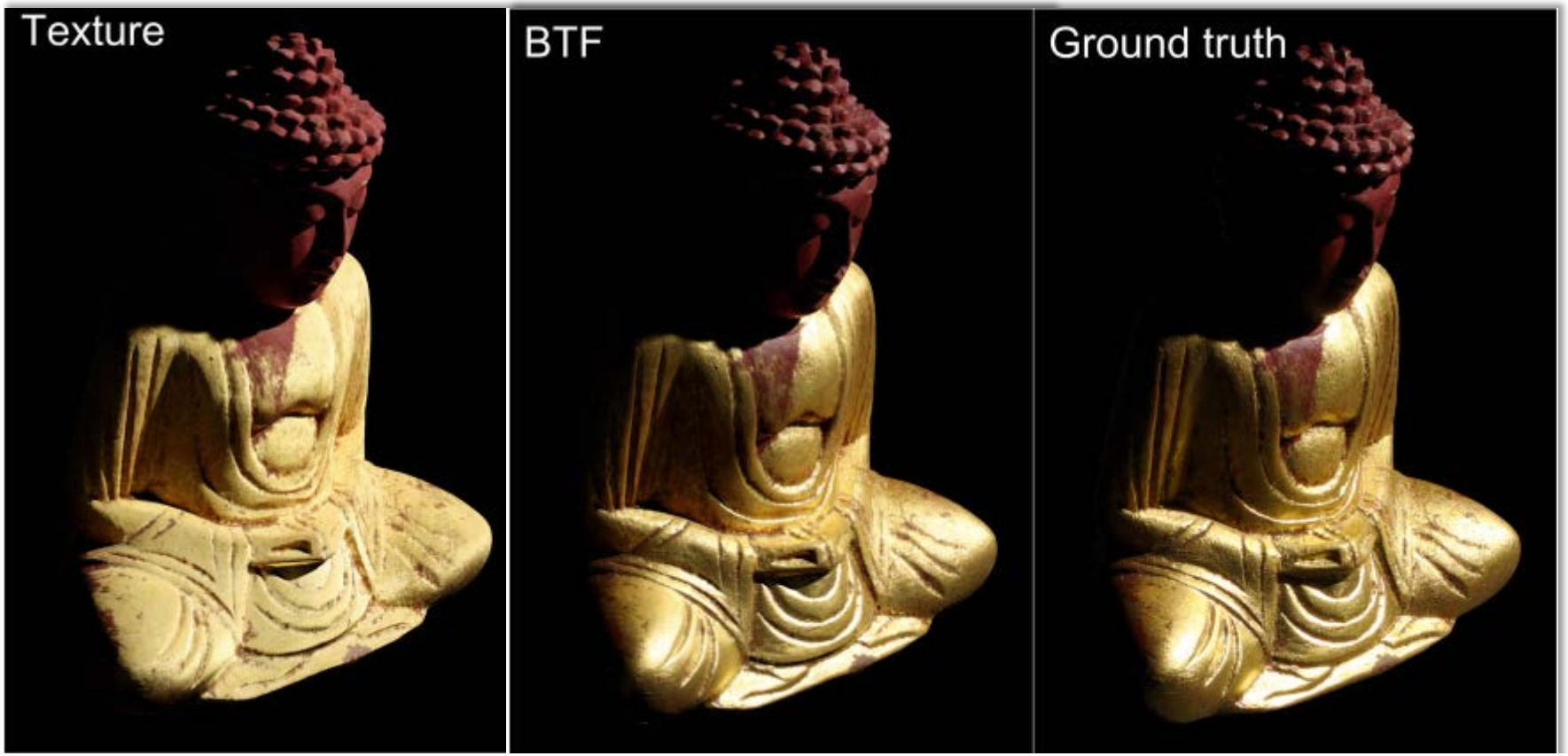
Bidirectional Texture Function

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



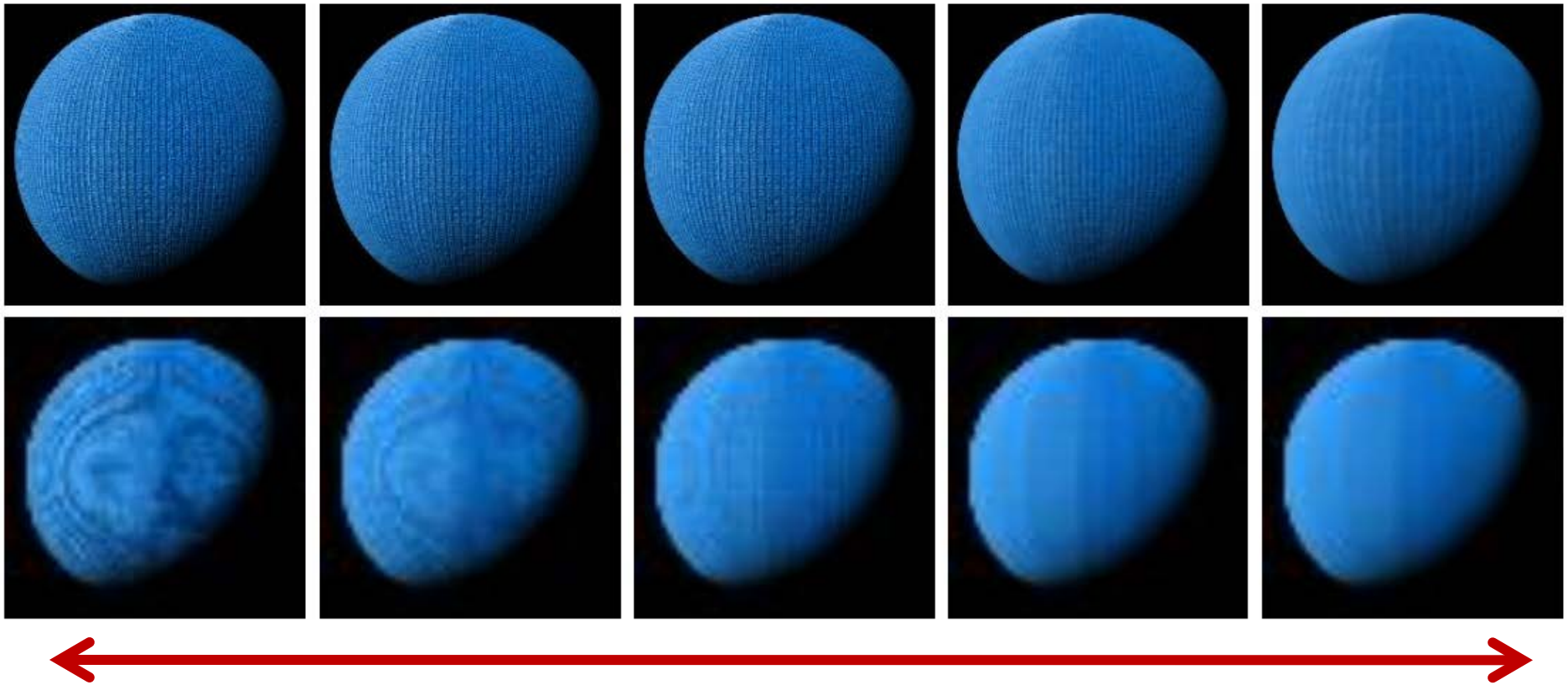
[Filip et al.11]

Bidirectional Texture Function



[Schwartz et al.11]

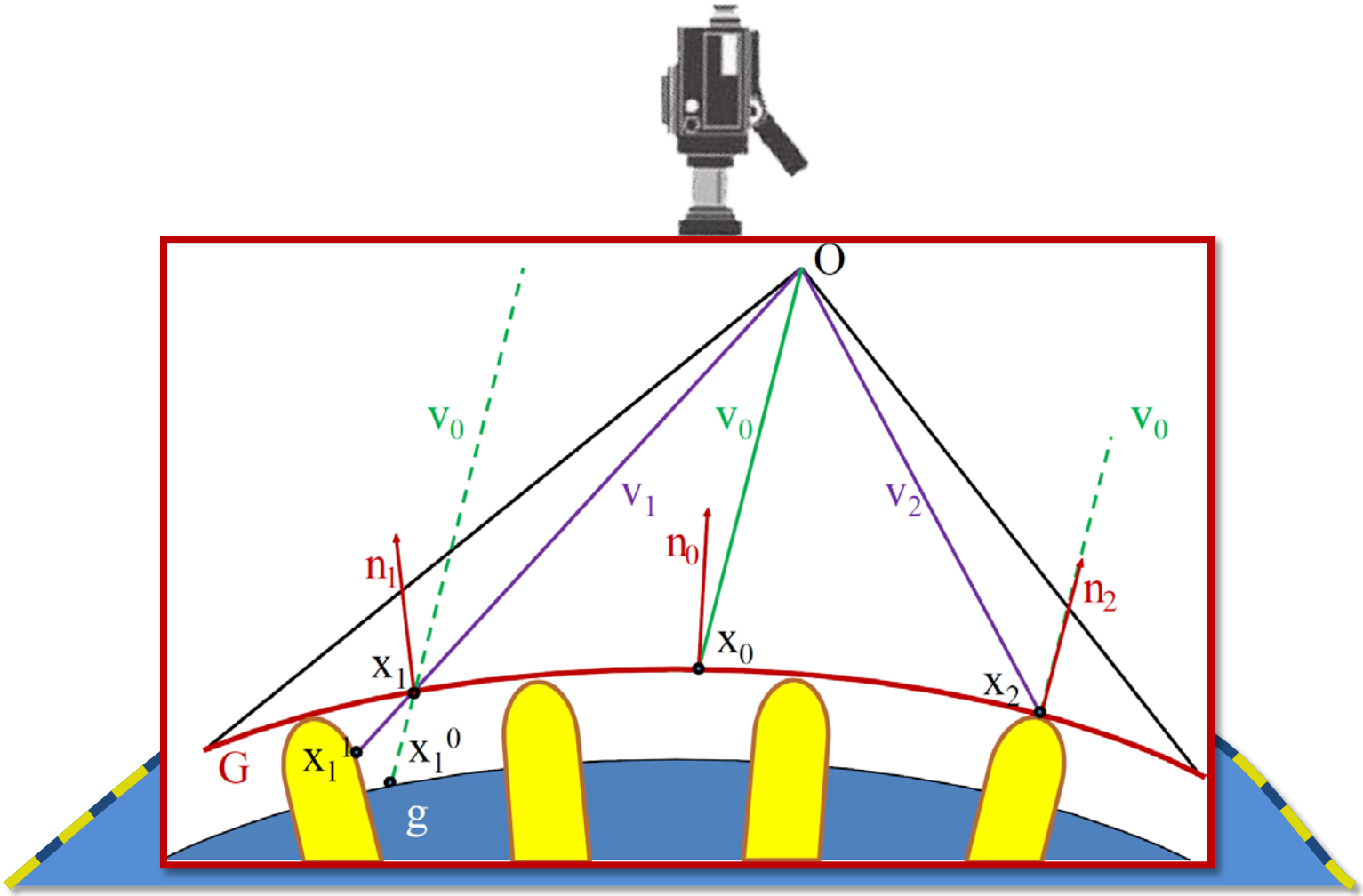
BTF – The problem of filtering



Undersampling (Aliasing)

Over-smooth (Blur)

BTF – The problem of filtering



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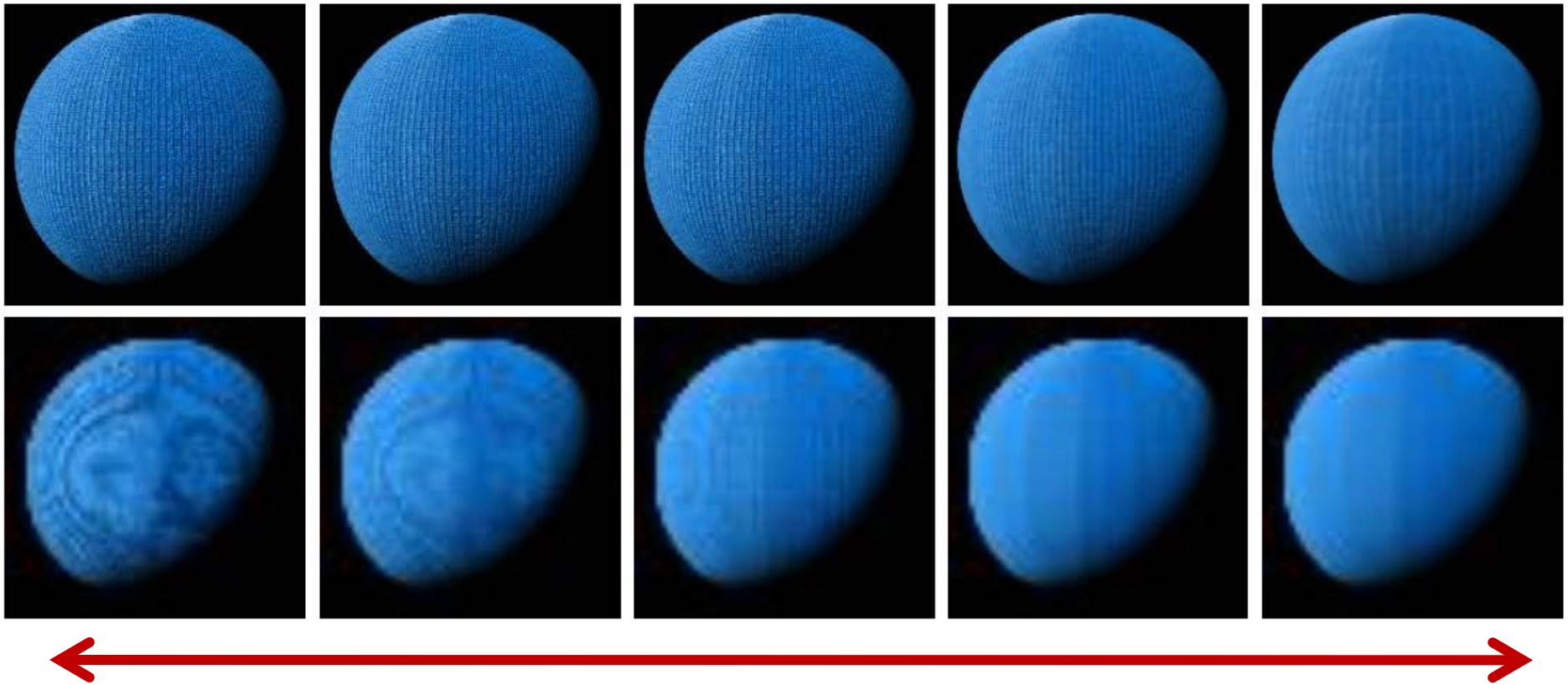
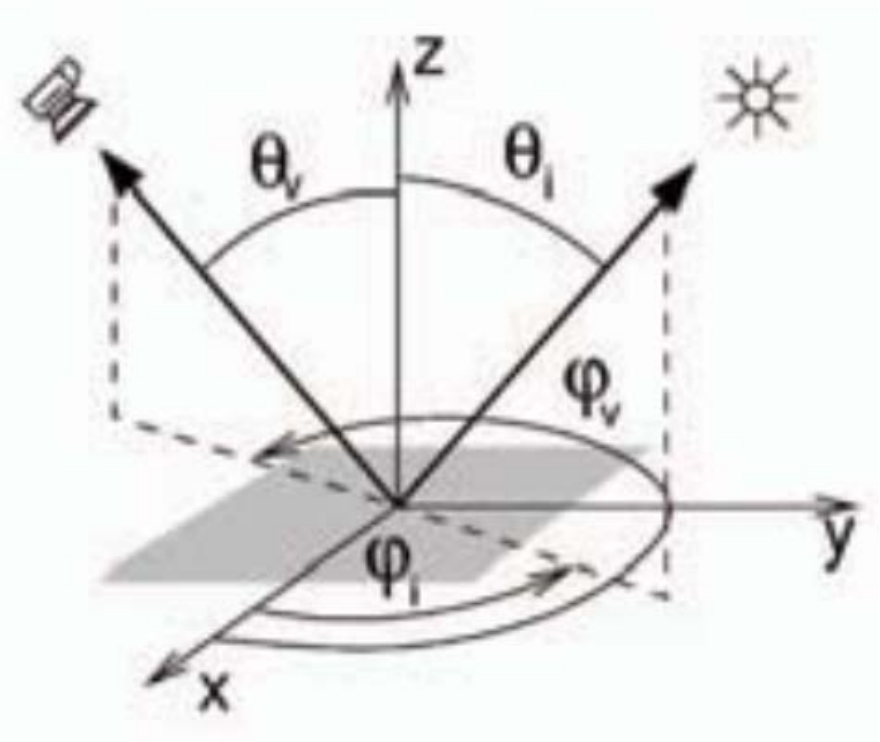


Undersampling (Aliasing)

Over-smooth (Blur)

Bidirectional Texture Function

- **Angular-dependent** textures



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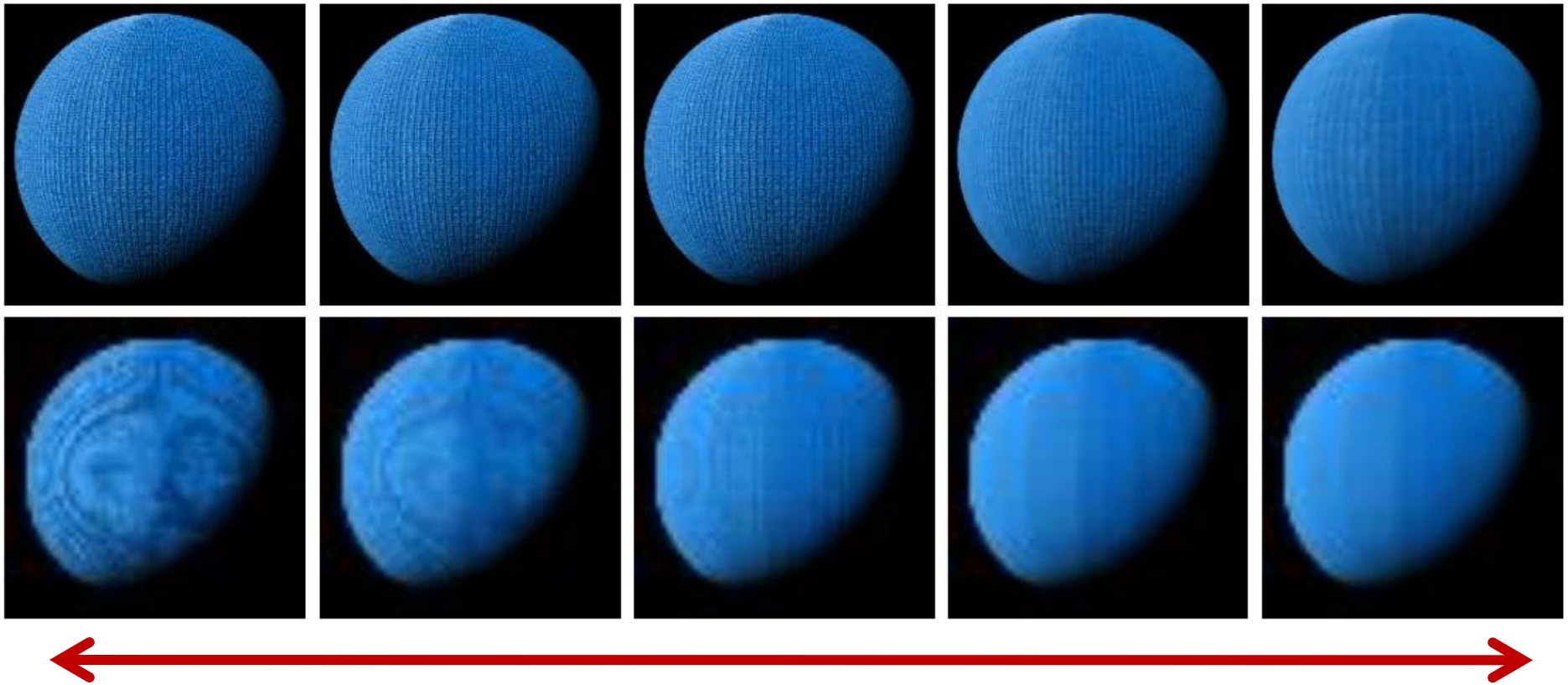
BTF – The problem of filtering



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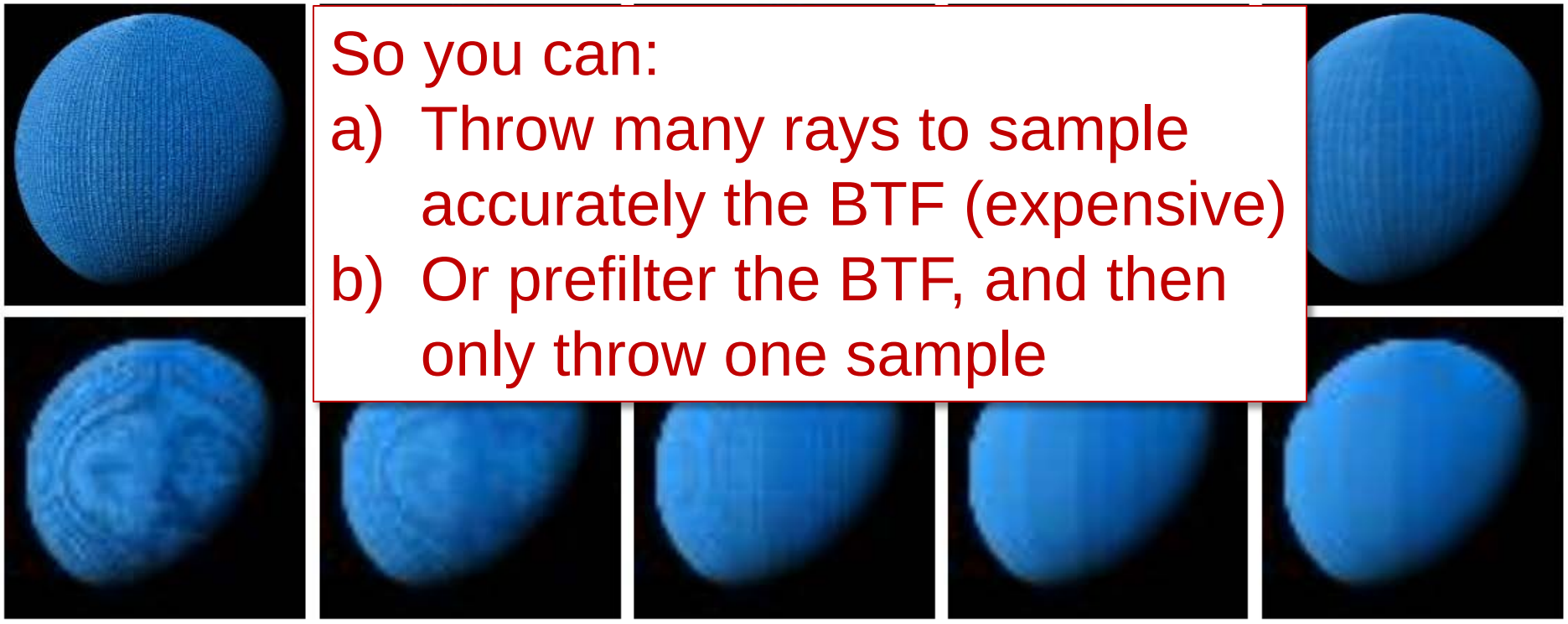


So you can:

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 equivalente** 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?

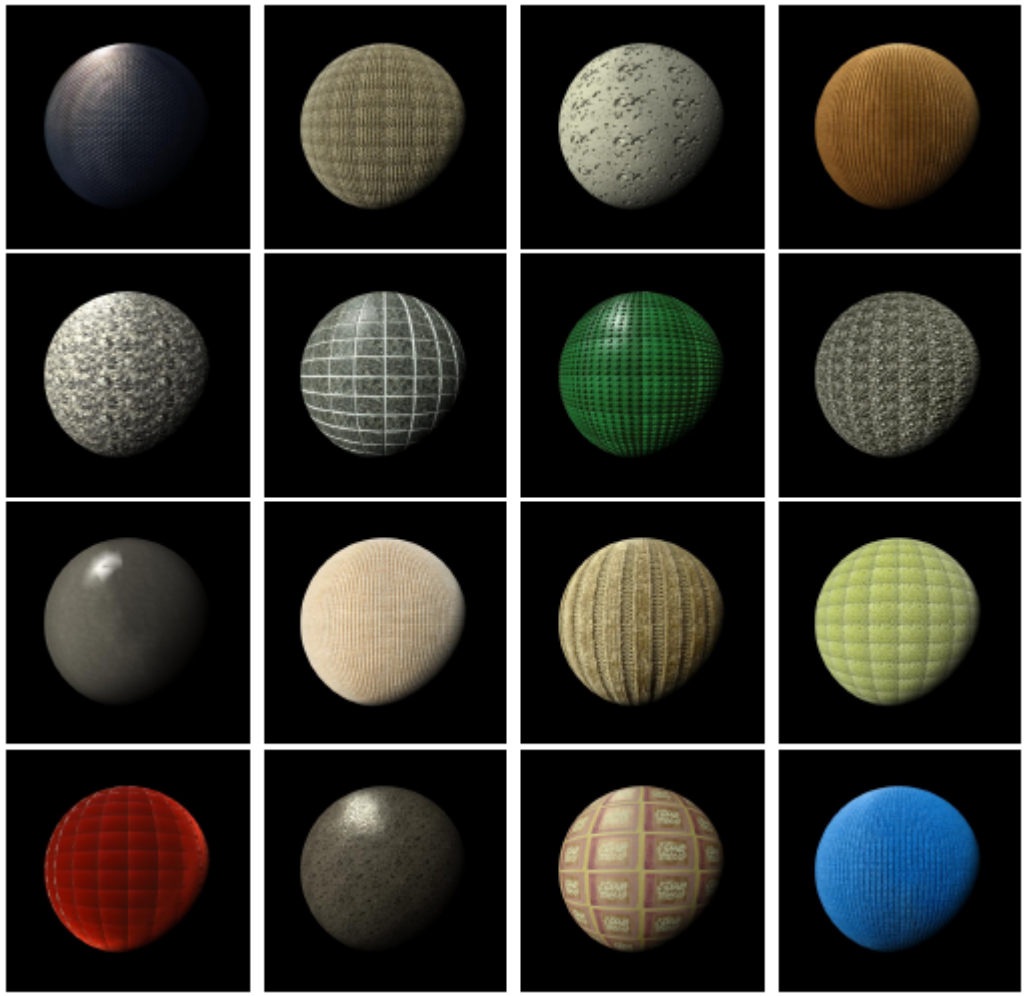
Perceptual Experiments

- **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

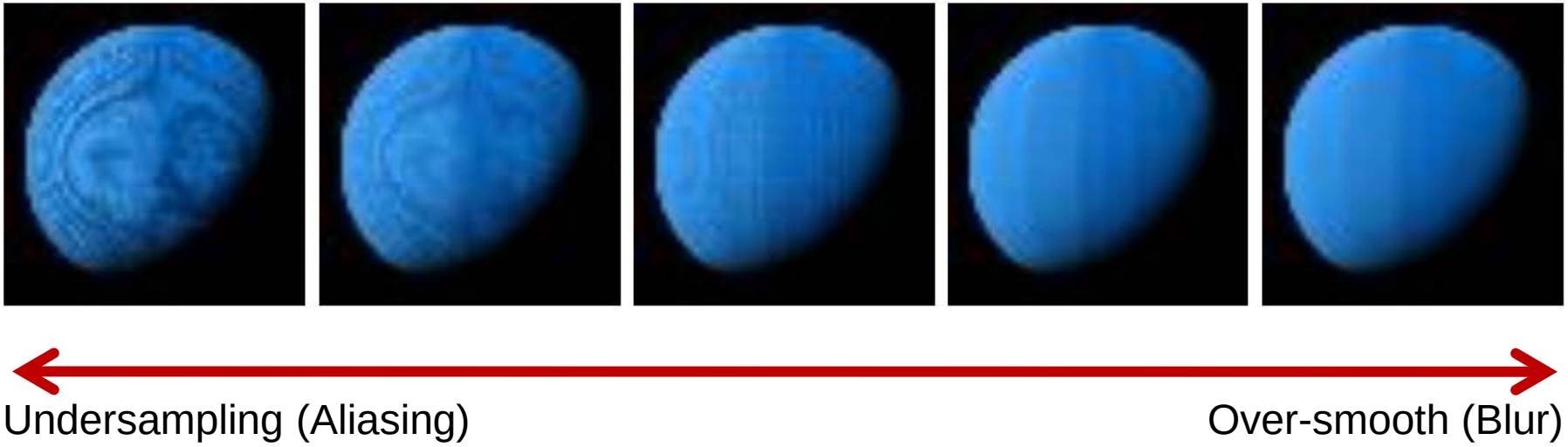


Perceptual Experiments

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

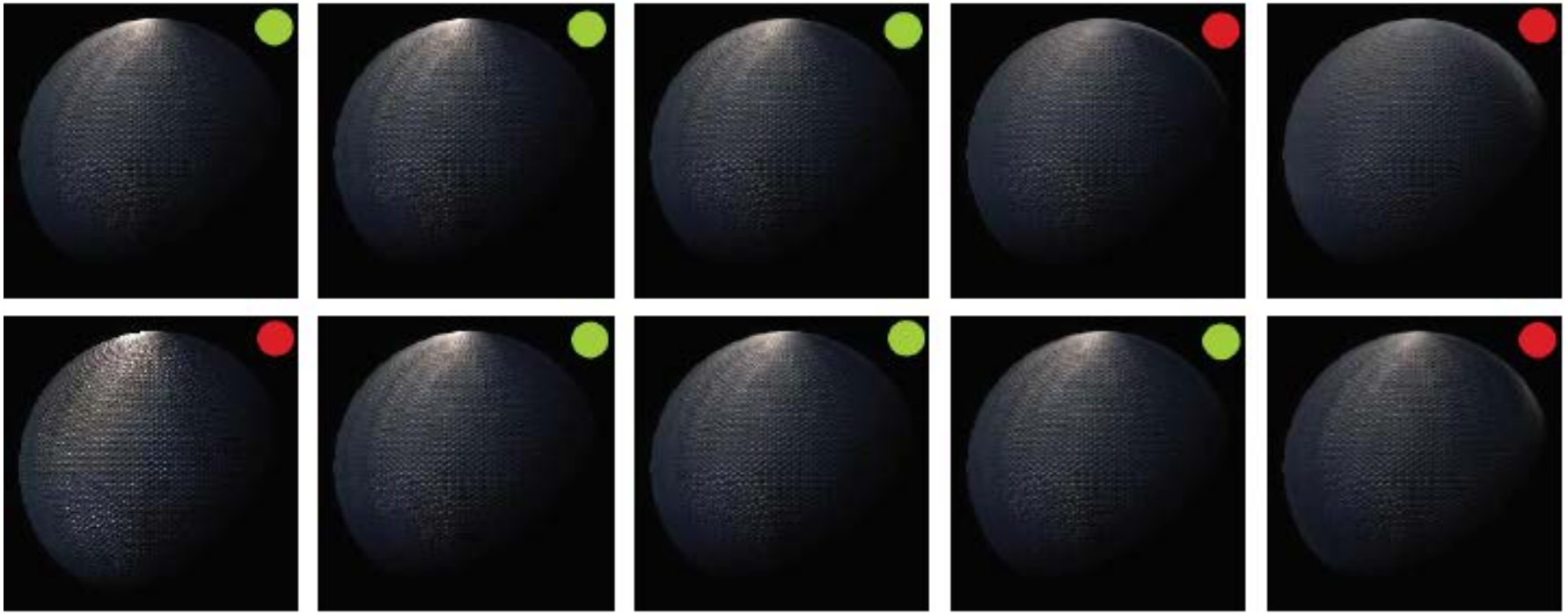
Perceptual Experiments

Spatial domain



Perceptual Experiments

Angular domain

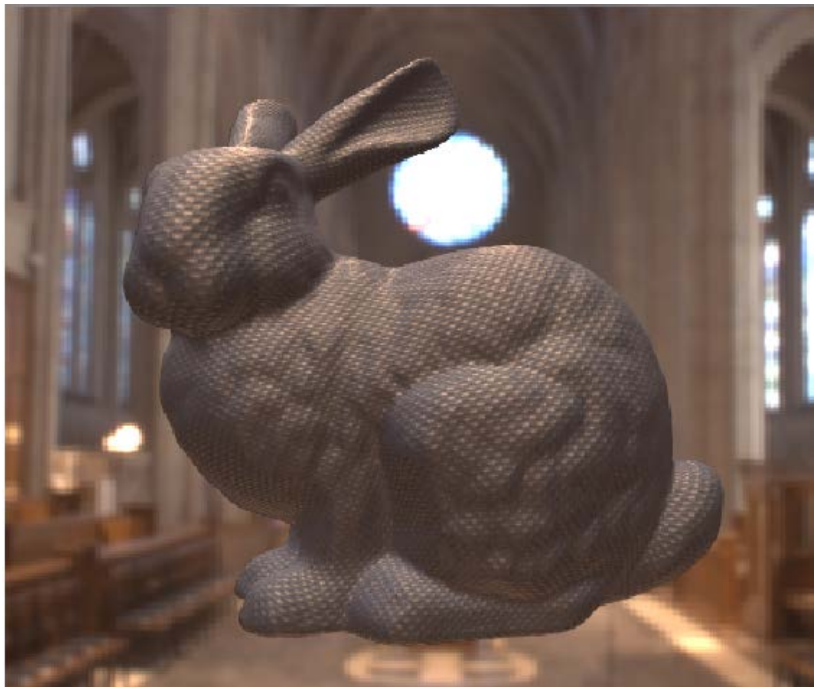


Undersampling (Aliasing) Over-smooth (Blur)

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)

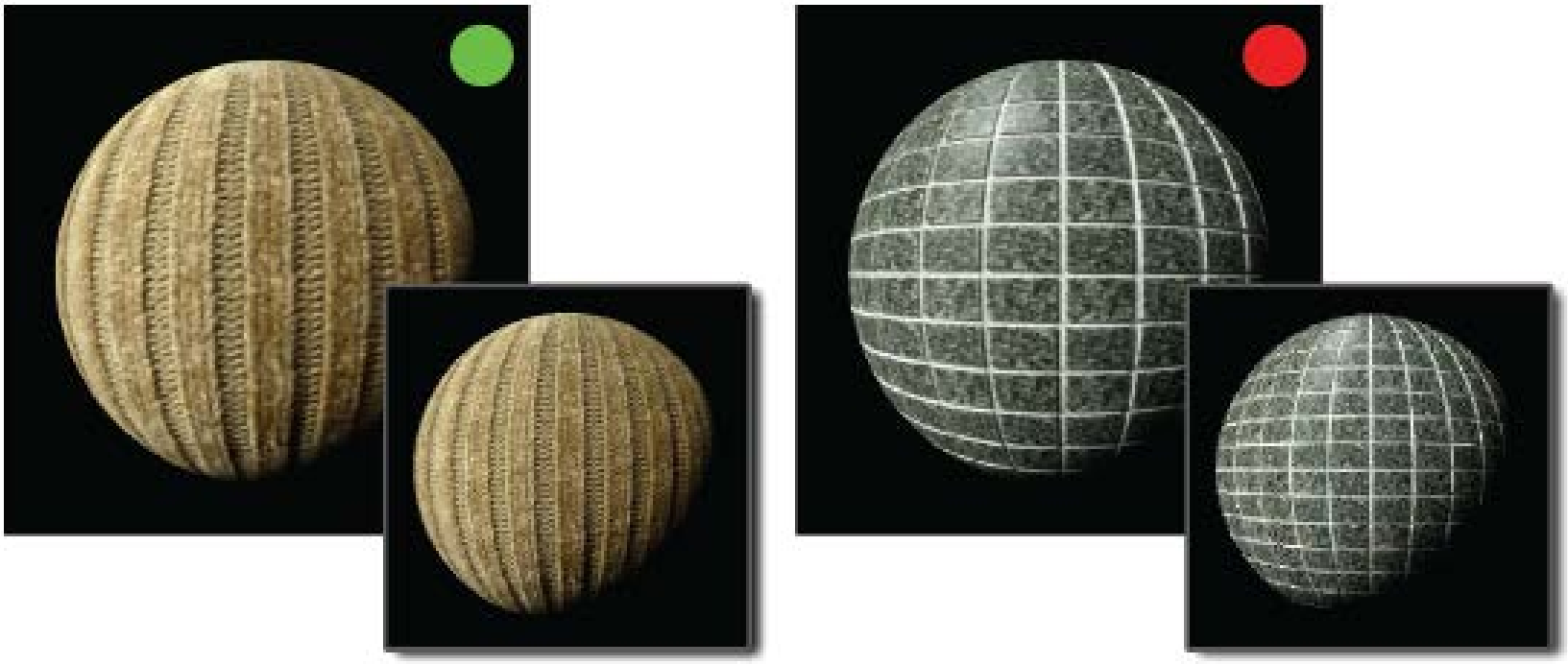
- **Aliasing** (contrast) is preferred in **static** scenes…
- … in contrast, **oversmooth** appearance is preferred for **dynamic** scenes.
- The **angular** domain supports for **more aggresively pre-filter** than the spatial domain.

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?



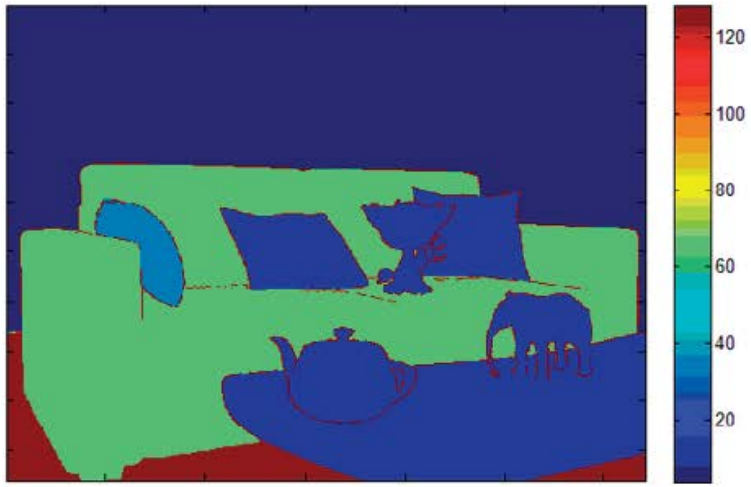
Applications

- 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 aggresively 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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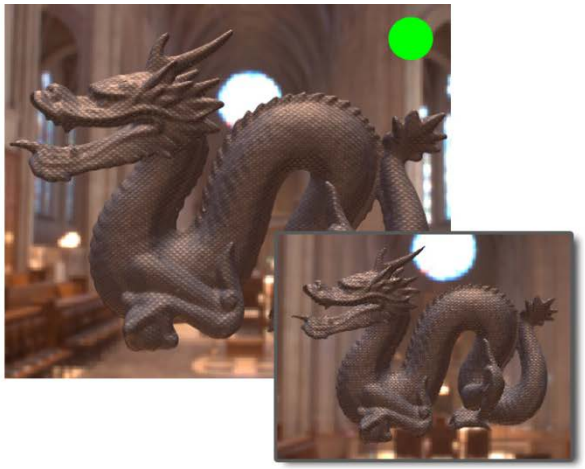
Conclusions

- **Approximate pre-filtering** can be applied to BTF without sacrificing visual quality.
- 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/