

Spatially-Varying Diffuse Reflectance Capture Using Irradiance Map Rendering for Image-Based Modeling Applications

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The figure shows five objects reconstructed using SfM. Left object show reconstructions rendered using the appearance as texture. Right objects shows reconstructions rendered using the reflectance captured using the method proposed in this paper as texture.

The Problem

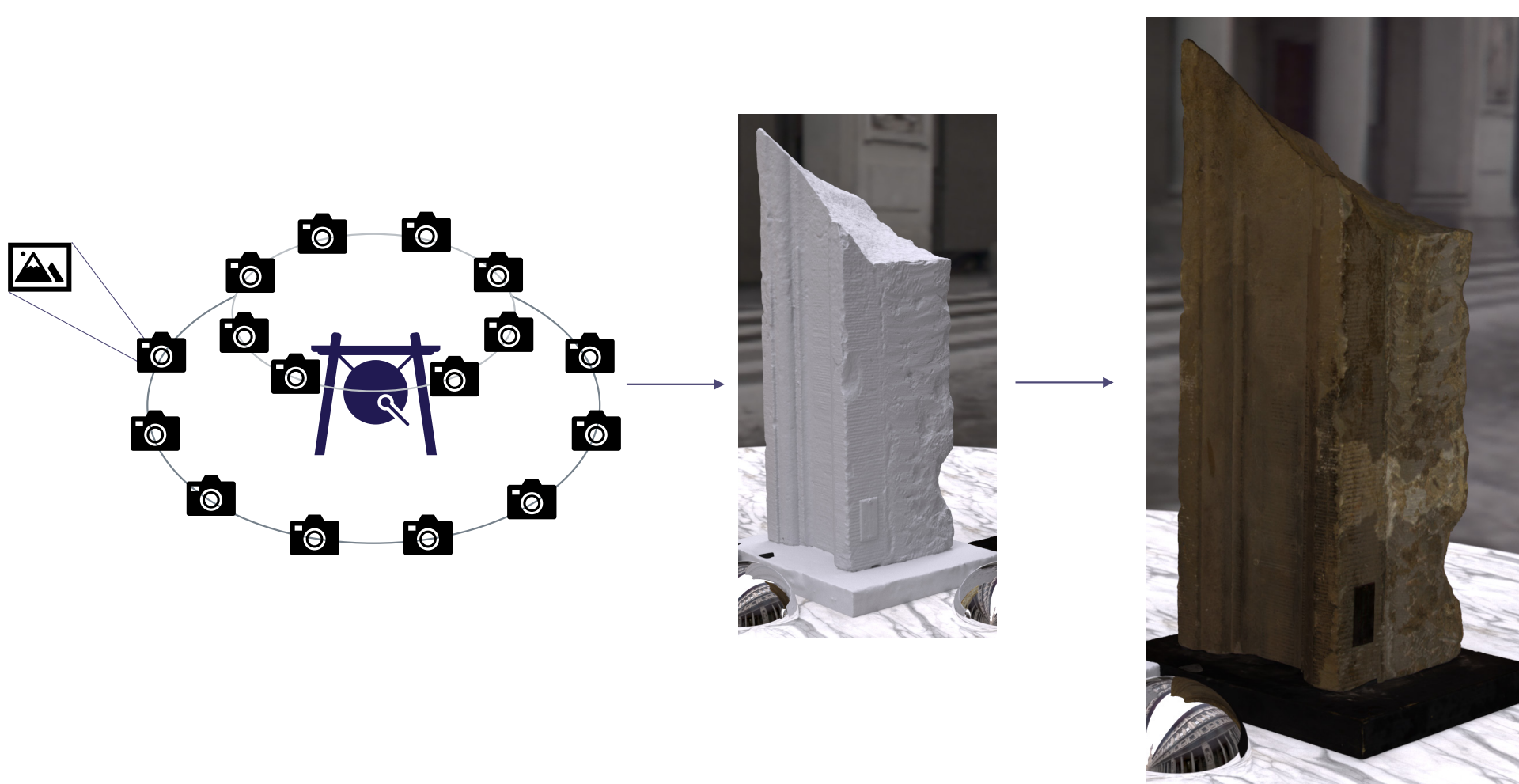
- Structure from motion only results in the appearance from the capture process as “reflectance” hence cannot be used for re-lighting.
- Digitization of objects reflectance are either perception based or requires specialized, usually large, equipment.

Augmented SFM

- Augment classical structure from motion with an image containing a known light source.

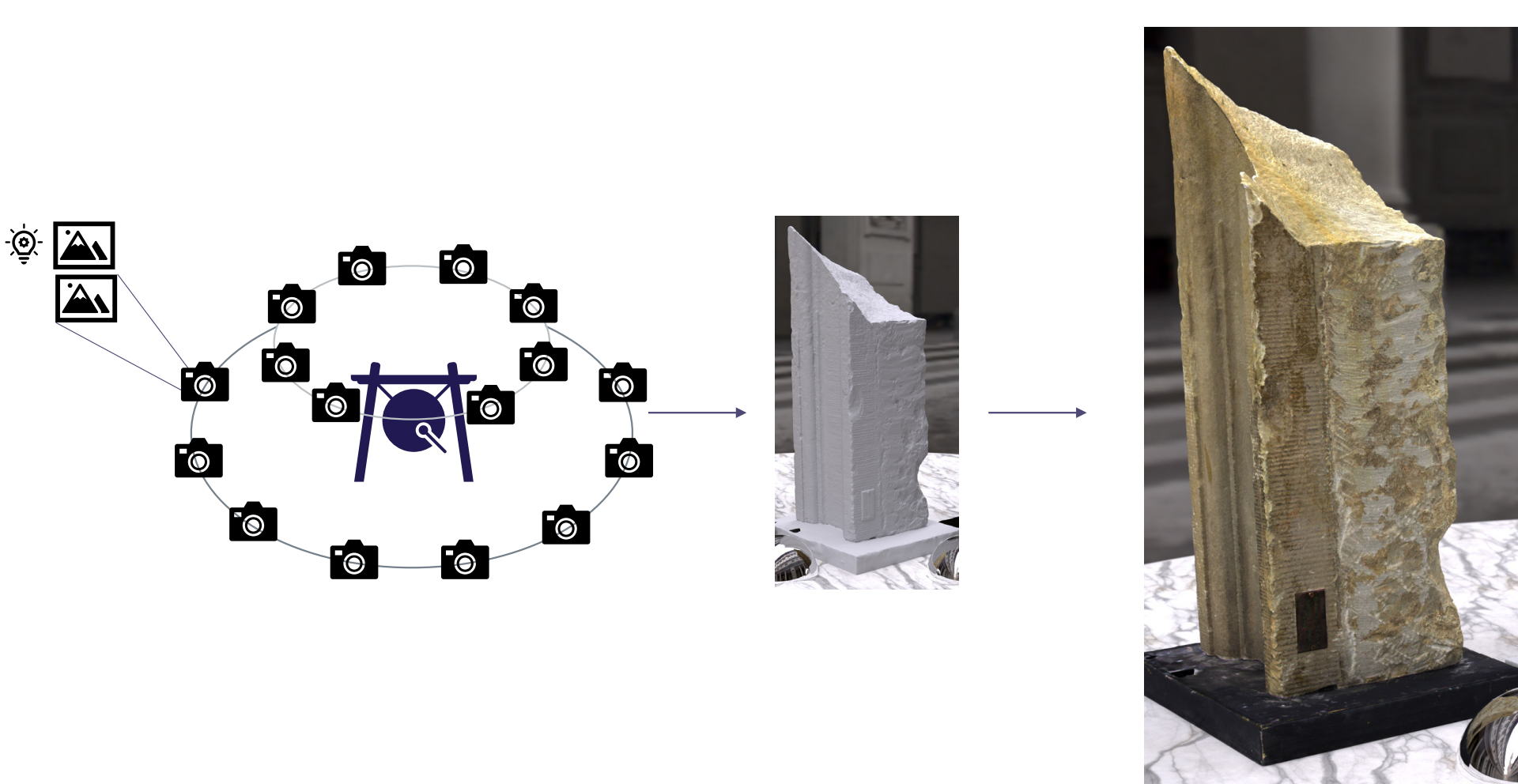
$$\frac{\rho_d(x)}{\pi} = \frac{\frac{S_u}{S_{u+f}} \cdot P_{u+f}(x) - P_u(x)}{P_i(x)}$$

Classical SFM



Normal structure from motion process. Capture one image at each location, calculate 3D model, and project appearance images as “reflectance”.

Augmented SFM



Our “augmented” structure from motion process. Capture two images at each location, one with the unknown light, and one including a known light source. Calculate

Results



The figures show the results of capturing the same object in three different environments. Left: Captured inside a lab with static lighting only. Middle: Captured inside seminar room with mixed static and dynamic lighting coming from outside facing windows. Right: Captured outside on a sunny day in the shadow of a building.

Conclusion

- Minimal addition to traditional Structure from Motion Pipeline
- Minimal additional equipment needed
- Improve use of digitized objects
- Unconstrained, unknown illumination conditions

References

Ladefoged, K. S., & Madsen, C. B. (2020). Spatially-Varying Diffuse Reflectance Capture Using Irradiance Map Rendering for Image-Based Modeling Applications. I 2019 IEEE International Symposium on Mixed and Augmented Reality (s. 46-54). [8943701] IEEE Computer Society Press. <https://doi.org/10.1109/ISMAR.2019.00-27>