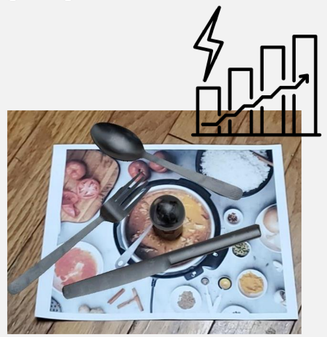
Energy and Quality Trade-offs for Augmented Reality Systems

Emily Port, Jinhan Hu, Robert LiKamWa

Arizona State University

Motivation

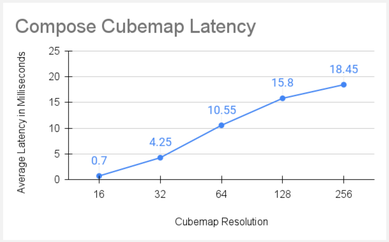
- Lighting for augmented reality is crucial for making an object in a scene look realistic
- Current systems such as GLEAM[1] are able to accurately replicate the lighting of an environment
- AR with lighting estimation is energy intensive, so trade-offs are necessary to make the framework useful for mobile devices



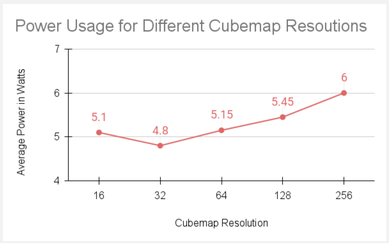
This is an example of high-quality lighting estimation

Cubemap resolution can be manipulated to **balance the energy consumption** and **realism** of lighting estimation frameworks

Resolution Performance



- Latency is reduced at lower resolutions
- Lower resolutions do not provide enough samples of the probe to compose all 6 faces of the cubemap
- Empty faces result in black spots on the virtual object(s) which compromises the quality
- The power usage for 16 pixels strays from the norm because it can update much faster



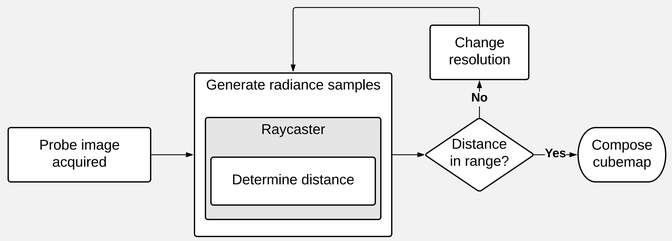
16 Pixels 32 Pixels 64 Pixels 128 Pixels 256 Pixels

Adaptive Resolution Change

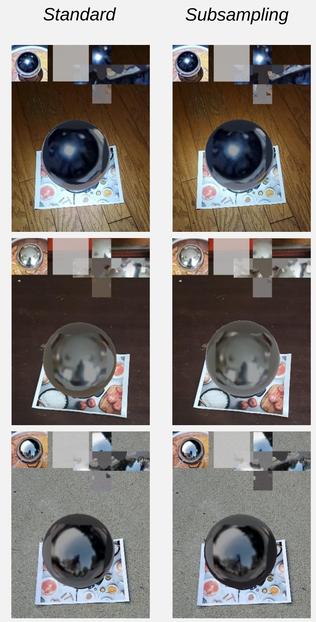
- Resolution needs strongly depend on the camera distance from the probe
- Adaptively changing the resolution based on the current needs can reduce the overall energy consumption

16 Pixels

128 Pixels



Sub-Sampling



- By using a non-discriminative sub-sampling technique to select half of the radiance samples, latency can be improved by 38%
- The visual quality is not significantly impacted using this sub-sampling method

Conclusions

Adjusting the resolution based off current needs and sub-sampling can reduce the energy use of GLEAM without making significant sacrifices in quality.

References

[1] Prakash et al. GLEAM: An Illumination Estimation Framework for Real-time Photorealistic Augmented Reality on Mobile Devices @ MobiSys ‘19

Funded by NSF CNS-1950534