

Adaptive Gating for Single-Photon 3D Imaging

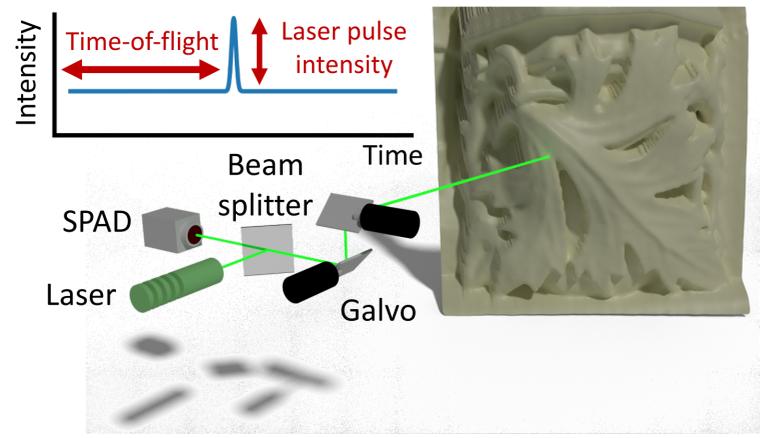
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imaging.cs.cmu.edu/adaptive_gating

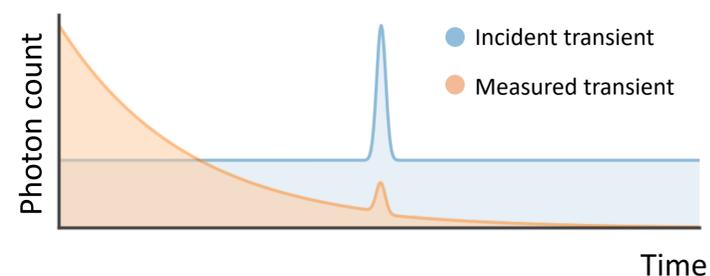


SEE BELOW THE SKIN

3D imaging with SPADs

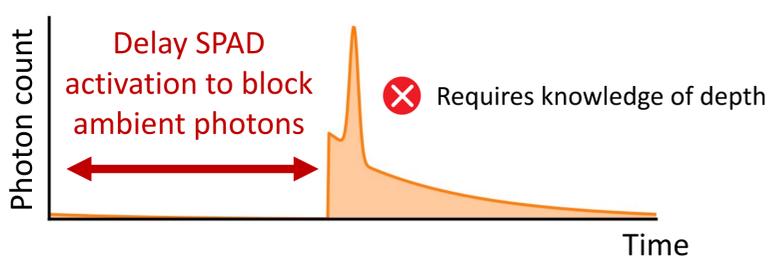


Problem: pile-up distortion

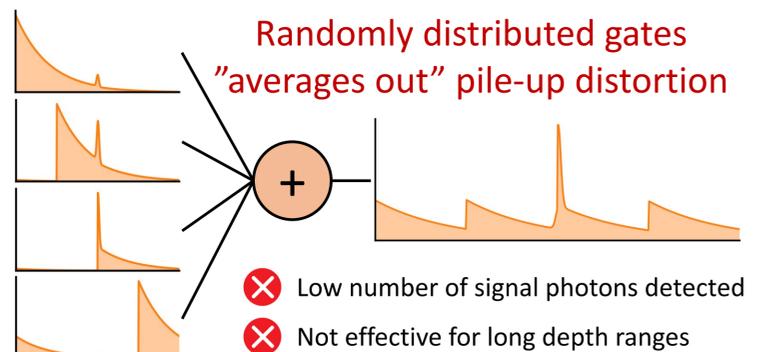


Pile-up mitigation: common approaches

Approach 1: static gating

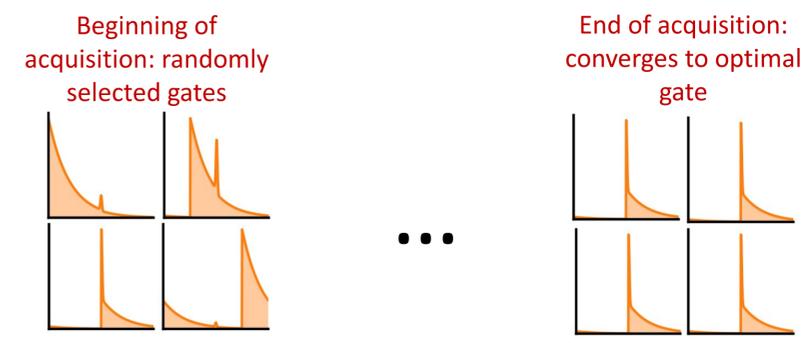


Approach 2: asynchronous gating [Gupta et. al]



Our approach

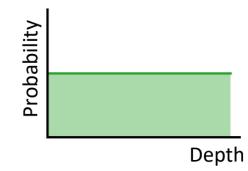
Adaptive gating: changing gate position based on previous photon observations



- ✓ Does not require prior knowledge of depth
- ✓ Effective for long depth ranges
- ✓ Converges to optimal gate (maximizes signal photon detection)

Algorithm: adaptivity through Thompson sampling

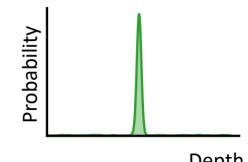
initialize depth distribution (use prior or uniform distribution)



while (SPAD acquiring):

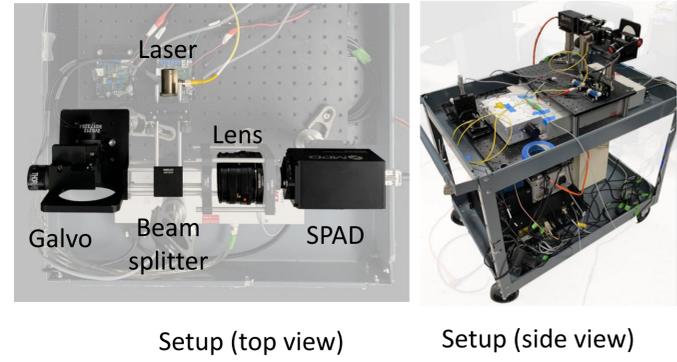
- sample depth distribution
- set gate as sampled depth
- wait for photon detection
- update distribution

recover depth from converged depth distribution (or stop acquisition early when confident)

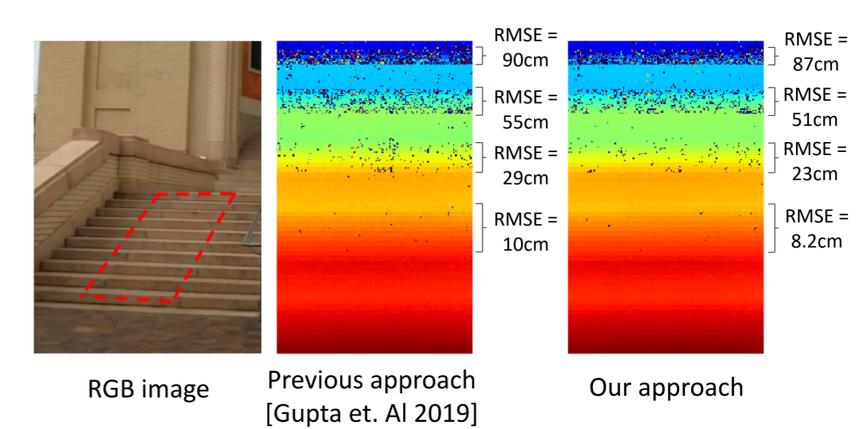


Measured data experiments

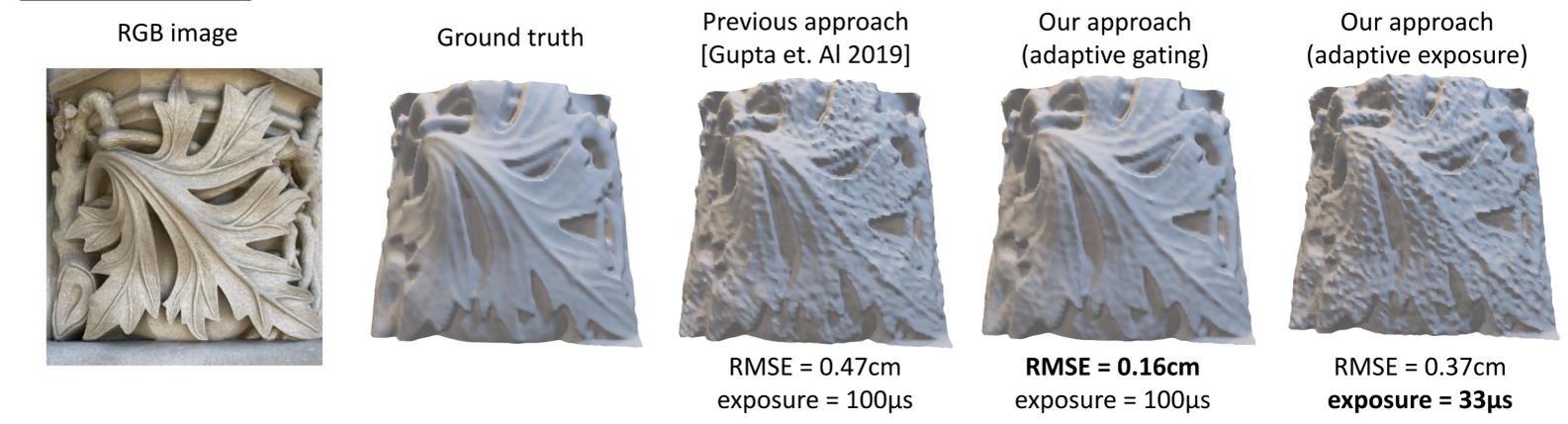
Hardware prototype: mobile setup for capturing outdoor scenes



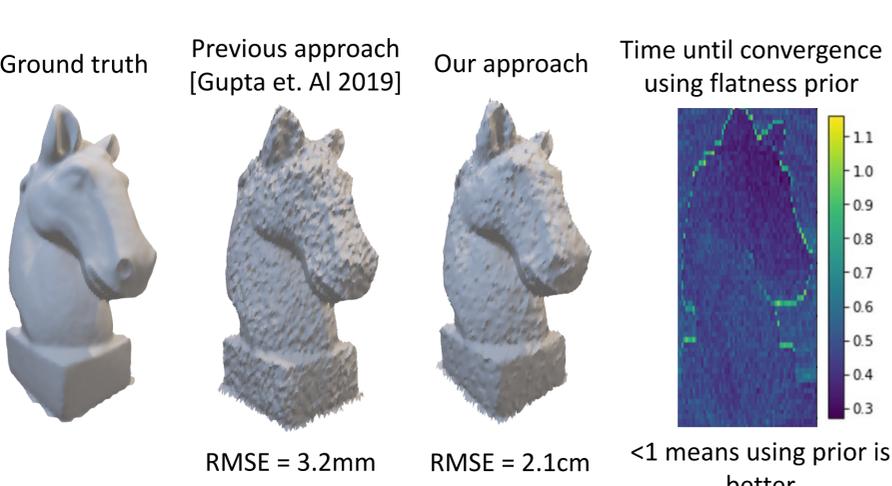
Outdoor scene: stairs



Outdoor scene: leaf



Indoor scene: horse



Indoor scene: office (using depth prior)

