MIT Media Lab | Camera Culture

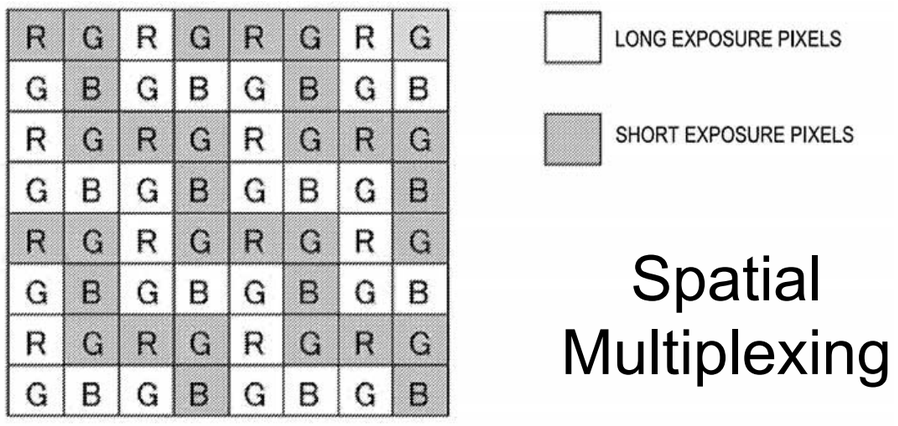
Unbounded High Dynamic Range Photography

Hang Zhao, Boxin Shi, Christy Fernandez-Cull, Sai-Kit Yeung and Ramesh Raskar

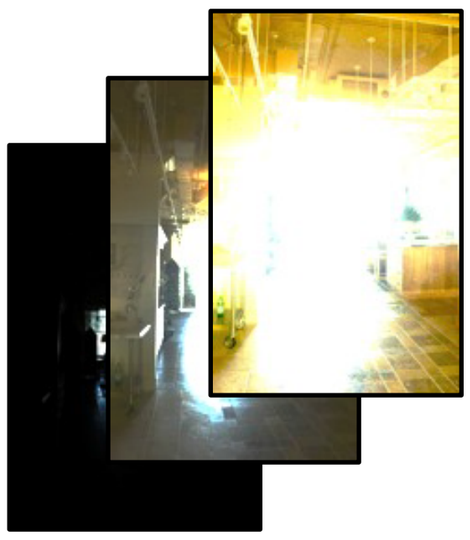
ICCP 2015
Best Paper Runner-up

❑ Background

✧ High Dynamic Range (HDR) Photography is the technique that preserves both bright and dark details in a photo. Among traditional solutions, however, there is a fundamental **Trade-off** between ***Resolution*** & ***Time***!



Spatial Multiplexing



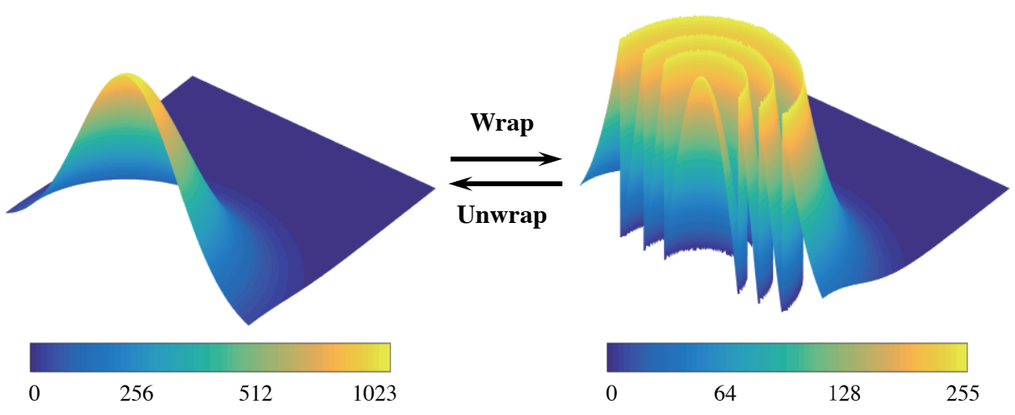
Temporal Multiplexing

❑ Our Solution

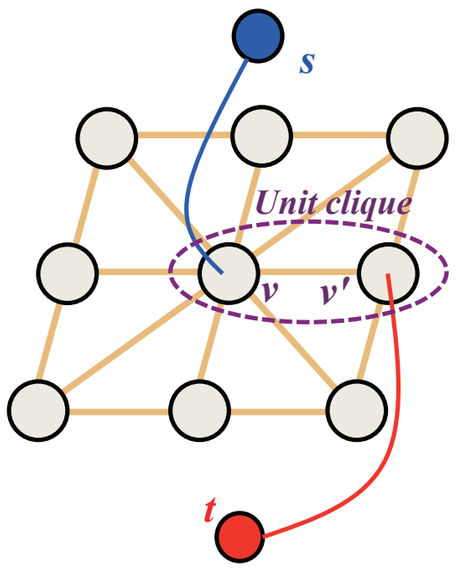
✧ We propose a modulo camera that takes the modulus image of scene radiance with co-design of hardware and software.

Modulo Camera

$$I_m(x,y) = \mathrm{mod}(I(x,y), 2^N)$$



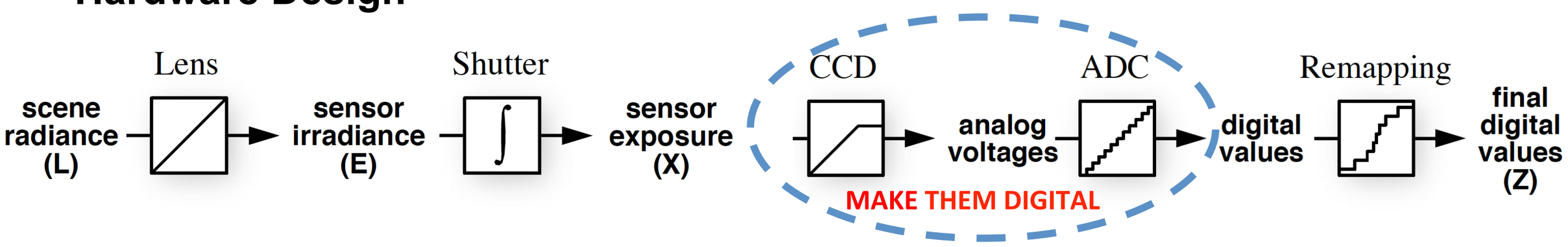
Software Algorithm



Markov Random Field
with 8 neighbors
Optimization with Graph Cuts

$$C(k|I_m) = \sum\nolimits_{(i,j)\in\mathbb{G}} V(|\hat{I}_i - \hat{I}_j|)$$

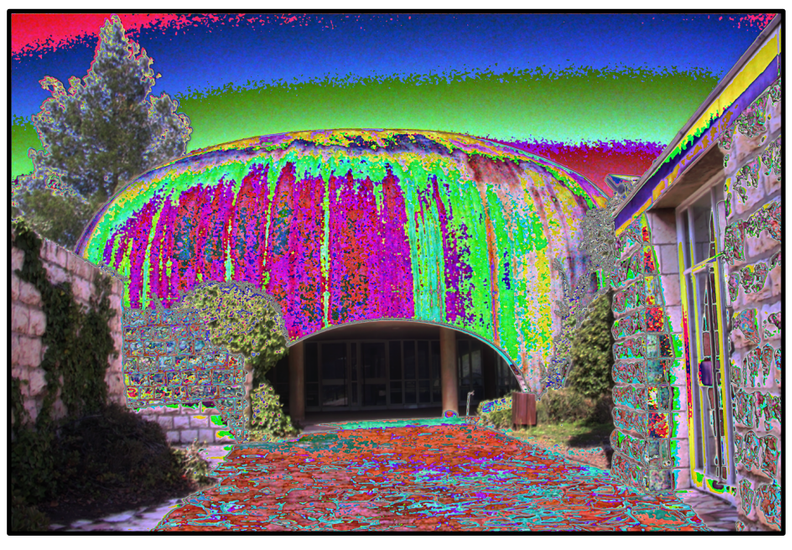
Hardware Design



❑ Results

Intensity camera

Modulo camera



Recovered (tone mapped)