Computational Photography with Novel Camera Sensors

Smart photography solutions for the future
Hang Zhao, Boxin Shi and Ramesh Raskar

Unbounded High Dynamic Range (UHDR) Photography

- **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 Trade-off between Resolution & Time!

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

![Modulo Camera](image1)

![Software Algorithm](image2)

Hardware Design
- **Lens**
- **Shutter**
- **CCD**
- **ADC**
- **Remapping**

Intensity camera Modulo camera Recovered (tone mapped) Modulo camera Recovered

![Results](image3)

Sub-pixel Layout for Super-Resolution Photography

- **Background**
  - Multi-image super-resolution aims to recover a high-resolution image with multiple low-resolution counterparts.

- **Our Solution**
  - We show a sensor of asymmetric sub-pixel layout would increase the spatial sampling compared to a conventional sensor.

Pixel Geometry Design
- OTCCD pixel (with 4 sub-pixels) in the octic group

OTCCD images rotated by 0, 90, 180, 270 degrees

- **Comparison**

![Comparison](image4)

<table>
<thead>
<tr>
<th>Super-Resolution</th>
<th>ECCV 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-resolution: 24.39</td>
<td></td>
</tr>
<tr>
<td>Super-resolution: 1.75</td>
<td></td>
</tr>
</tbody>
</table>