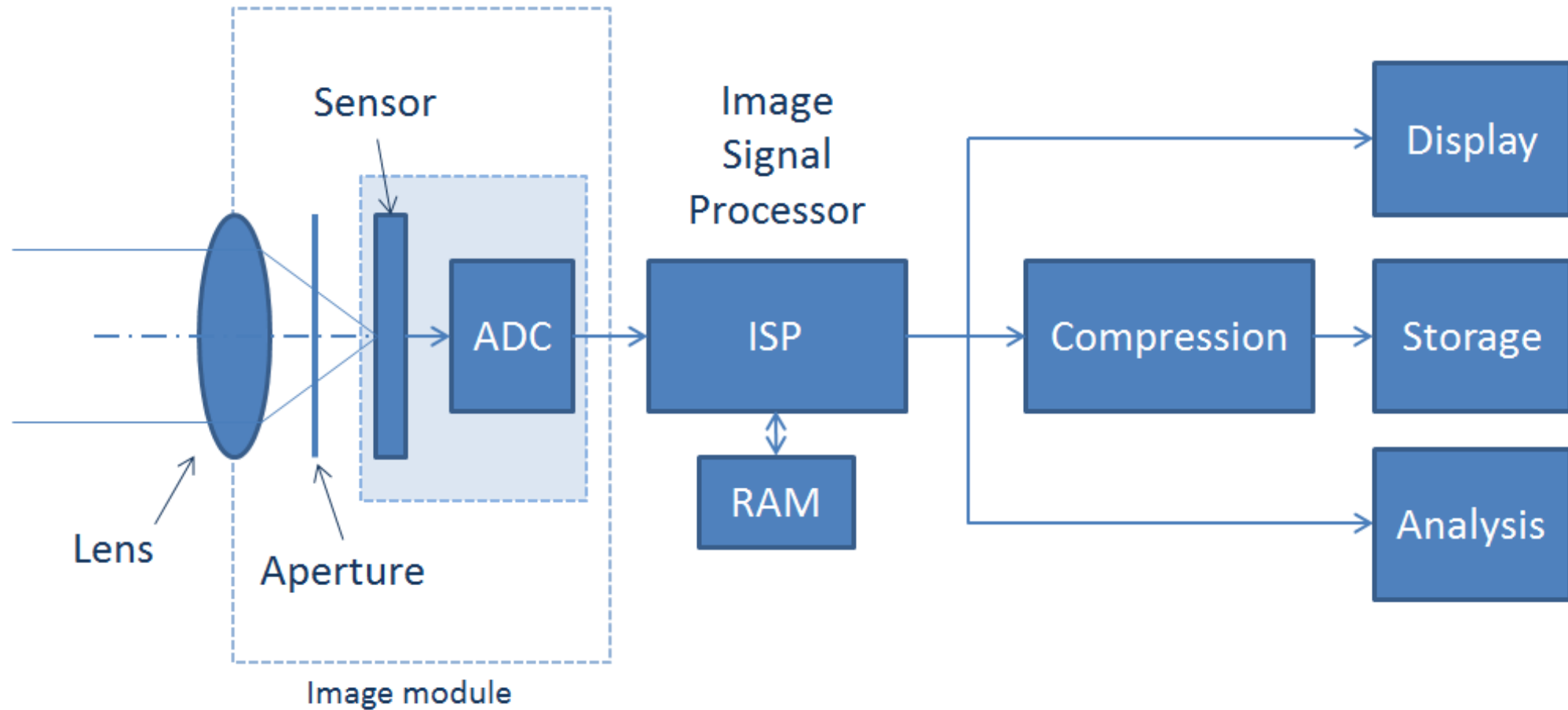


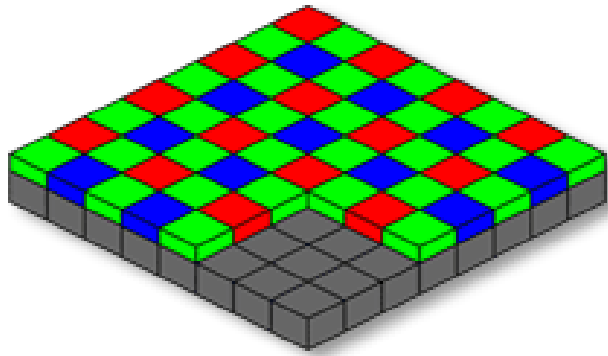
# Computational Photography

Misc topics in

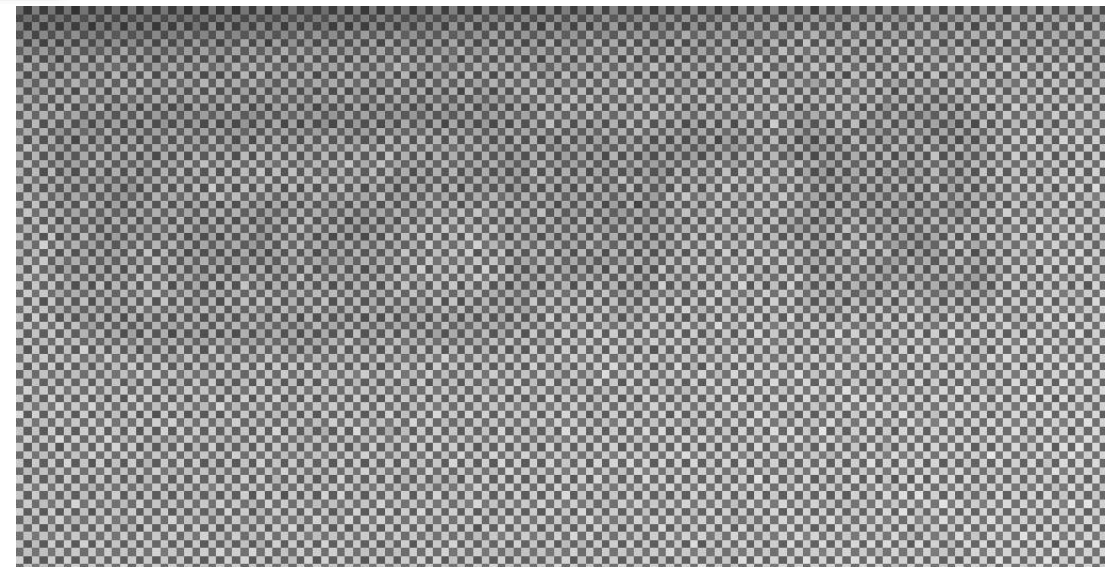
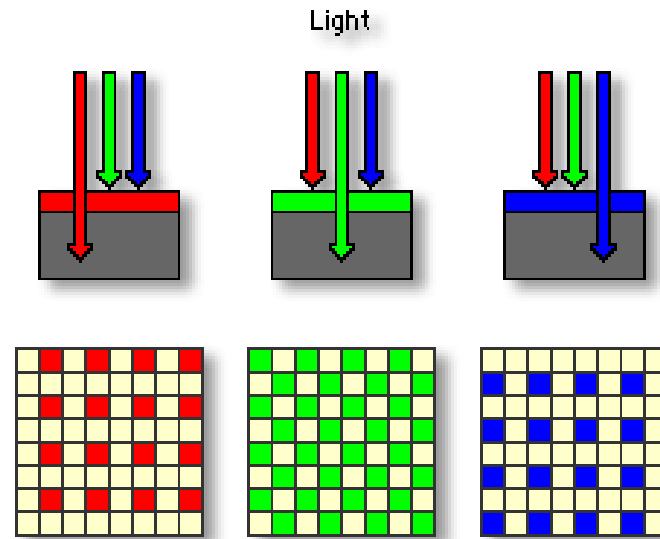
# From Photon to Image



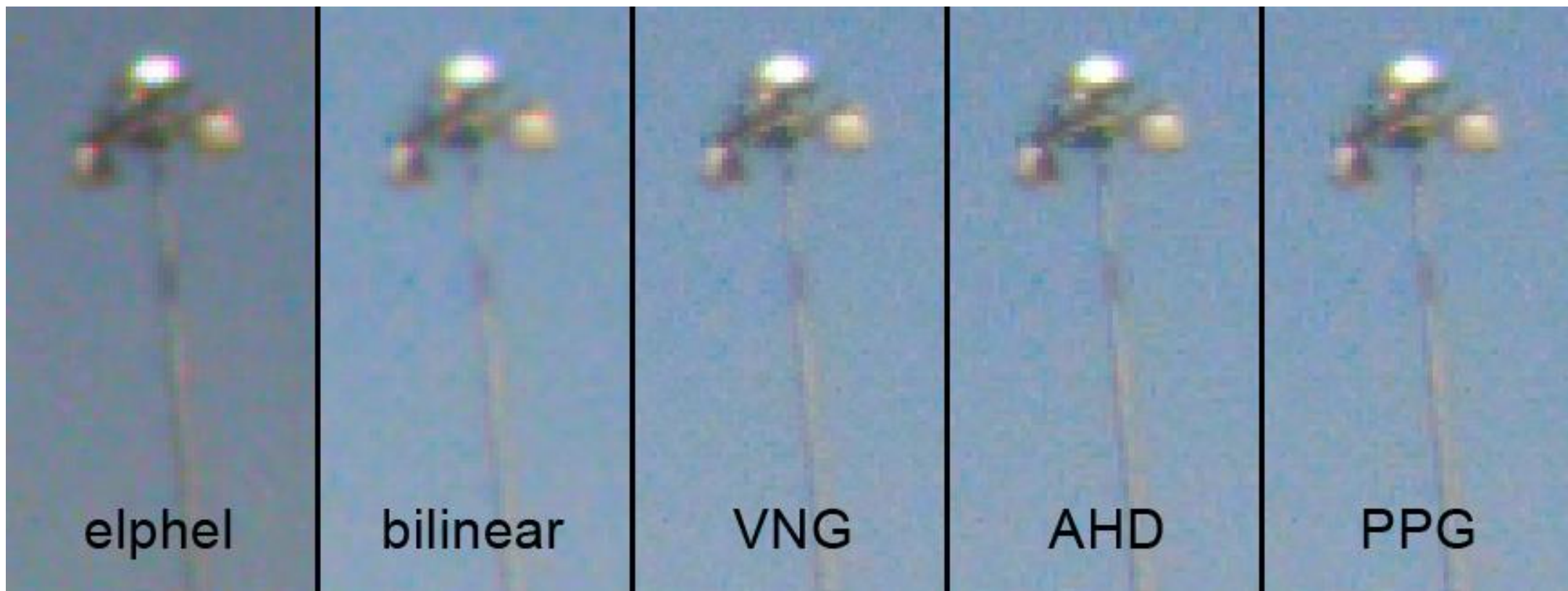
# CFA and Demosaicing



Color Filter Array Sensor



# Algorithms



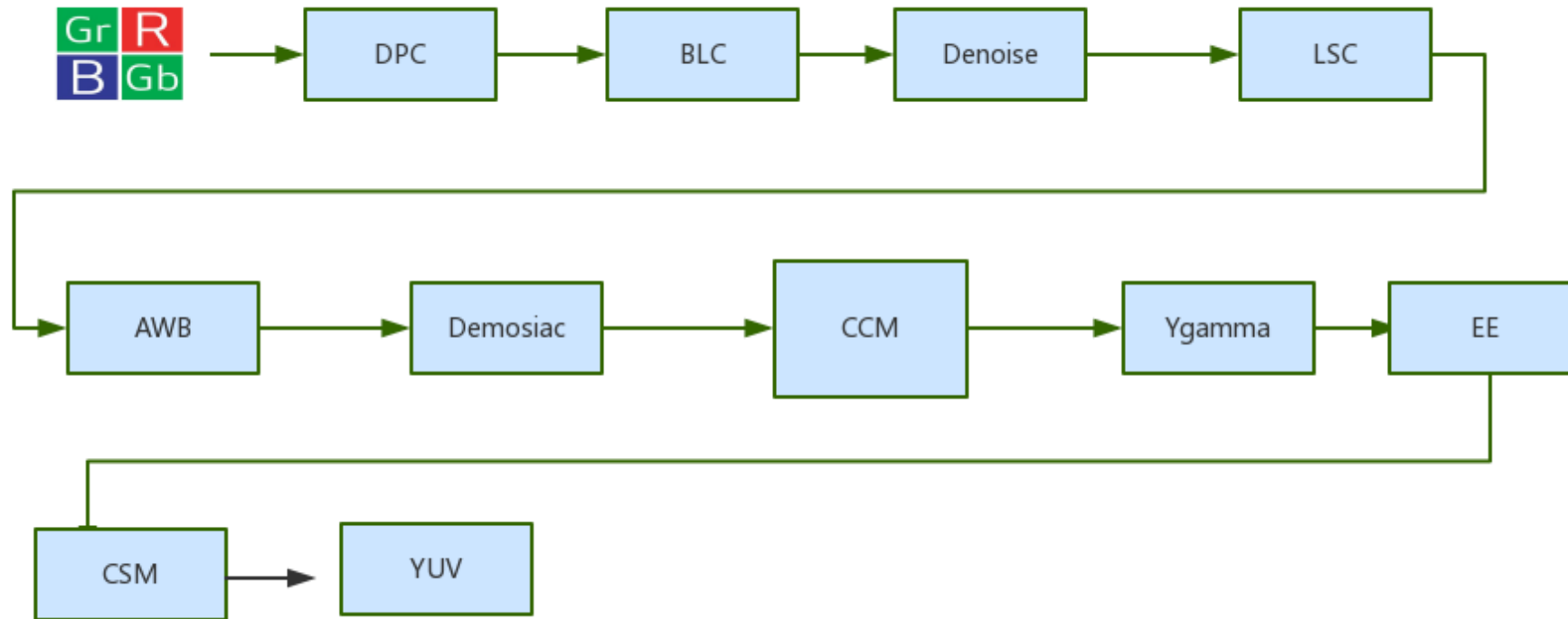
# White Balance

- Gray world, brightest pixel



# Inside an ISP

- Hundreds of tunnable parameters and LUTs.

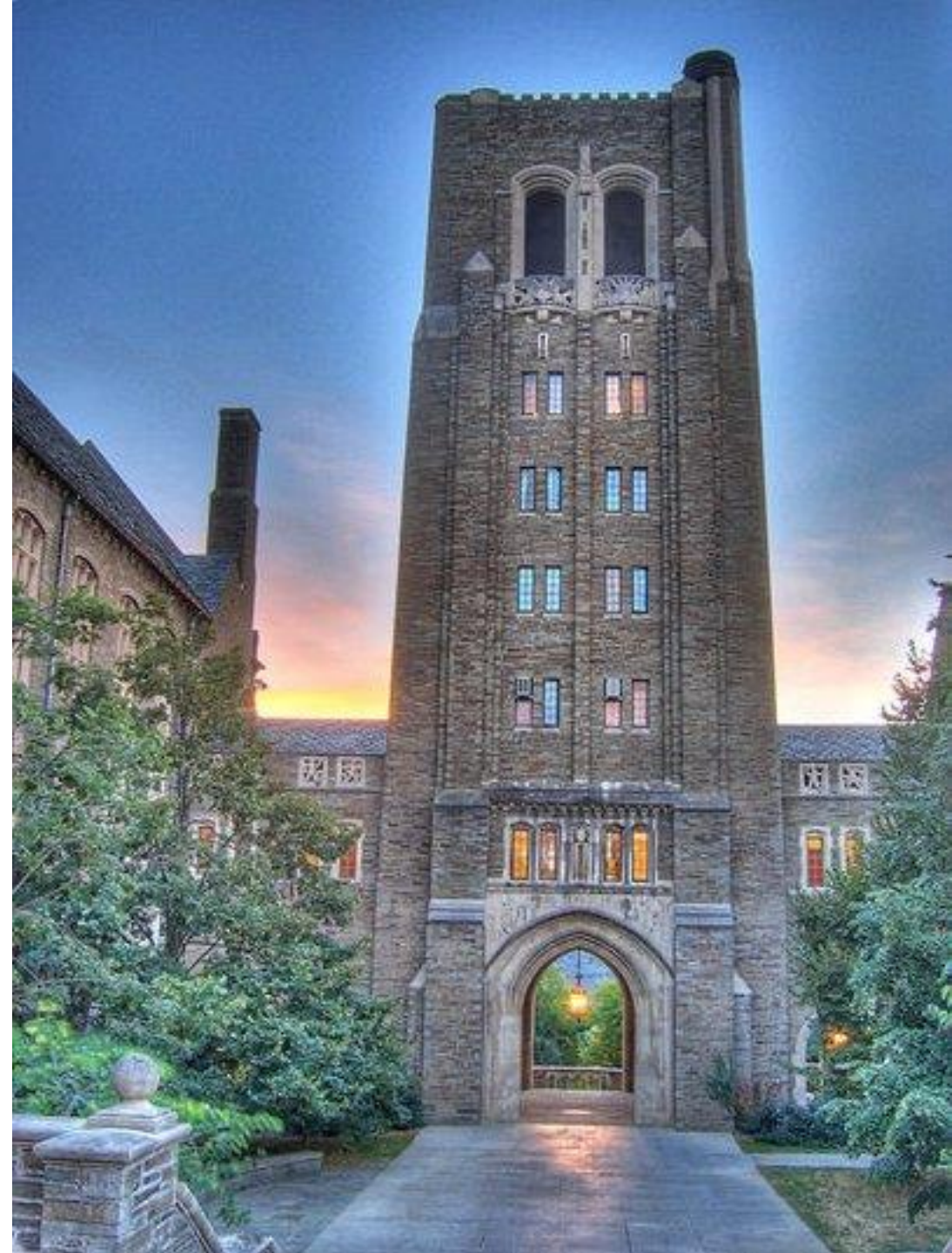




# Tone Mapping & HDR



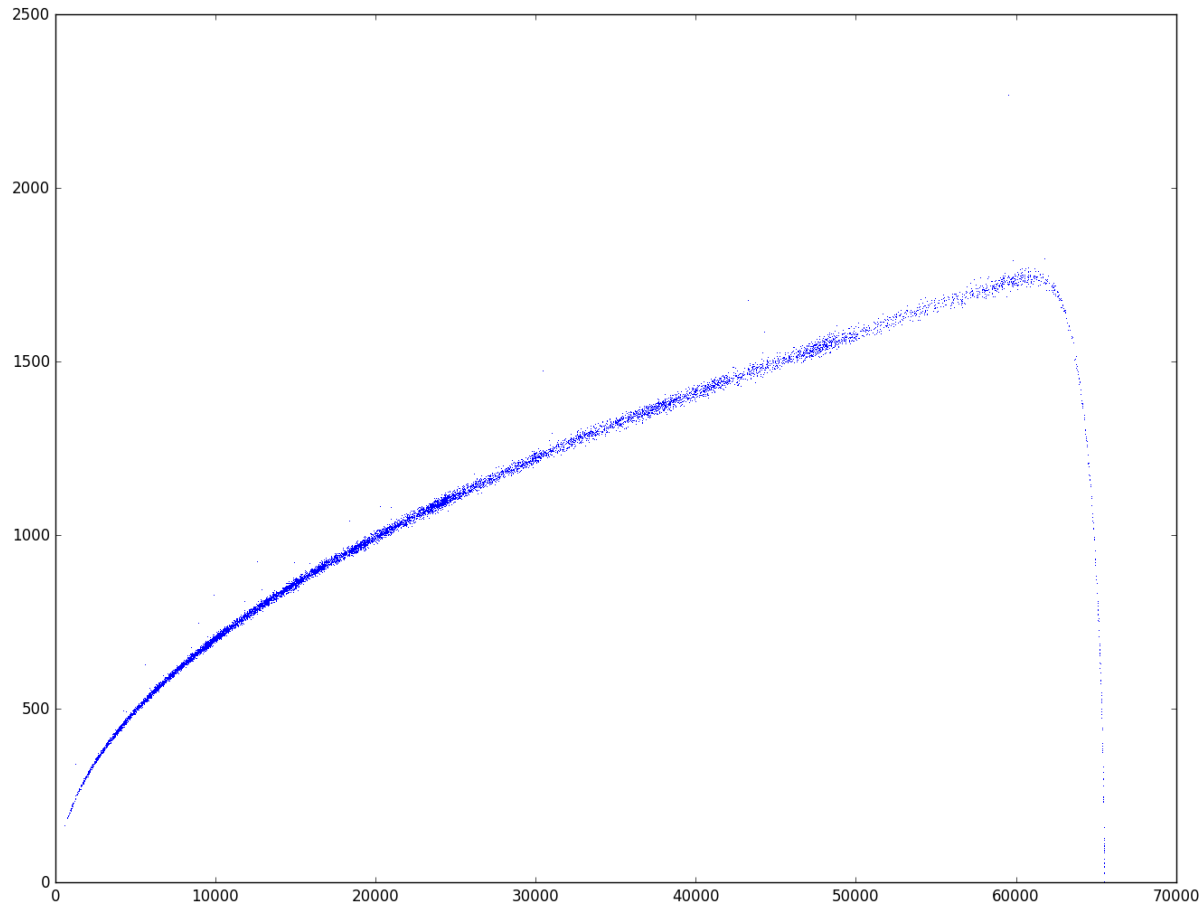
# Local Tone Mapping



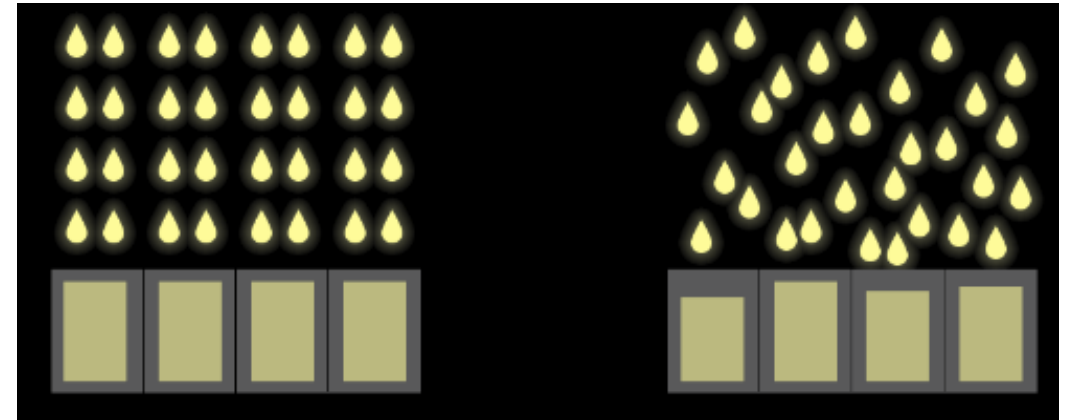




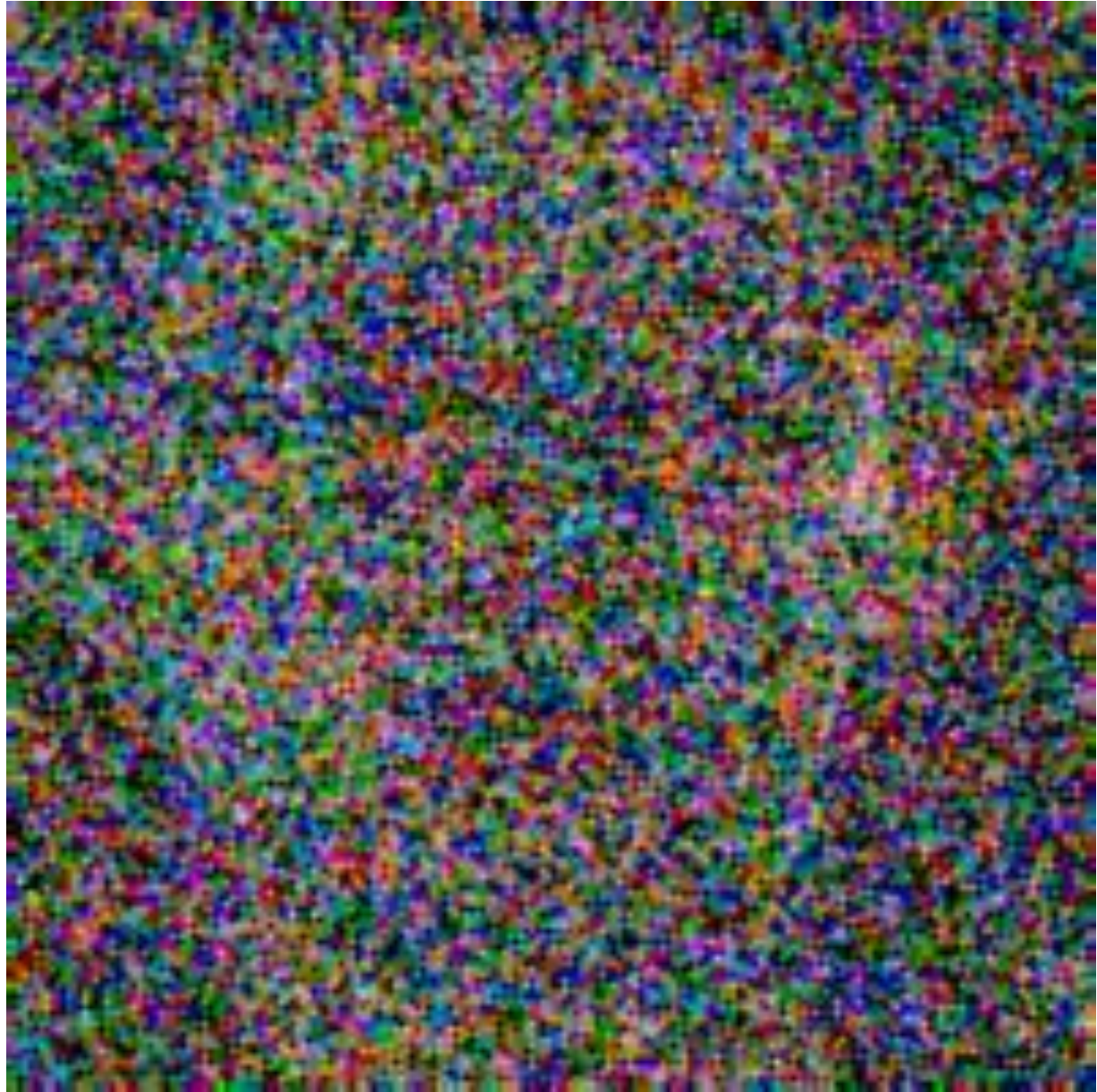
# Noise in Image: Thermal Noise & Photon Noise



$$\overline{v_n^2} = 4k_B T R$$









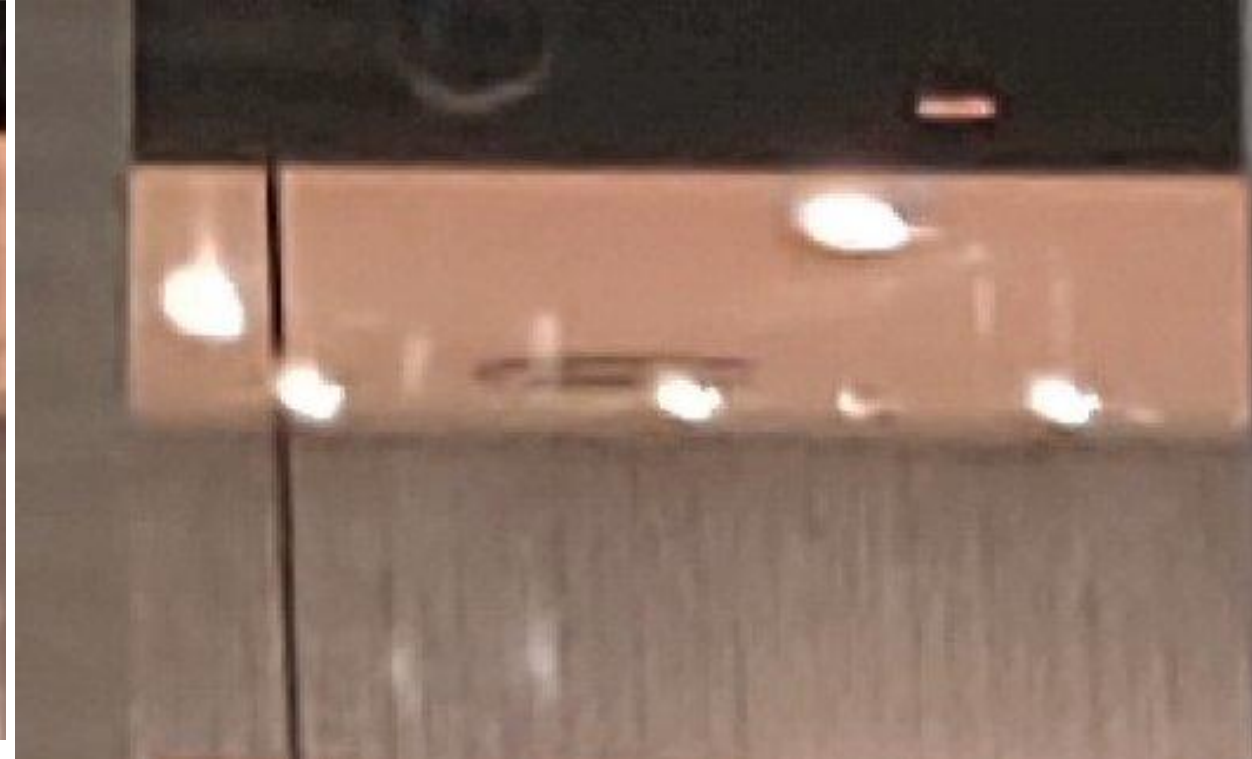
# Denoising by Multi-frame Fusion



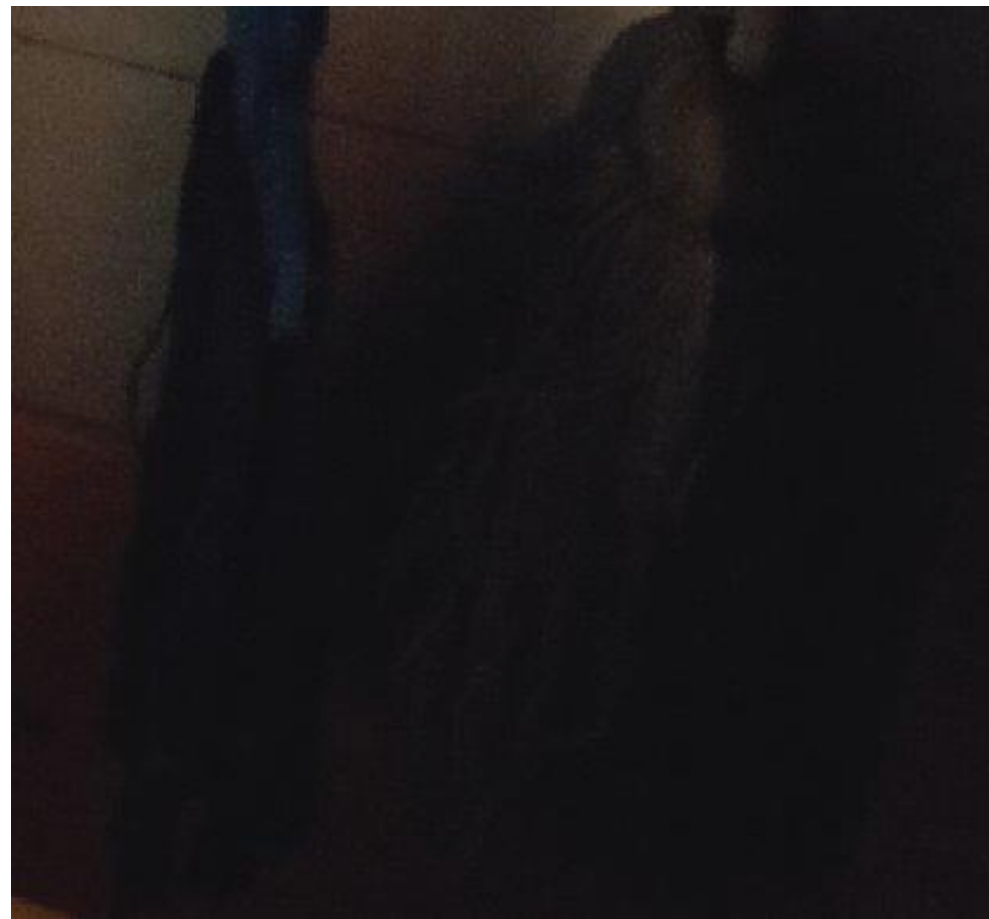
# Denoising by Neural Network



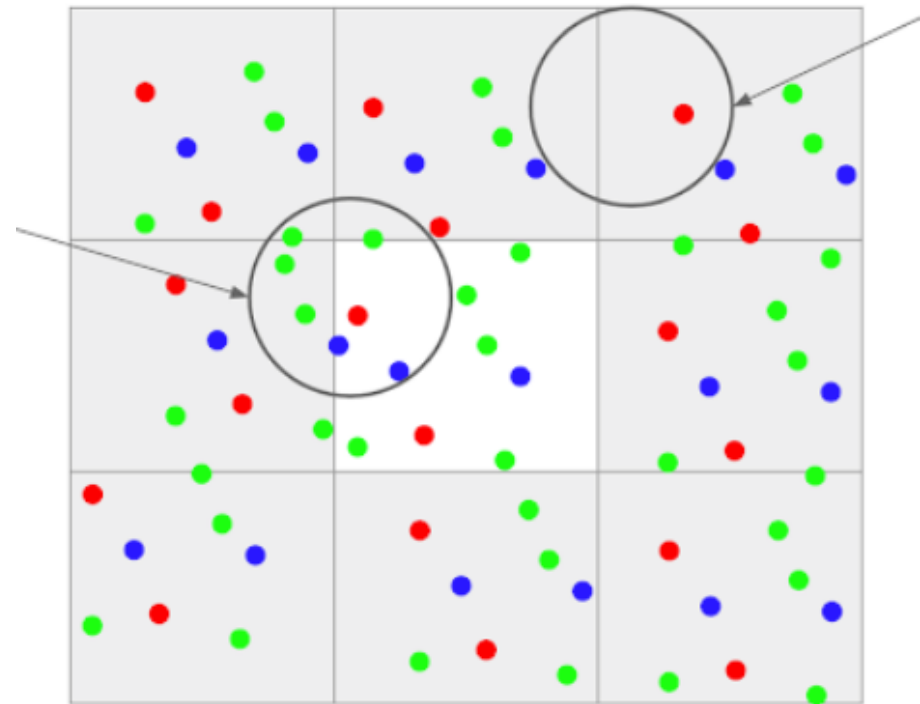




# Seeing in the Dark



# Super Resolution by Subpixel Registration

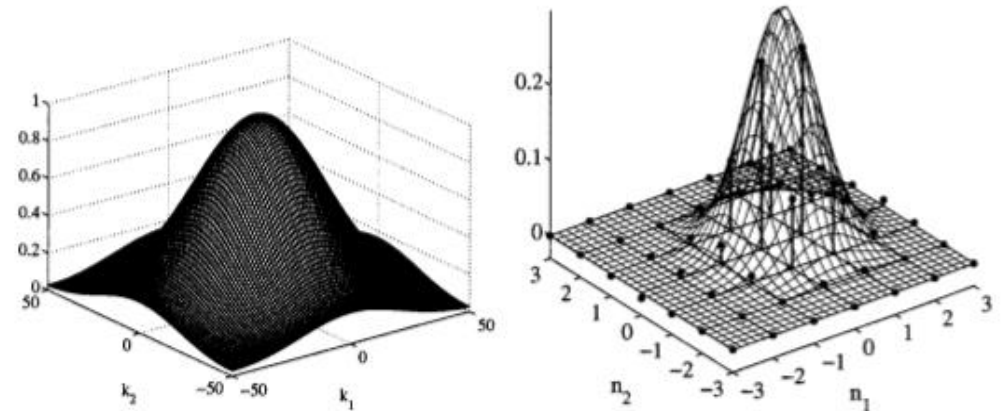
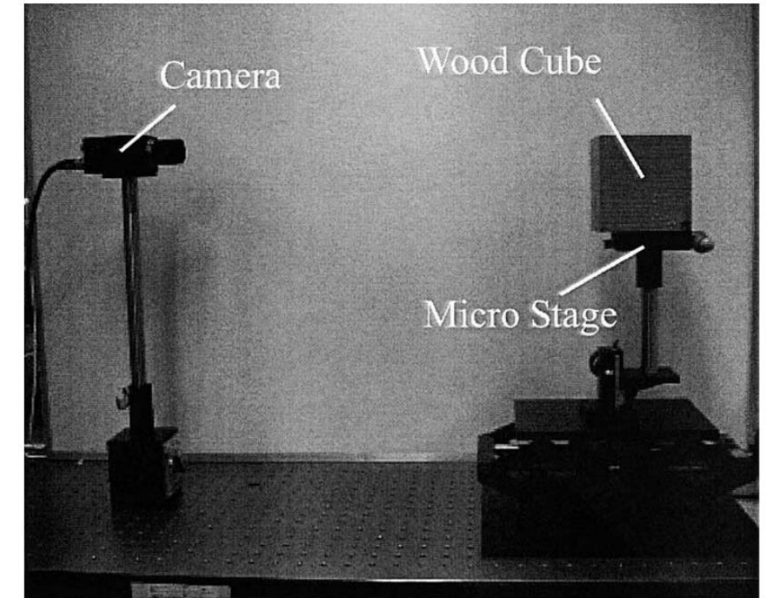
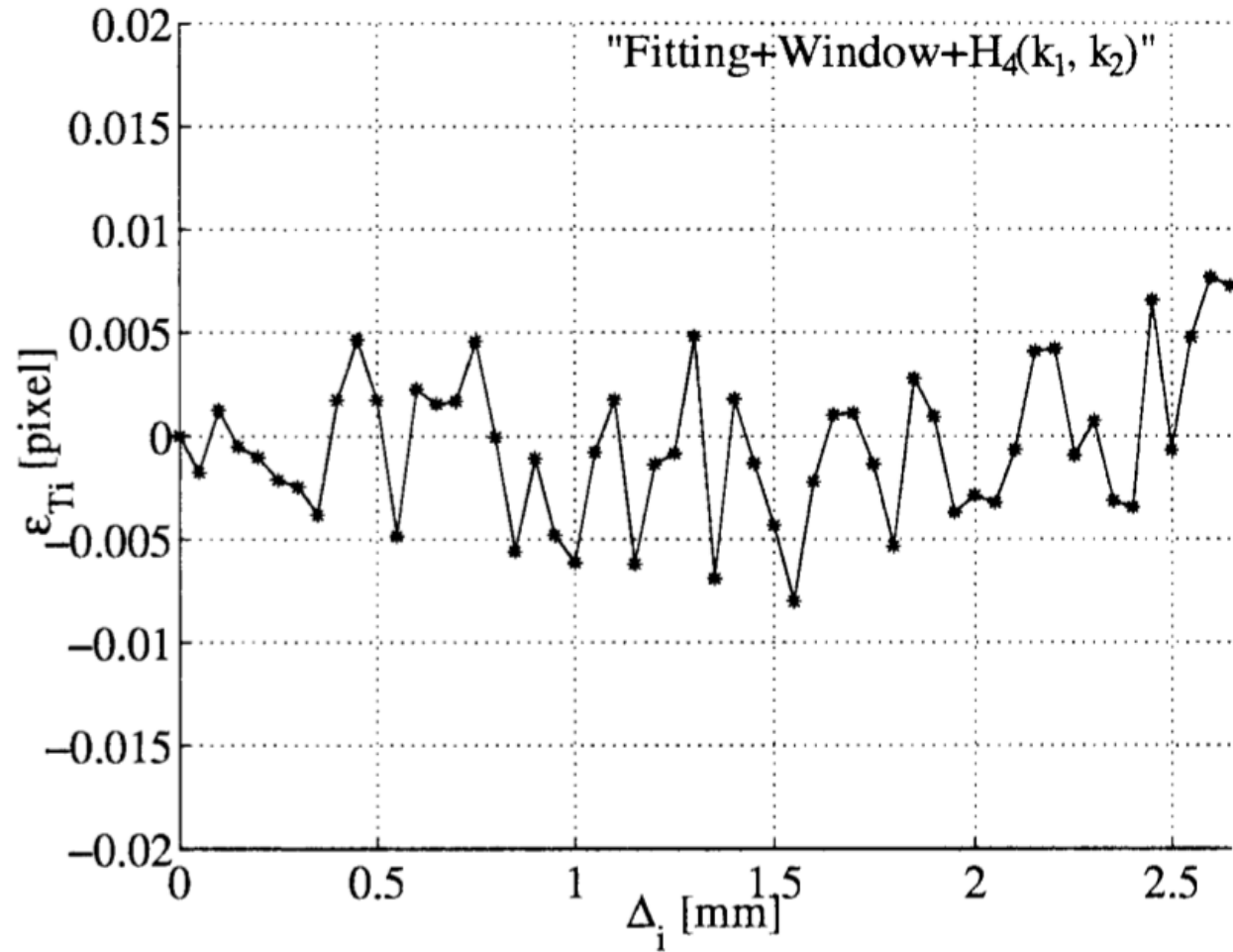


[https://3.bp.blogspot.com/-HerRsuhYbSU/W8PB0pTqgII/AAAAAAAAADYU/M03RG5n11AcTpDHpRJdU\\_SZ0m0pVPFOYgCLcBGAs/s400/image10.gif](https://3.bp.blogspot.com/-HerRsuhYbSU/W8PB0pTqgII/AAAAAAAAADYU/M03RG5n11AcTpDHpRJdU_SZ0m0pVPFOYgCLcBGAs/s400/image10.gif)

# Optical Flow

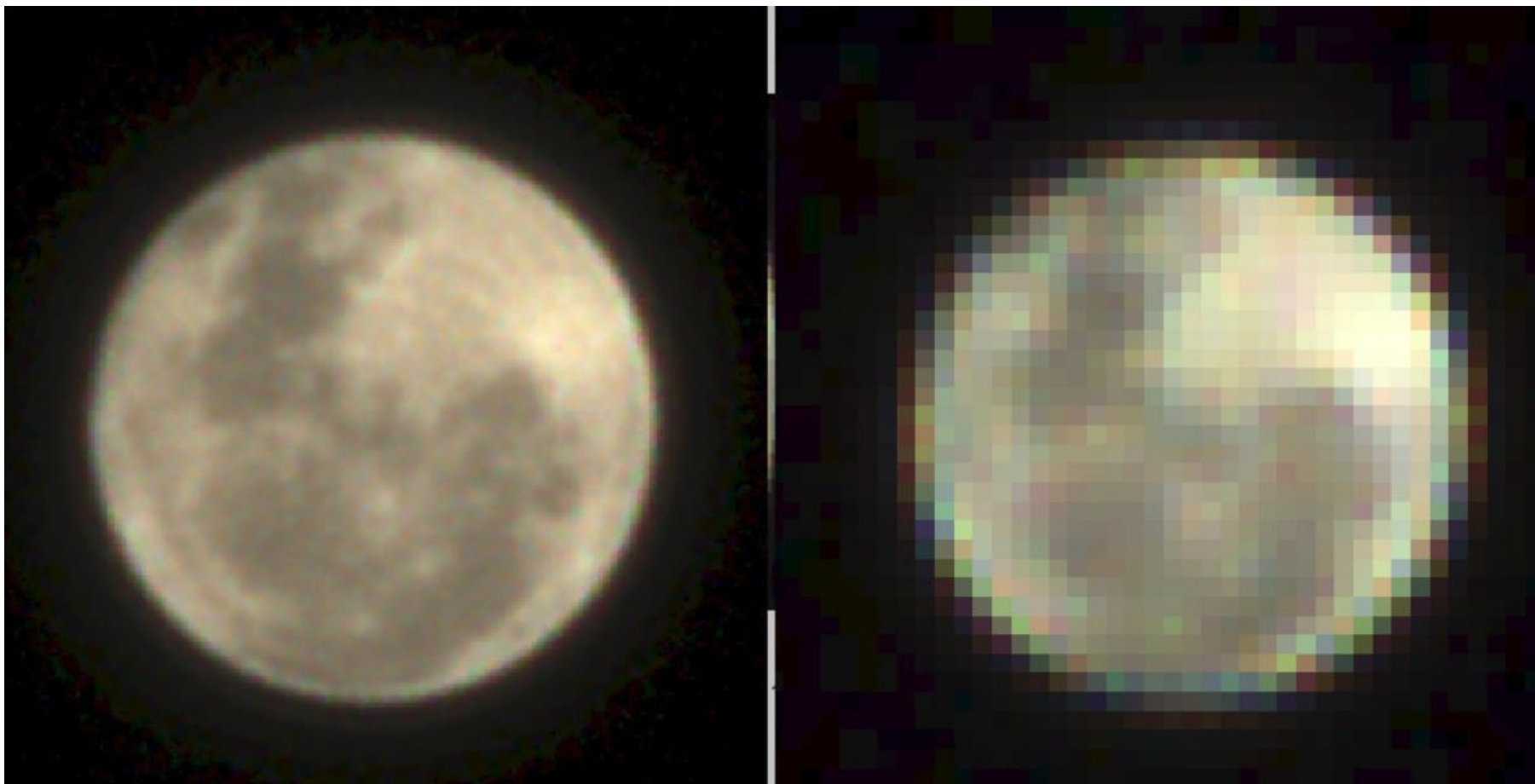


# Sub-pixel Displacement Estimation

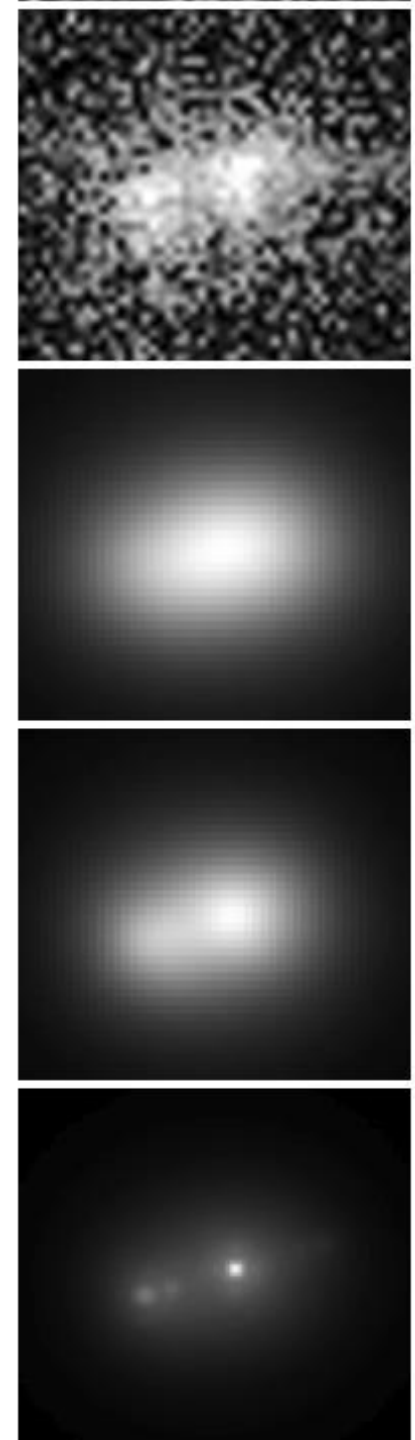




# Super Resolution

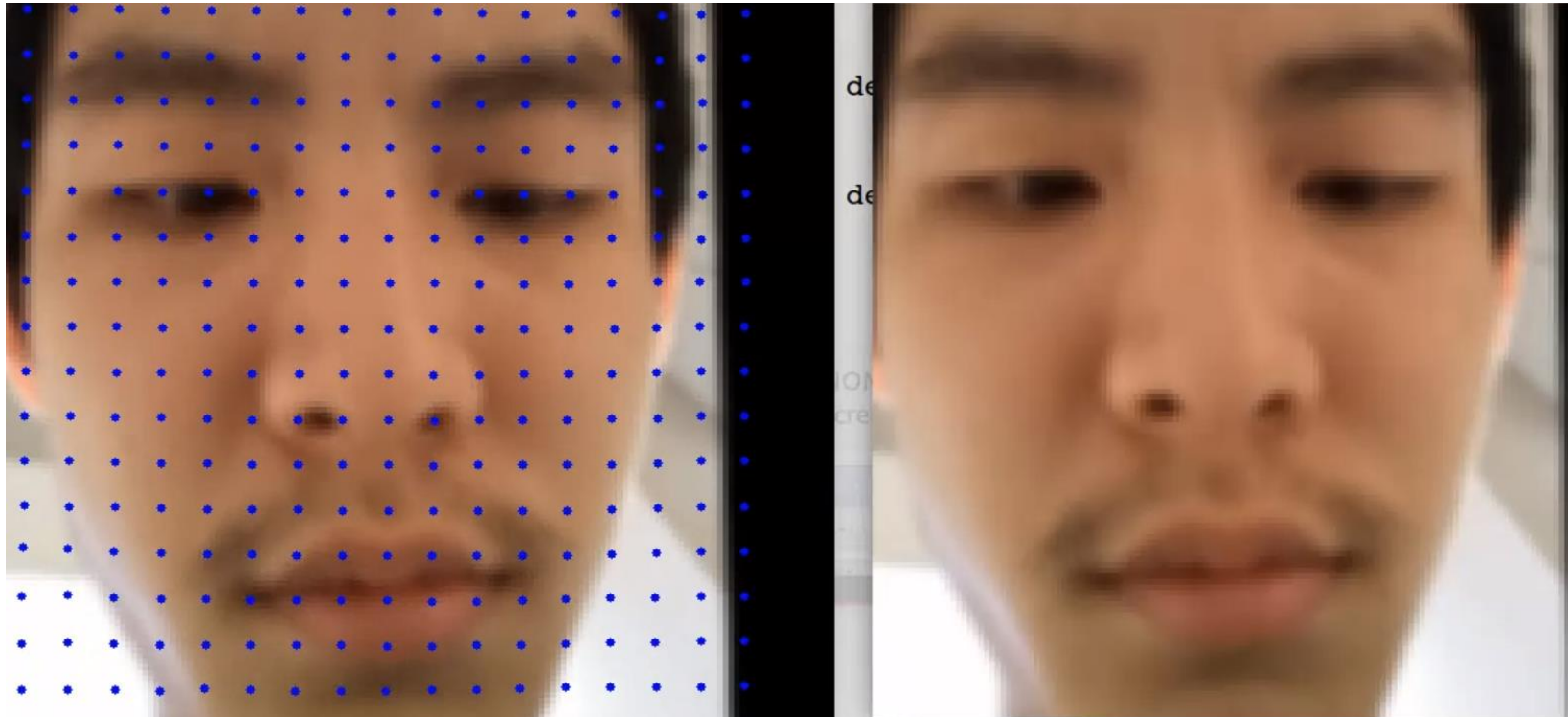


# Deblur, Lucky Imaging

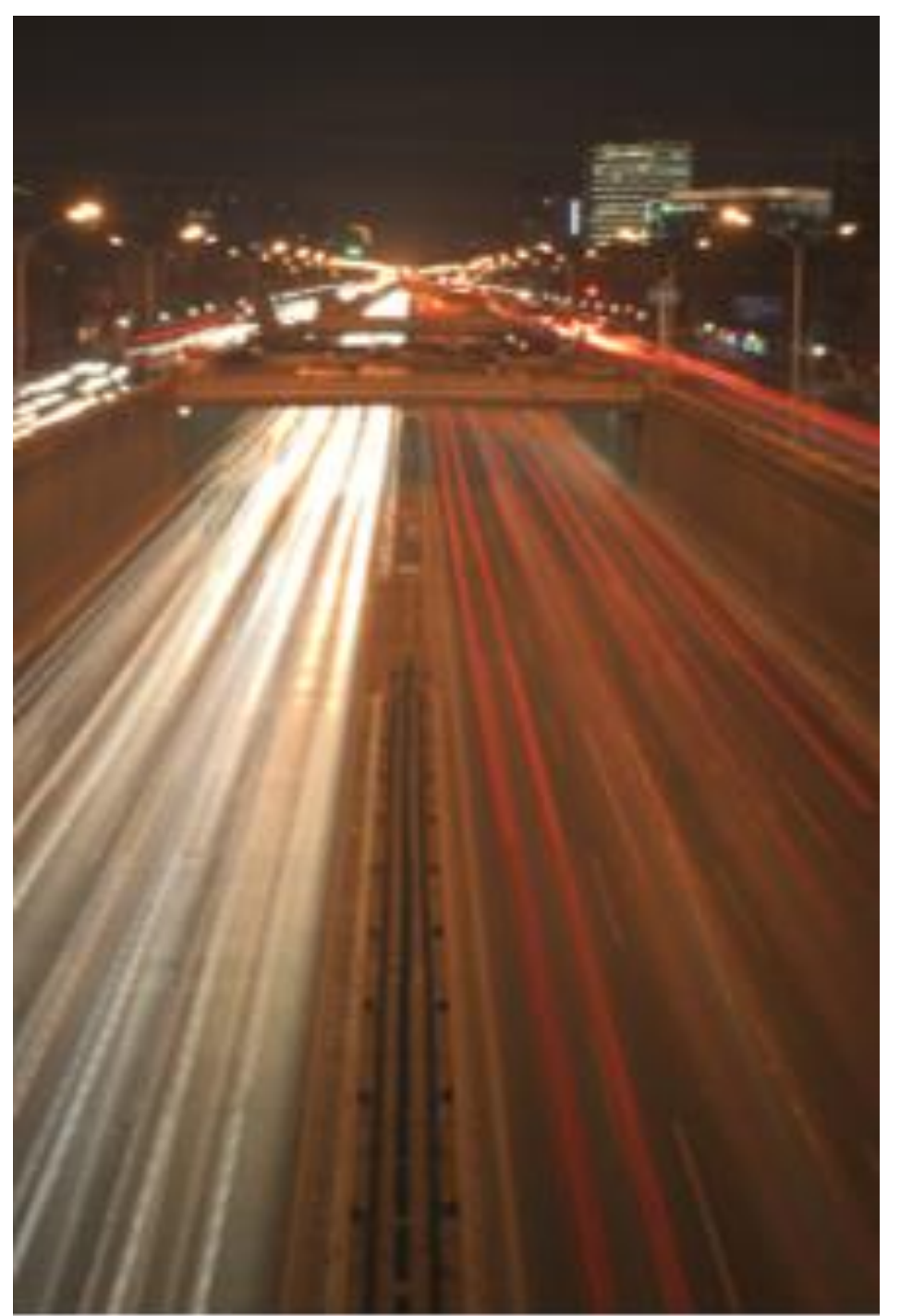


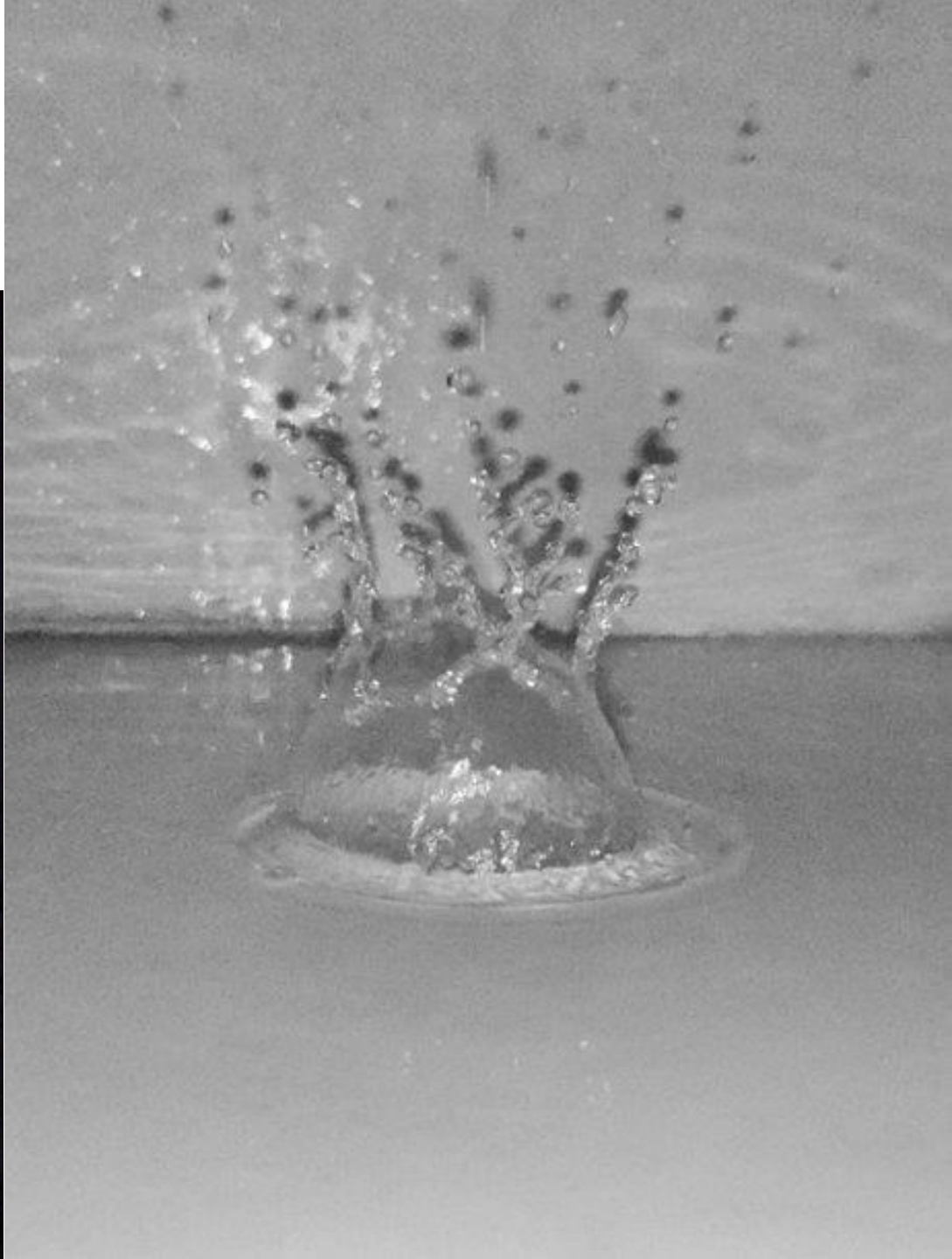
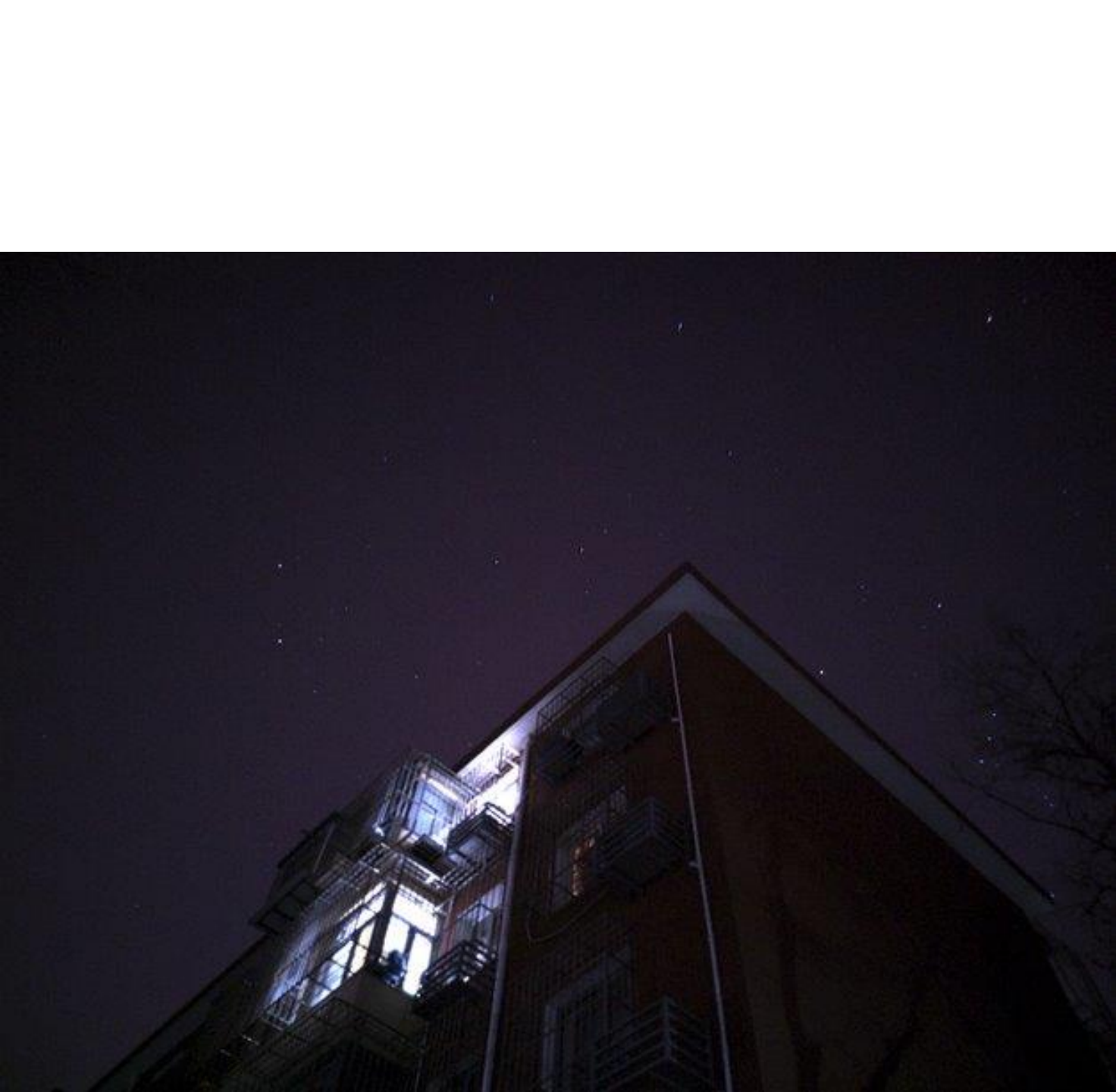
# Image Registration

- <https://sharefs.svc.brainpp.cn/fhq/emc-home/work/tmp/meshstabilize.mp4>









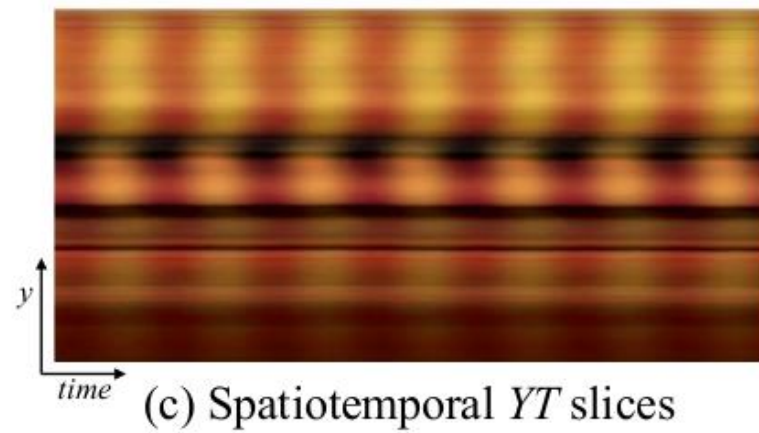




(a) Input

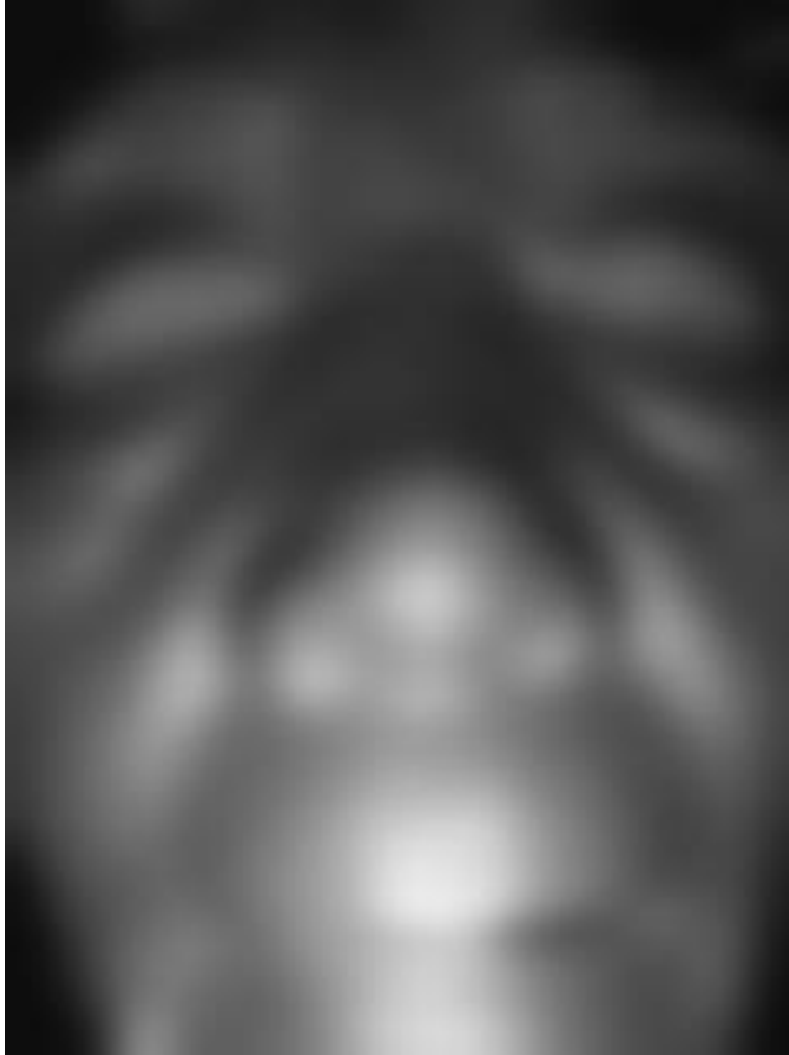


(b) Magnified

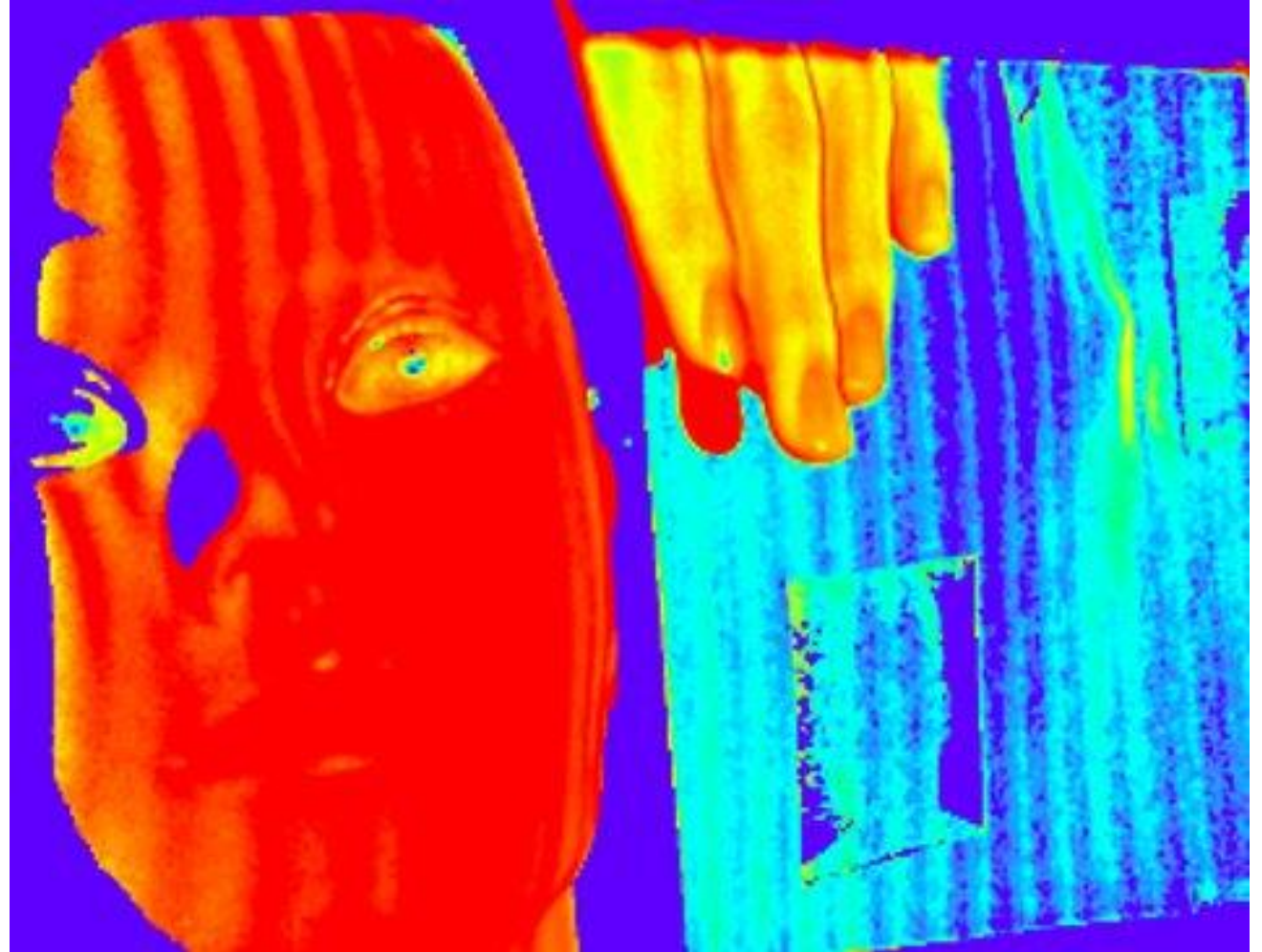
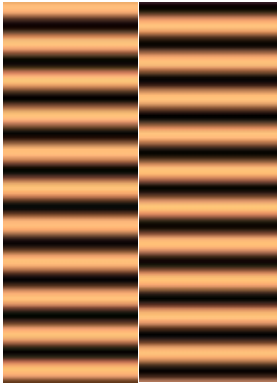


(c) Spatiotemporal *YT* slices

# Manipulation of Light



# Manipulation of Light







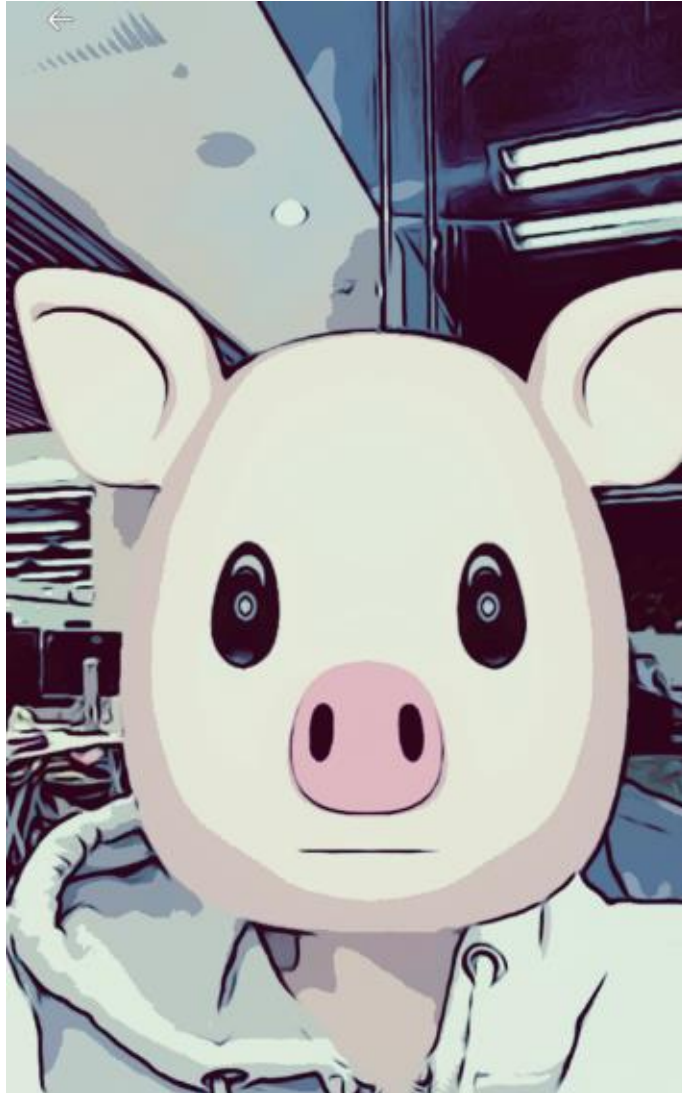
# Image Filtering Techniques

- Bilateral Filter:  $\sum(A[i,j] * s(A[i,j] - A[i_0, j_0]))$





# Image Filtering Techniques



# Computational Photography

- What you "see" is not exactly what you see.
- Computation matters in imaging!