

SIGGRAPH 2007 Computational Photography Papers Fast Forward

Digital Visual Effects, Spring 2007

Yung-Yu Chuang

2007/5/29

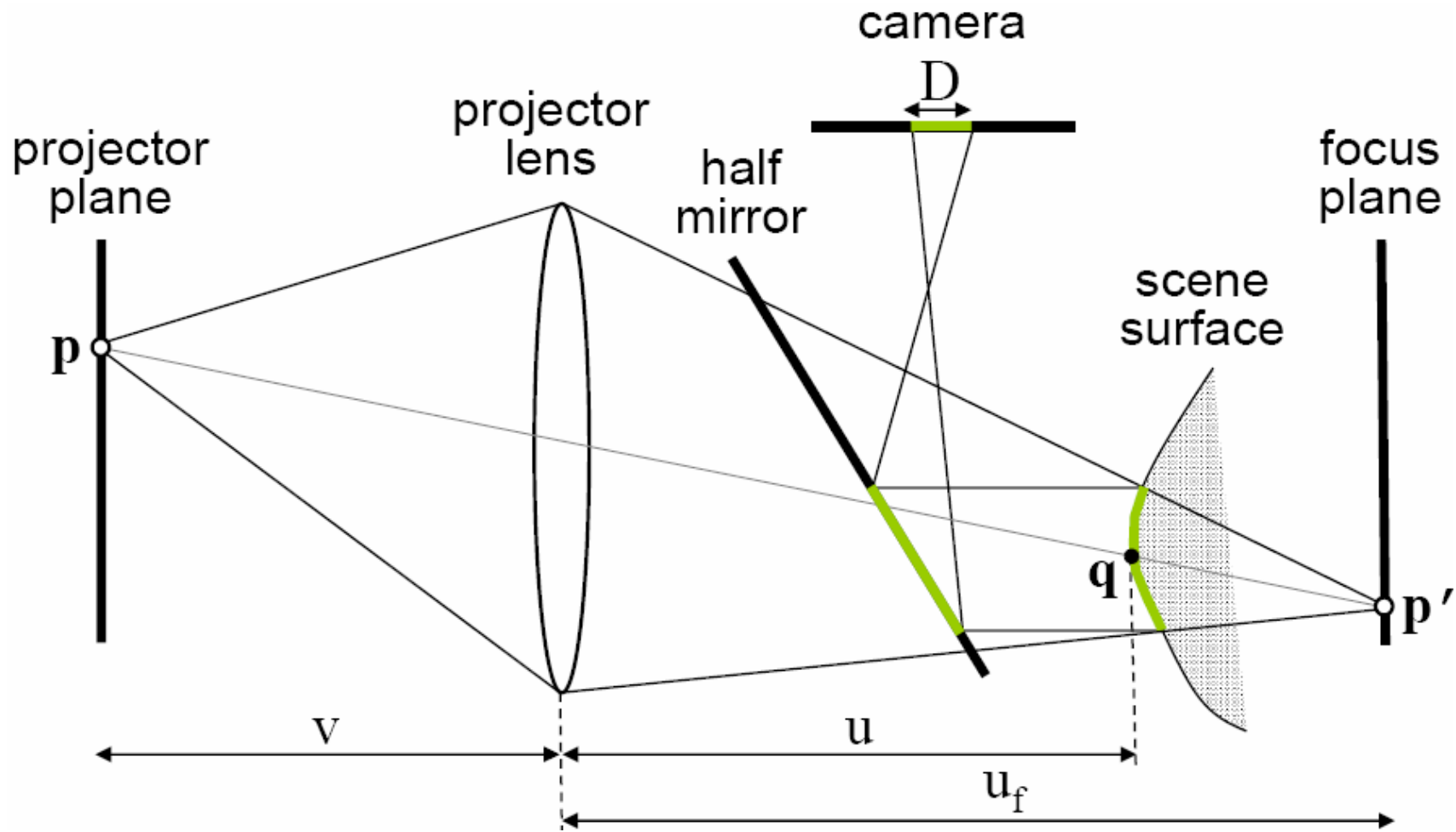
Announcements

- Voting for project #3 artifacts starts today and is due by the end of Next Monday
- Please send me the title and team members of your final project by the end of Sunday.
- Final project proposal next Tuesday. 5-min presentation for each team. Schedule will be announced next Monday.

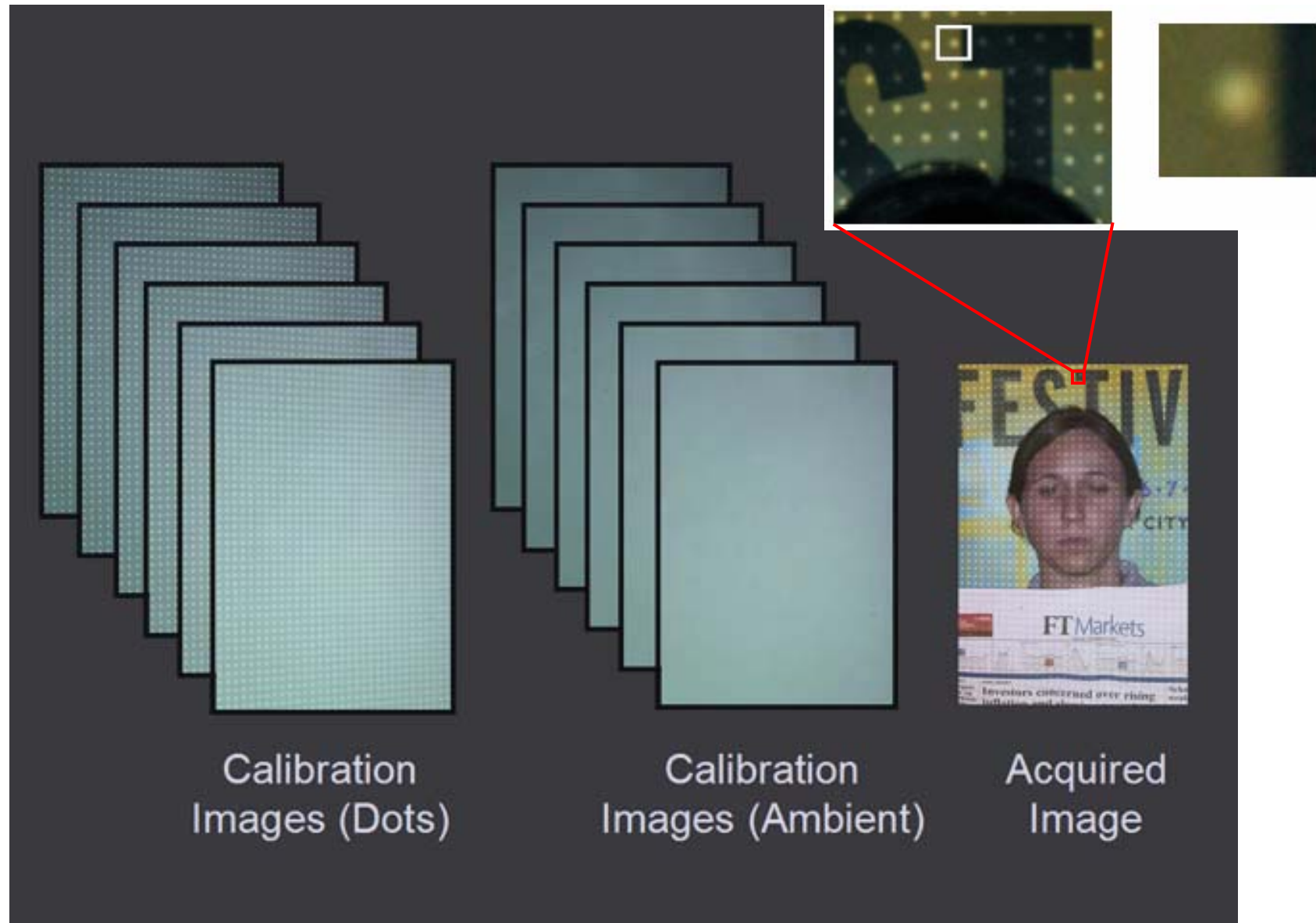
New cameras

- Active refocusing
- Coded aperture

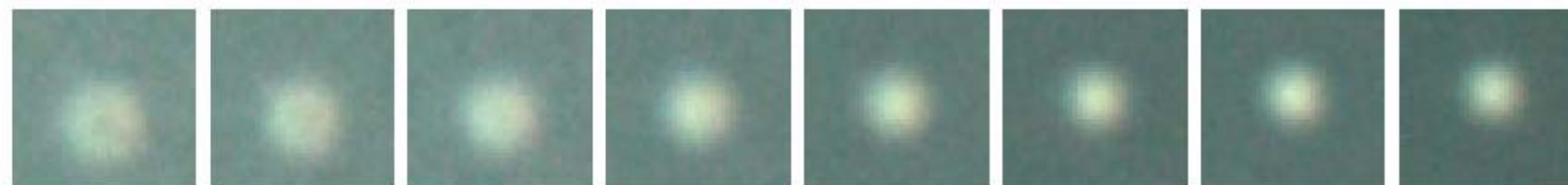
Active Refocusing



Active Refocusing



Active Refocusing



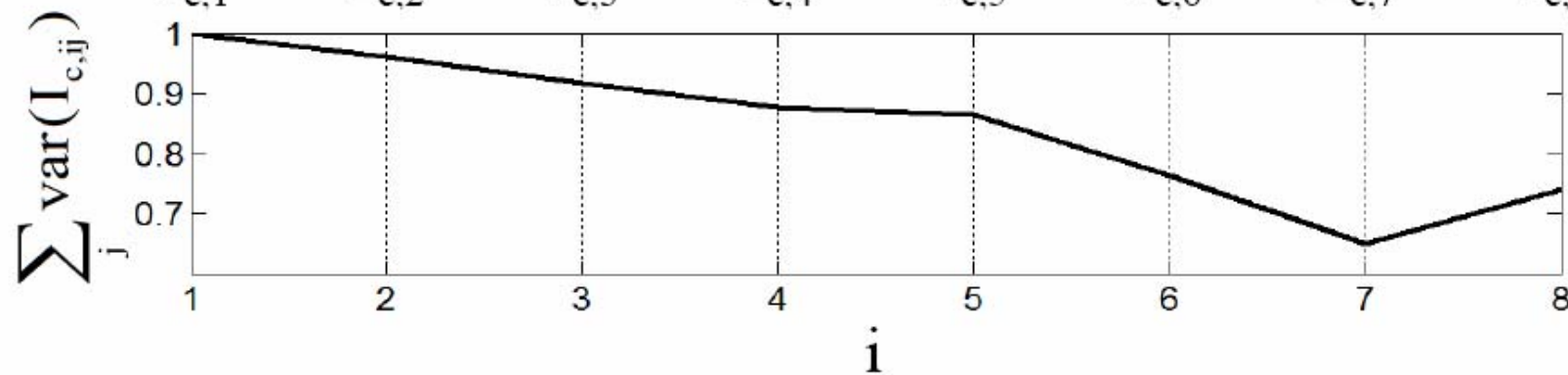
$F_{b,1}$ $F_{b,2}$ $F_{b,3}$ $F_{b,4}$ $F_{b,5}$ $F_{b,6}$ $F_{b,7}$ $F_{b,8}$



$F_{c,1}$ $F_{c,2}$ $F_{c,3}$ $F_{c,4}$ $F_{c,5}$ $F_{c,6}$ $F_{c,7}$ $F_{c,8}$



$I_{c,1}$ $I_{c,2}$ $I_{c,3}$ $I_{c,4}$ $I_{c,5}$ $I_{c,6}$ $I_{c,7}$ $I_{c,8}$



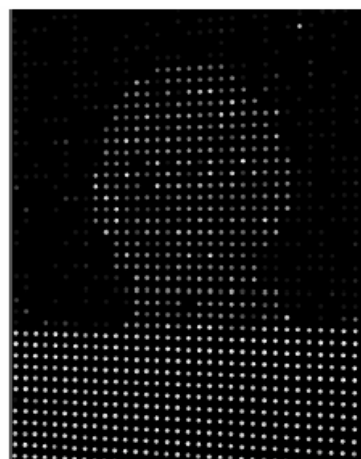
Active Refocusing



(a) Acquired Image



(b) Dots Removed



(c) Sparse Depth



(d) Color Segmentation



(e) Merged Segmentation



(f) Dense Depth



(g) Refocused (Far)



(h) Refocused (Mid)



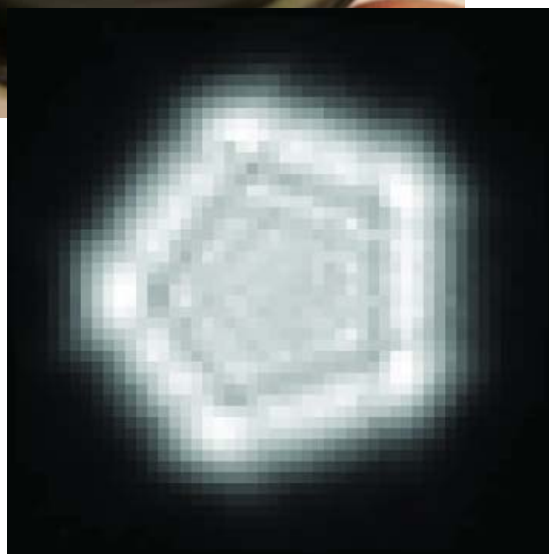
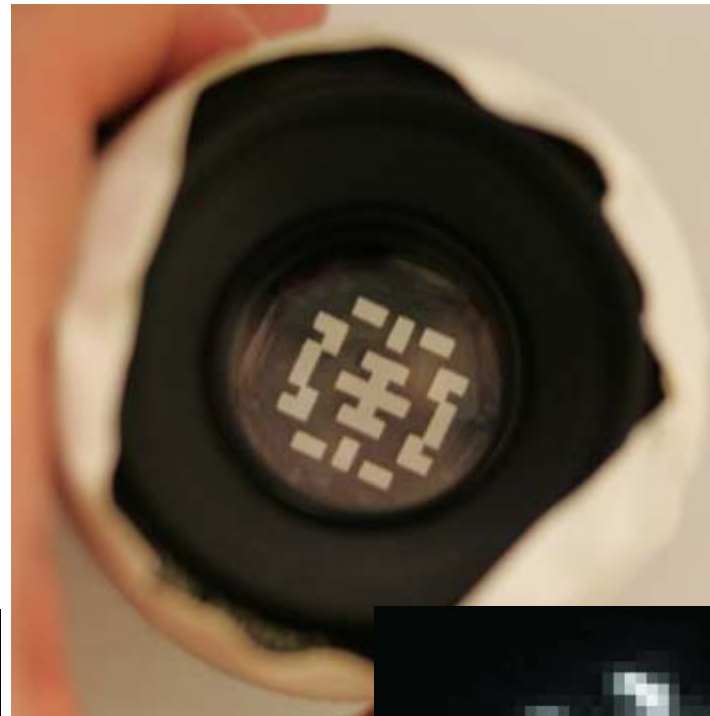
(i) Refocused (Near)



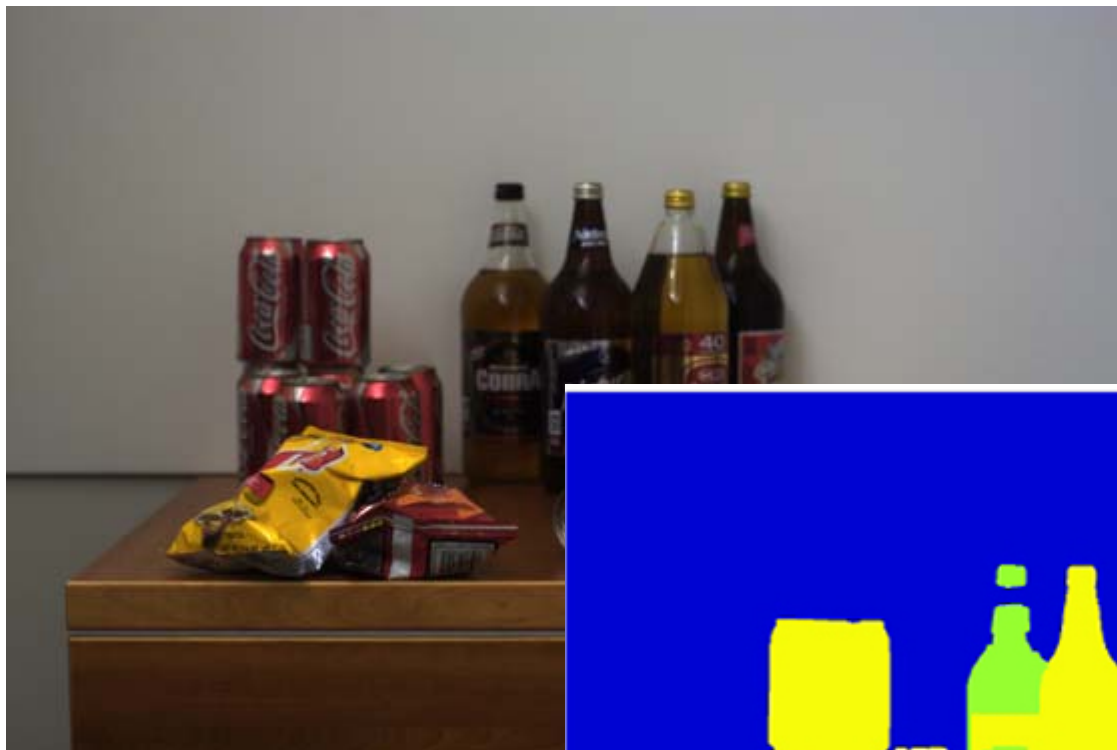
(j) Refocused (Near, Light 2)

[video](#)

Coded aperture



Coded aperture



Coded aperture



Better images from multiple photographs

- Image deblurring with blurred/noisy image pairs*
- Multiscale shape and detail enhancement from multi-light image collections*

Image deblurring



Image deblurring



Image deblurring



(a) blurry images and true kernels



(b) noisy image



(c) denoised image

Image deblurring

$$B = I \otimes K \quad \mathbf{b} = \mathbf{A}\mathbf{k}$$

$$I = N_D + \Delta I$$

$$\min_{\mathbf{k}} \|\mathbf{A}\mathbf{k} - \mathbf{b}\|^2 + \lambda^2 \|\mathbf{k}\|^2$$

$$\text{subject to } k_i \geq 0, \text{ and } \sum_i k_i = 1$$

[video](#)

Shape and detail enhancement



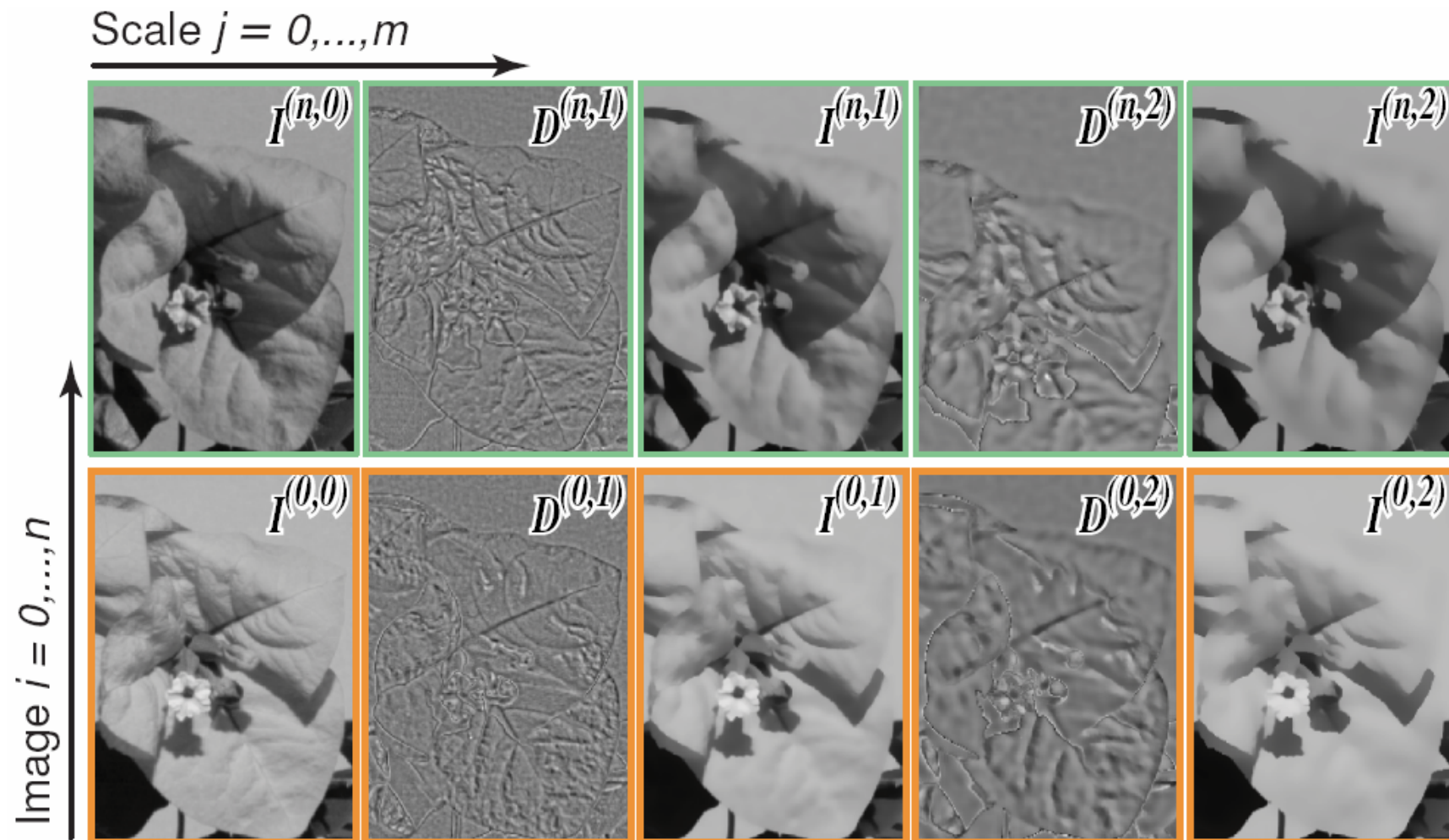
Input: 3 MLIC Images

Shape and detail enhancement

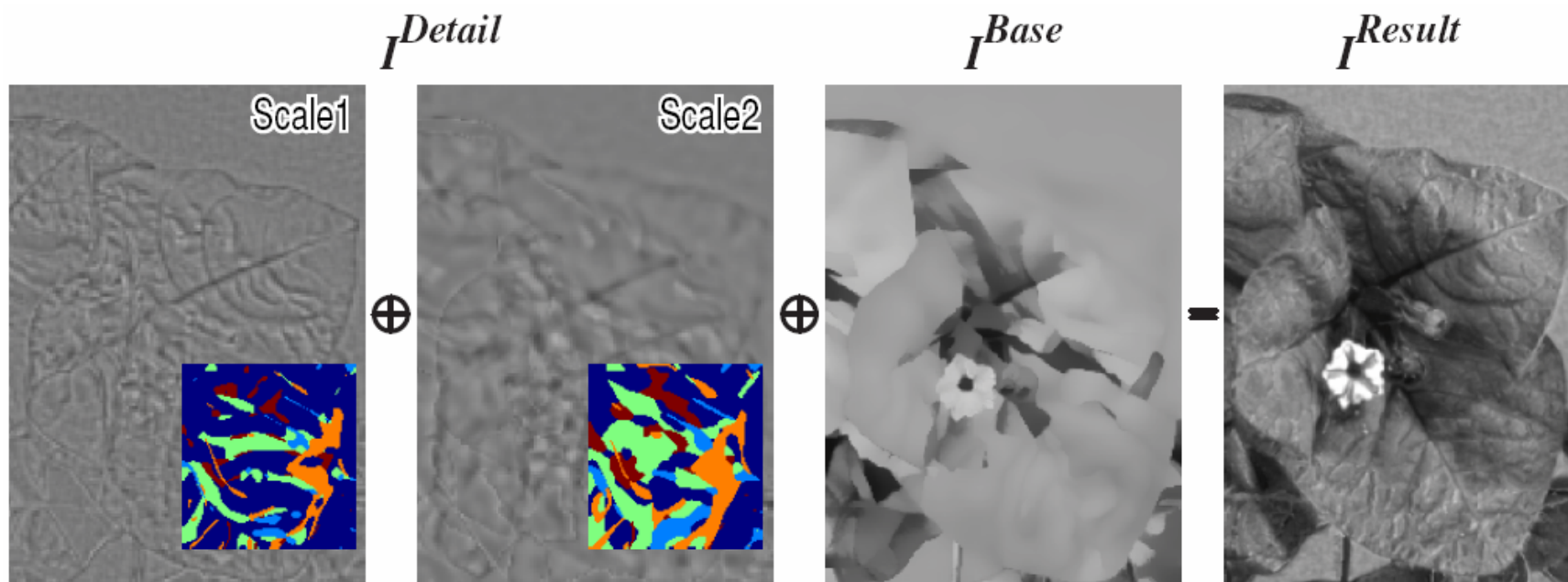


Our Results: Enhanced Shape and Surface Detail

Shape and detail enhancement



Shape and detail enhancement



Shape and detail enhancement



Input: 5 MLIC Images

Our Result

Shape and detail enhancement

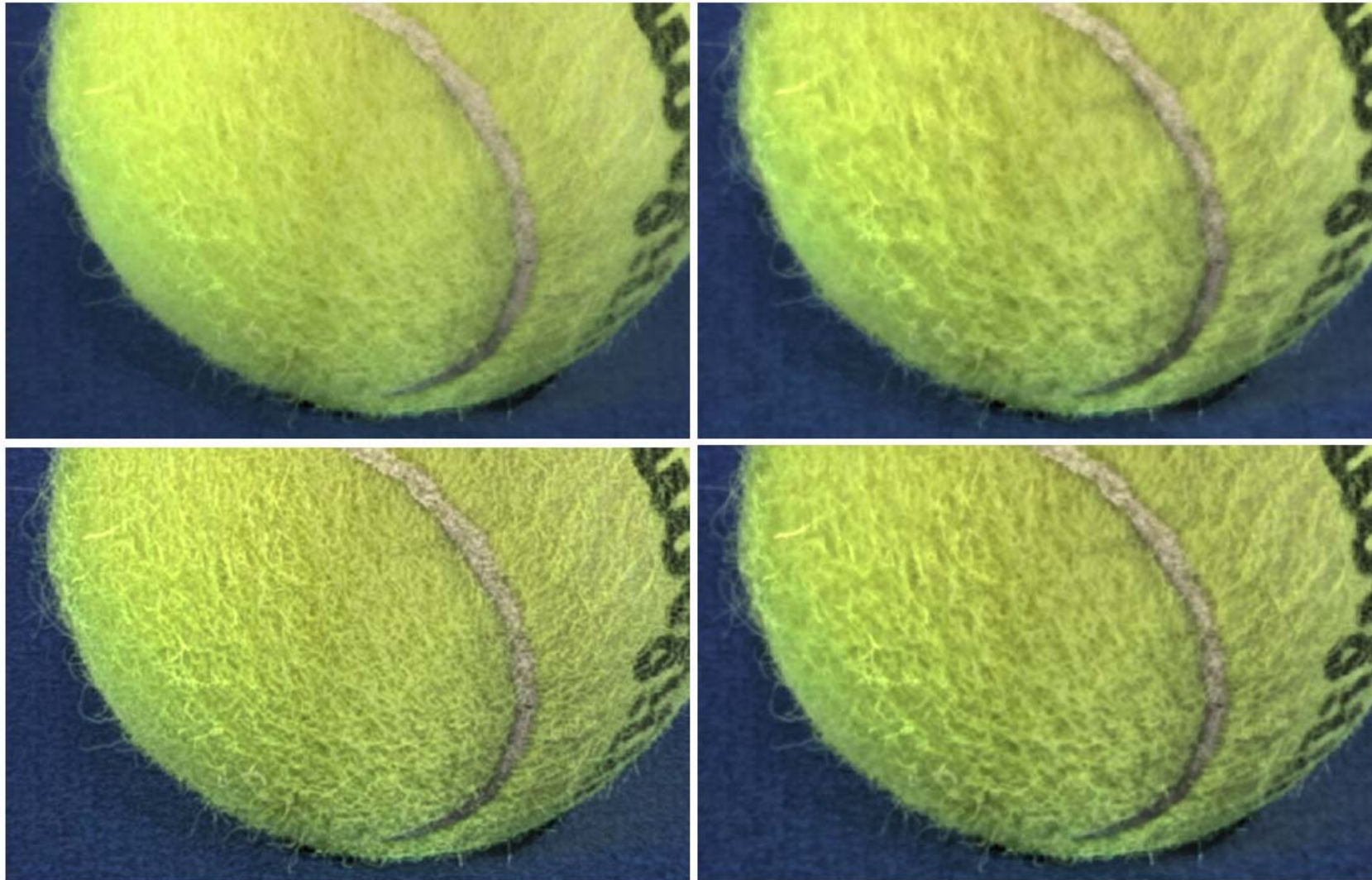
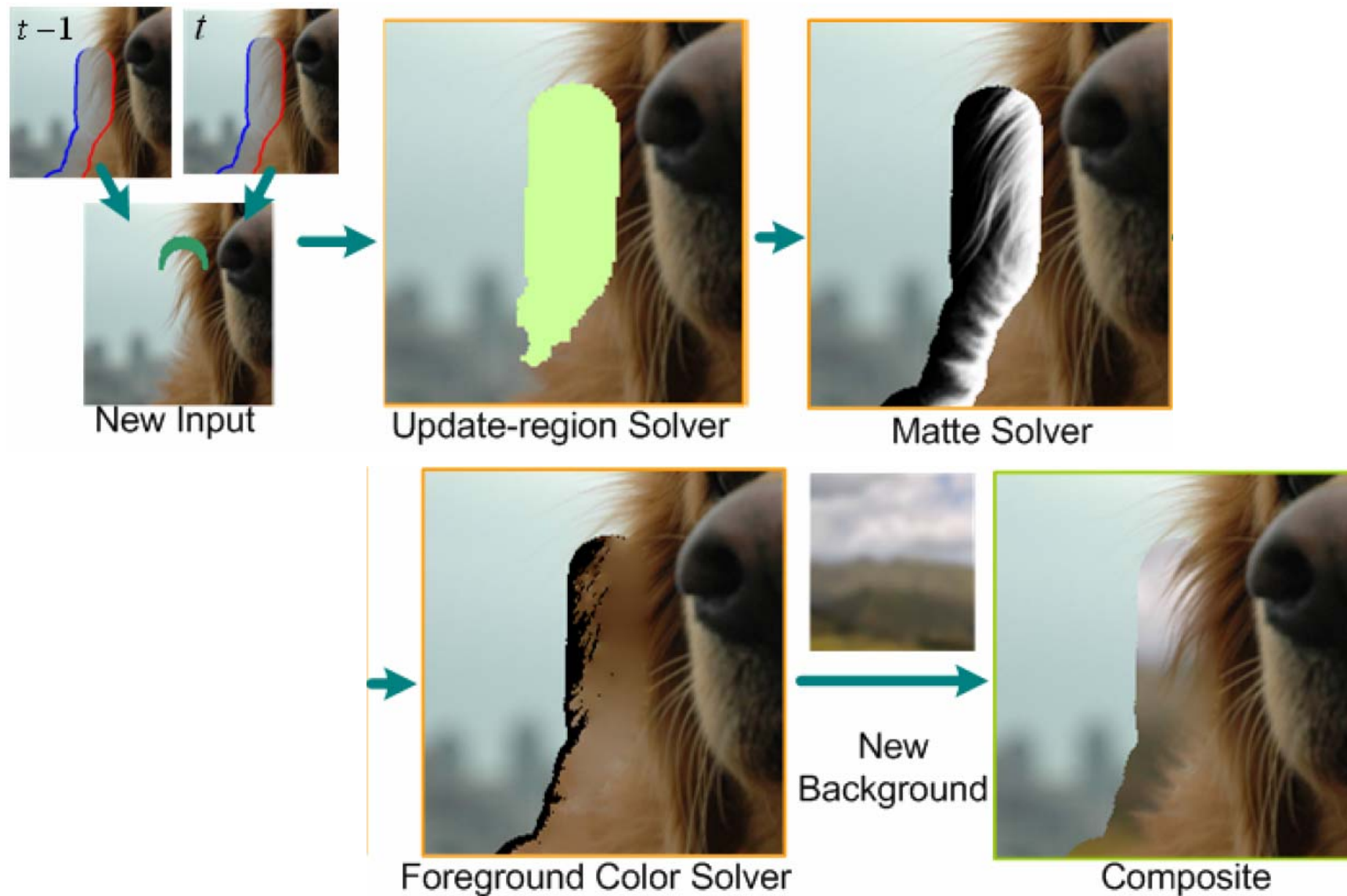


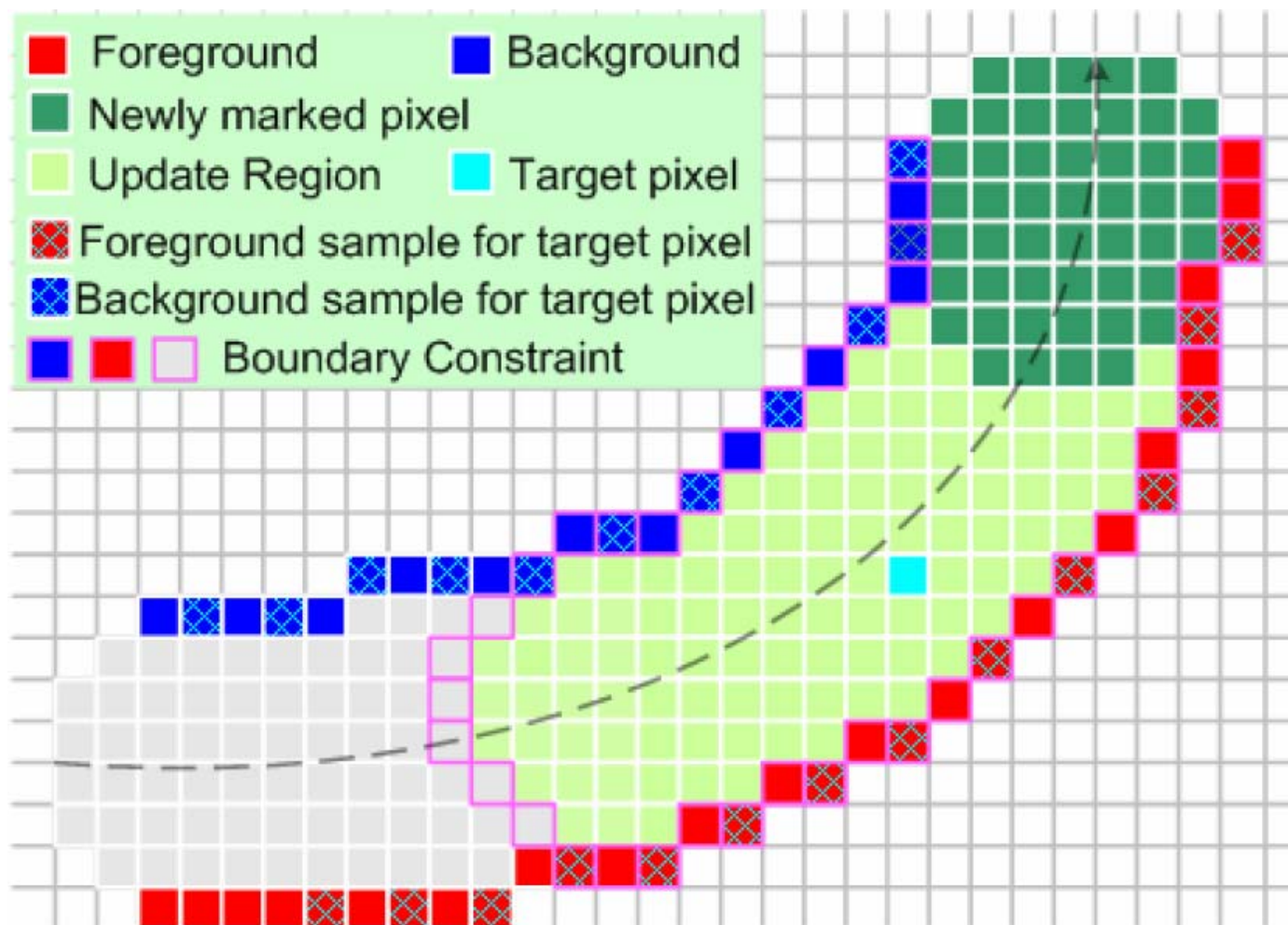
Image manipulation

- Soft scissor*
- Seam carving for resizing*

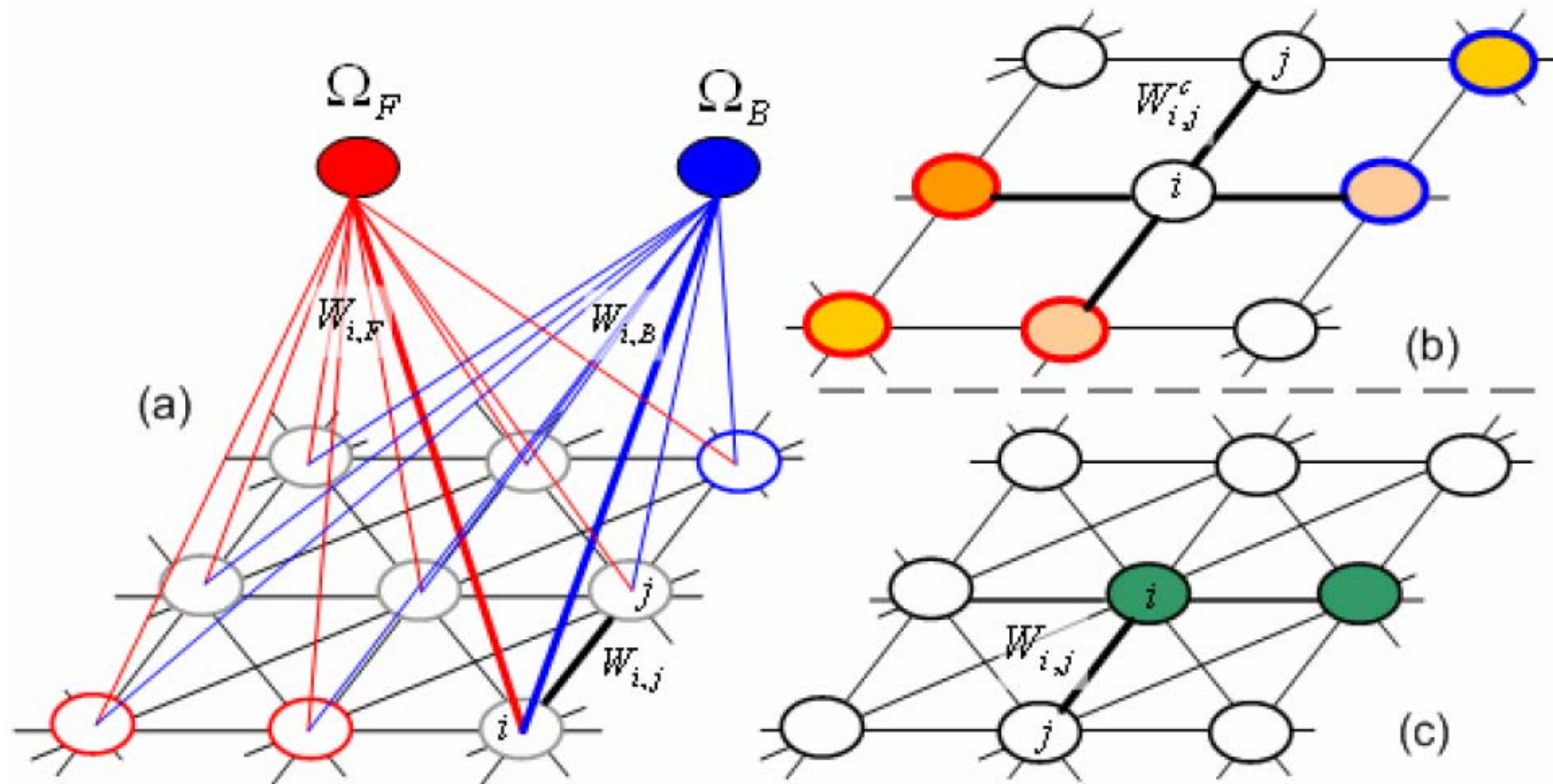
Soft Scissor



Soft Scissor

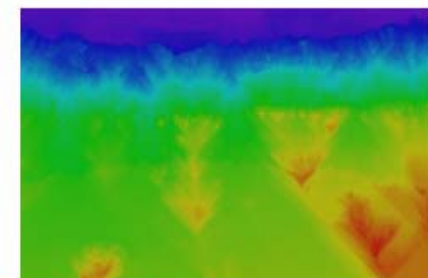
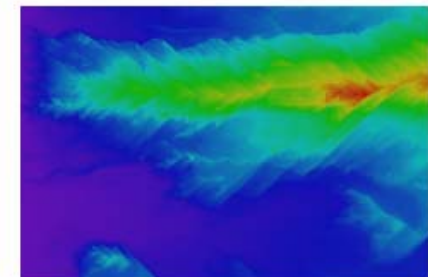


Soft Scissor



[video](#)

Seam carving for resizing



Seam carving for resizing



Seam carving for resizing



video



(b) Crop



(c) Column



(d) Seam

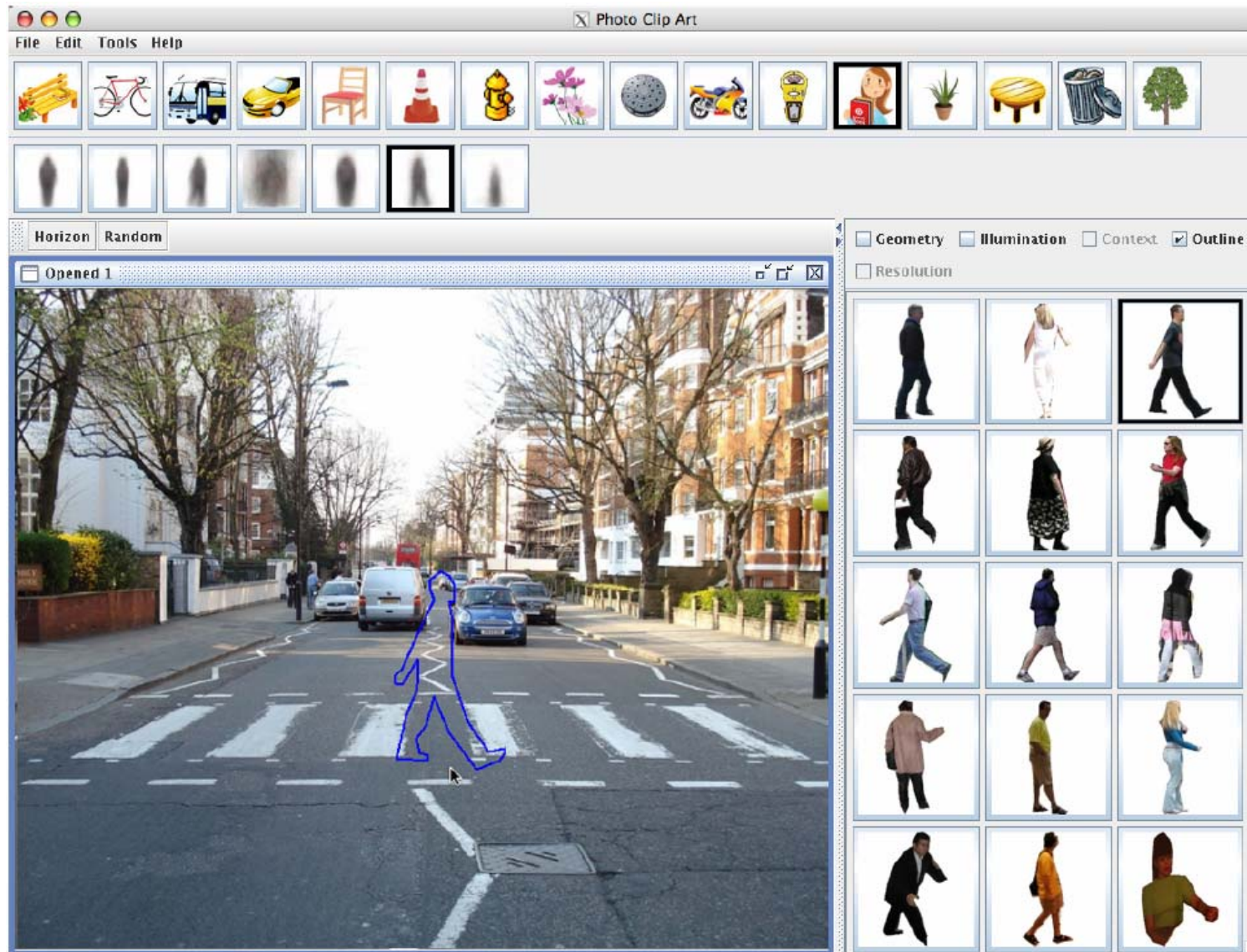


(e) Pixel

Trends

- Many pictures
 - Photo clip art
 - Scene completion using millions of photographs
- Large pictures
 - Joint bilateral upsampling*
 - Real-time image processing with bilateral grid*
 - Efficient gradient-domain compositing
 - Capturing and viewing gigapixel images

Photo Clip Art



Extracted from LabelMe database

Photo Clip Art

- Challenges
 - Rich object library
 - Object segmentation
 - Estimating object size and orientation
 - Estimating light conditions
 - Intuitive user interface

Photo Clip Art

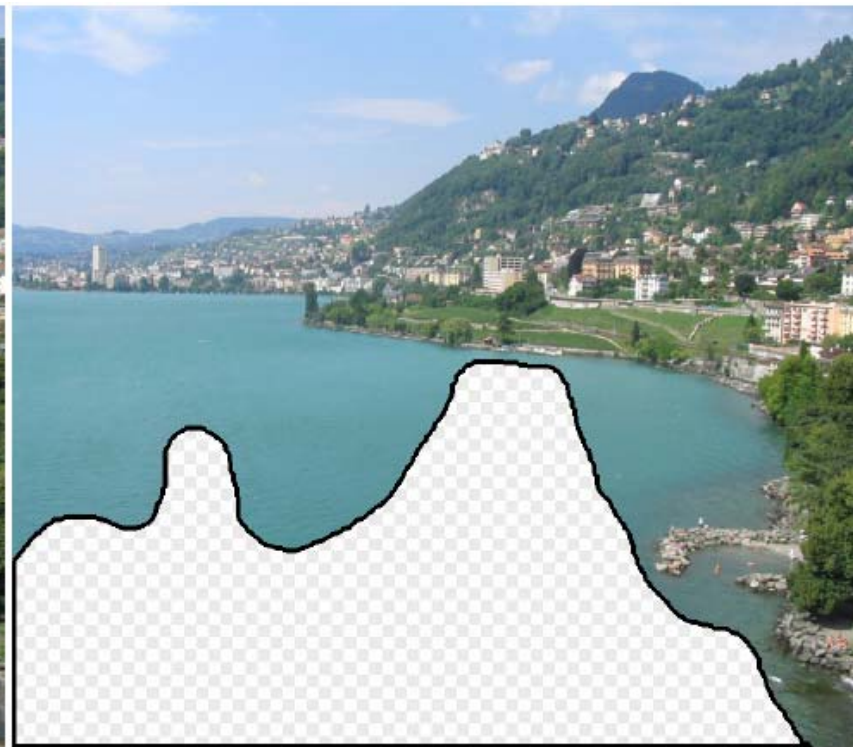


[video](#)

Scene Completion



Original Image



Input

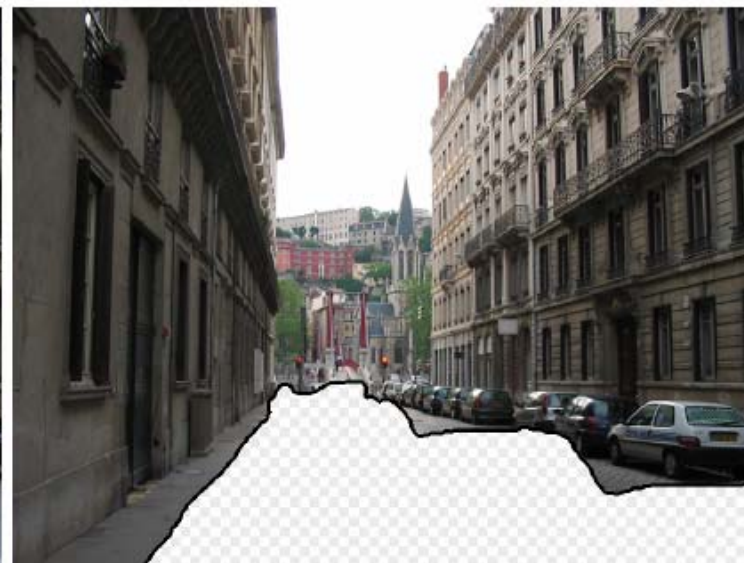
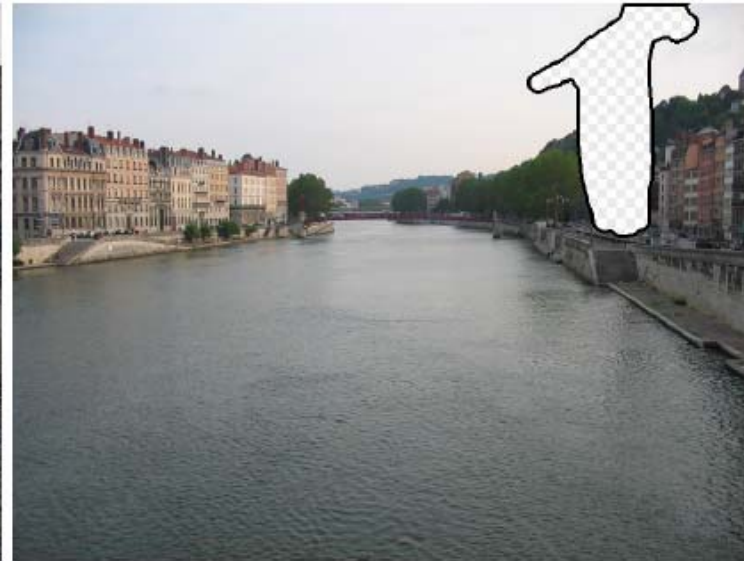
Scene Completion



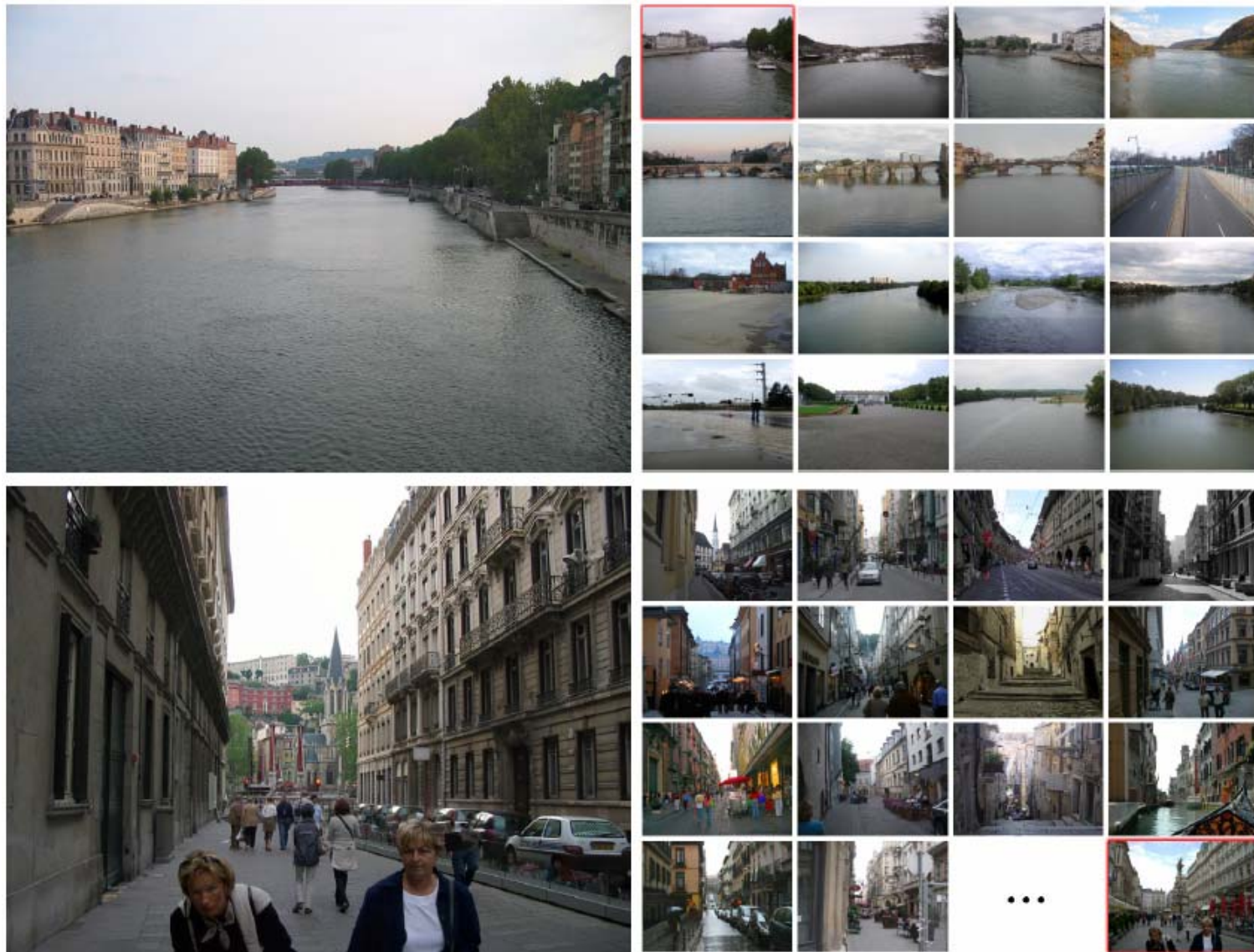
Scene Matches

Output

Scene Completion



Scene Completion



Scene Completion



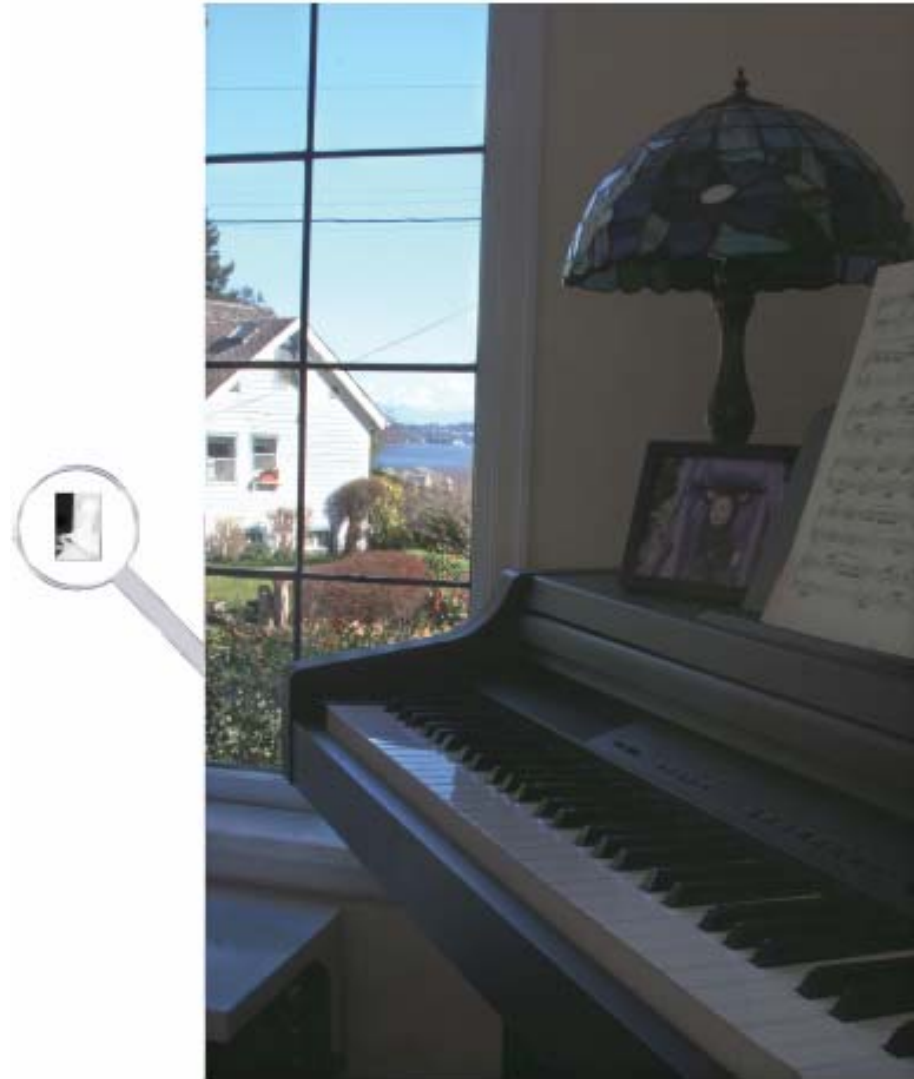
Joint bilateral upsampling

$$J_p = \frac{1}{k_p} \sum_{q \in \Omega} I_q f(\|p - q\|) g(\|I_p - I_q\|)$$

$$J_p = \frac{1}{k_p} \sum_{q \in \Omega} I_q f(\|p - q\|) g(\|\tilde{I}_p - \tilde{I}_q\|)$$

$$\tilde{S}_p = \frac{1}{k_p} \sum_{q_{\downarrow} \in \Omega} S_{q_{\downarrow}} f(\|p_{\downarrow} - q_{\downarrow}\|) g(\|\tilde{I}_p - \tilde{I}_q\|)$$

Joint bilateral upsampling



Upsampled Result

Joint bilateral upsampling



Nearest Neighbor

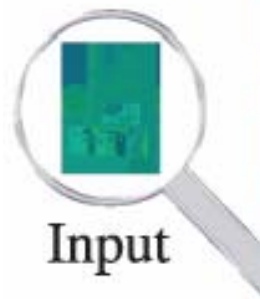
Bicubic

Gaussian

Joint Bilateral

Ground Truth

Joint bilateral upsampling



Upsampled Result

Joint bilateral upsampling



Nearest Neighbor Upsampling



Bicubic Upsampling

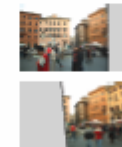


Gaussian Upsampling



Joint Bilateral Upsampling

Joint bilateral upsampling



Downsampled

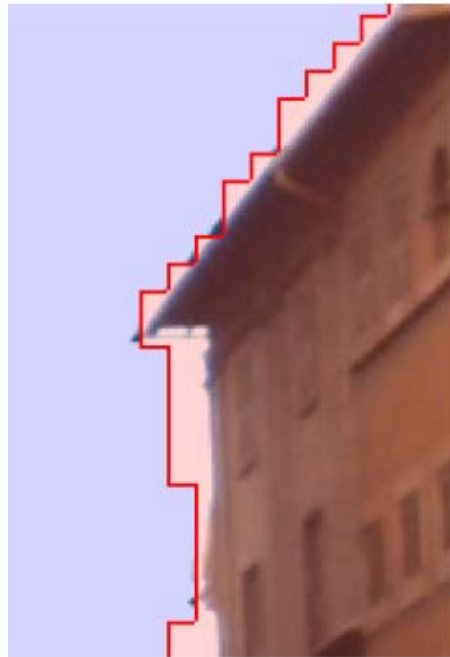


Input Solution



Input Images

Joint bilateral upsampling



Nearest Neighbor



Bicubic



Gaussian



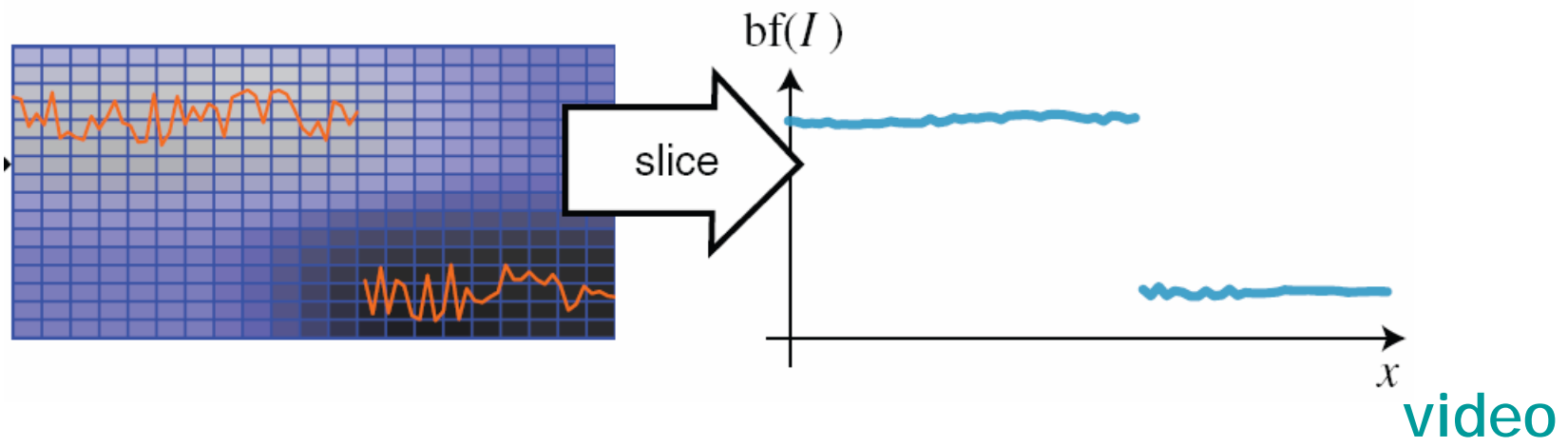
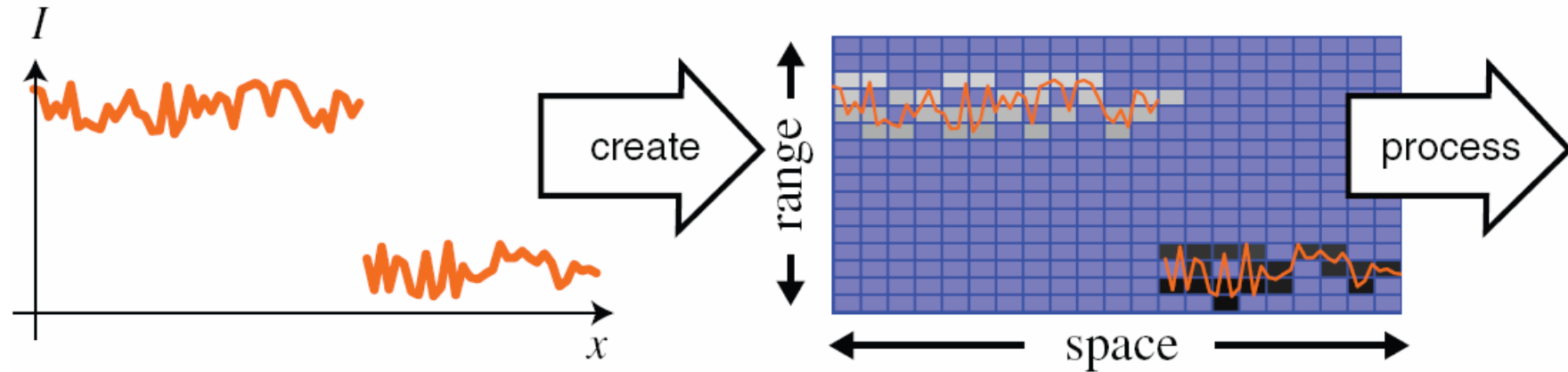
Joint Bilateral

Joint bilateral upsampling



Upsampled Result

Bilateral grid



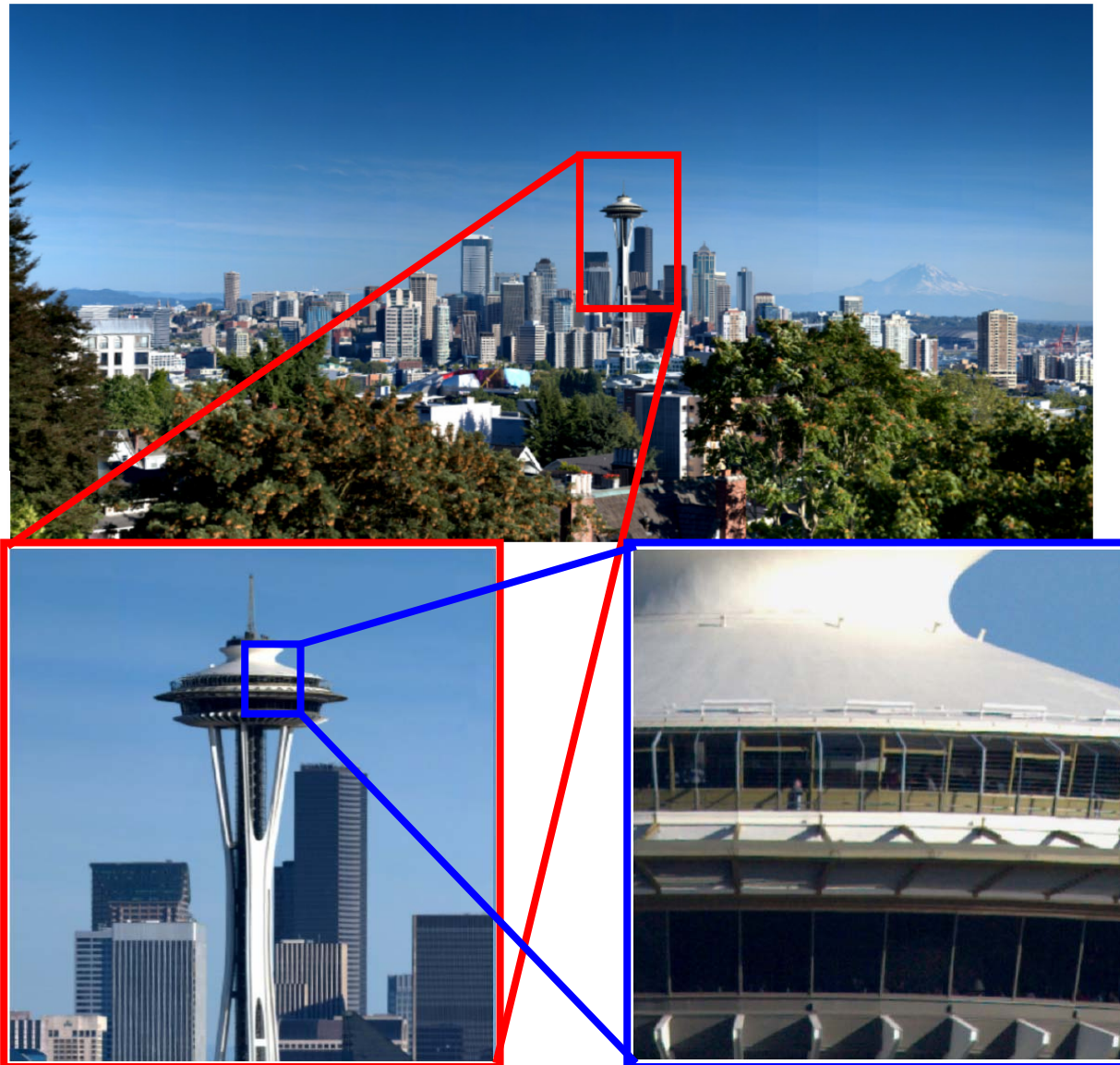
Efficient gradient domain compositing DigiVFX



Efficient gradient domain compositing DigiVFX



Gigapixel images



video

References

- Francesc Moreno-Noguer, Peter Belhumeur, Shree Nayar, [Active Refocusing of Images and Videos](#), SIGGRAPH 2007.
- Anat Levin, Rob Fergus, Fredo Durand, William Freeman, [Image and Depth from a Conventional Camera with a Coded Aperture](#), SIGGRAPH 2007.
- Lu Yuan, Jian Sun, Long Quan, Heung-Yeung Shum, [Image Deblurring with Blurred/Noisy Image Pairs](#), SIGGRAPH 2007.
- Raanan Fattal, Maneesh Agrawala, Szymon Rusinkiewicz, [Multiscale Shape and Detail Enhancement from Multi-light Image Collections](#), SIGGRAPH 2007.
- Jue Wang, Maneesh Agrawala, Michael Cohen, [Soft Scissors: An Interactive Tool for Realtime High Quality Matting](#), SIGGRAPH 2007.
- Shai Avidan, Ariel Shamir, [Seam Carving for Content-Aware Image Resizing](#), SIGGRAPH 2007.
- Jean-Francois Lalonde, Derek Hoiem, Alexei Efros, Carsten Rother, John Winn, Antonio Criminisi, [Photo Clip Art](#), SIGGRAPH 2007.
- James Hays, Alexei Efros, [Scene Completion Using Millions of Photographs](#), SIGGRAPH 2007.

References

- Johannes Kopf, Michael Cohen, Dani Lischinski, Matt Uyttendaele, [Joint Bilateral Upsampling](#), SIGGRAPH 2007.
- Jiawen Chen, Sylvain Paris, Fredo Durand, [Real-time Edge-Aware Image Processing with the Bilateral Grid](#), SIGGRAPH 2007.
- Aseem Agarwala, [Efficient Gradient-Domain Compositing Using Quadtrees](#), SIGGRAPH 2007.
- Johannes Kopf, Matt Uyttendaele, Oliver Deussen, Michael Cohen, [Capturing and Viewing Gigapixel Images](#), SIGGRAPH 2007.