Computational Photography

Digital Visual Effects

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Computational photography

DigiVFX

wikipedia:

Computational photography refers broadly to computational imaging techniques that enhance or extend the capabilities of digital photography. The output of these techniques is an ordinary photograph, but one that could not have been taken by a traditional camera.

What is computational photography

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- Convergence of image processing, computer vision, computer graphics and photography
- Digital photography:
  - Simply mimics traditional sensors and recording by digital technology
  - Involves only simple image processing
- Computational photography
  - More elaborate image manipulation, more computation
  - New types of media (panorama, 3D, etc.)
  - Camera design that take computation into account

Computational photography

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- One of the most exciting fields.
- Symposium on Computational Photography and Video, 2005
- Full-semester courses in MIT, CMU, Stanford, GaTech, University of Delaware
- A new book by Raskar and Tumblin in SIGGRAPH 2007.
- IEEE International Conference on computational Photography, San Francisco, 2009.

Siggraph 2006 Papers (16/86=18.6%)

Hybrid Images
Drag-and-Drop Pasting
Two-scale Tone Management for Photographic Look
Interactive Local Adjustment of Tonal Values
Image-Based Material Editing
Flash Matting
Natural Video Matting using Camera Arrays
Removing Camera Shake From a Single Photograph
Coded Exposure Photography: Motion Deblurring
Photo Tourism: Exploring Photo Collections in 3D
AutoCollage
Photographing Long Scenes With Multi-Viewpoint Panoramas
Projection Defocus Analysis for Scene Capture and Image Display
Multiview Radial Catadioptric Imaging for Scene Capture
Light Field Microscopy
Fast Separation of Direct and Global Components of a Scene Using High Frequency Illumination

Siggraph 2007 Papers (23/108=21.3%)

Image Deblurring with Blurred/Noisy Image Pairs
Photo Clip Art
Scene Completion Using Millions of Photographs
Soft Scissors: An Interactive Tool for Realtime High Quality Matting
Seam Carving for Content-Aware Image Resizing
Detail-Preserving Shape Deformation in Image Editing
Veiling Glare in High Dynamic Range Imaging
Do HDR Displays Support LDR content? A Psychophysical Evaluation
Ldr2hdr: On-the-fly Reverse Tone Mapping of Legacy Video and Photographs
Rendering for an Interactive 360-Degree Light Field Display
Multiscale Shape and Detail Enhancement from Multi-light Image Collections
Post-Production Facial Performance Relighting Using Reflectance Transfer
Active Refocusing of Images and Videos
Multi-aperture Photography
Dappled Photography: Mask-Enhanced Cameras for Heterodyned Light Fields and Coded Aperture Refocusing
Image and Depth from a Conventional Camera with a Coded Aperture
Capturing and Viewing Gigapixel Images
Efficient Gradient-Domain Compositing Using Quadtrees
Image Upsampling via Imposed Edges Statistics
Joint Bilateral Upsampling
Factored Time-Lapse Video
Computational Time-Lapse Video
Real-Time Edge-Aware Image Processing With the Bilateral Grid

Siggraph 2009 Papers (17/78=21.8%)

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Gaussian KD-Trees for Fast High-Dimensional Filtering

Edge-Avoiding Wavelets and their Applications

Multi-operator Media Retargeting

PatchMatch: A Randomized Correspondence Algorithm for Structural Image Editing

Modeling Human Color Perception under Extended Luminance Levels

Moving Gradients: A Path-Based Method for Plausible Image Interpolation

Optimizing Content-Preserving Projections for Wide-Angle Images

Content-Preserving Warps for 3D Video Stabilization

Visio-lization: Generating Novel Facial Images

Coordinates for Instant Image Cloning

SkyFinder: Attribute-based Sky Image Search

Paint Selection

Video SnapCut: Robust Video Object Cutout Using Localized Classifiers

Invertible Motion Blur in Video

Dark Flash Photography

4D Frequency Analysis of Computational Cameras for Depth of Field Extension

Bokode: Imperceptible Visual Tags for Camera-based Interaction from a Distance

Scope

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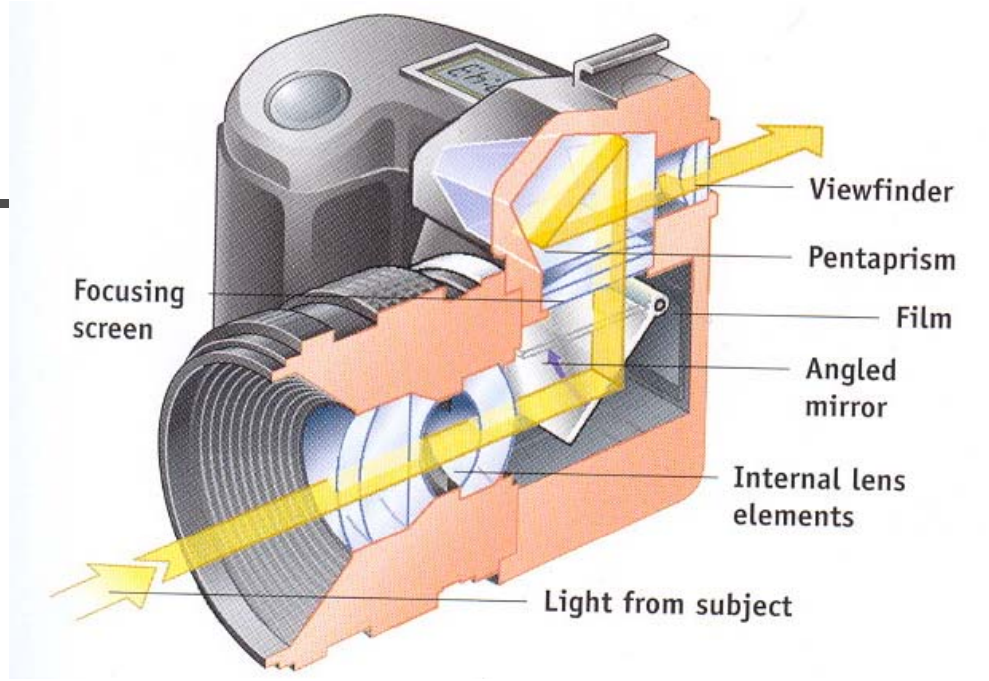
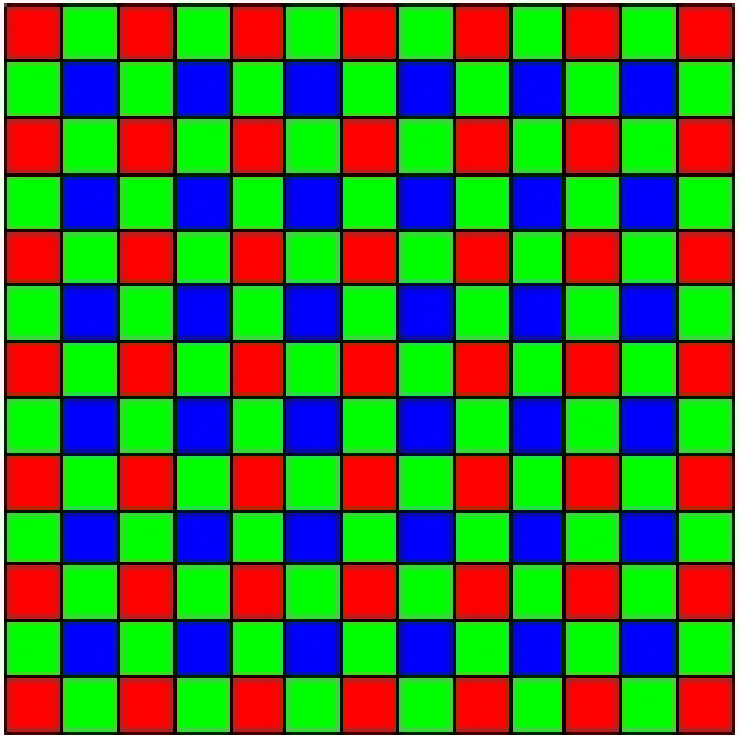
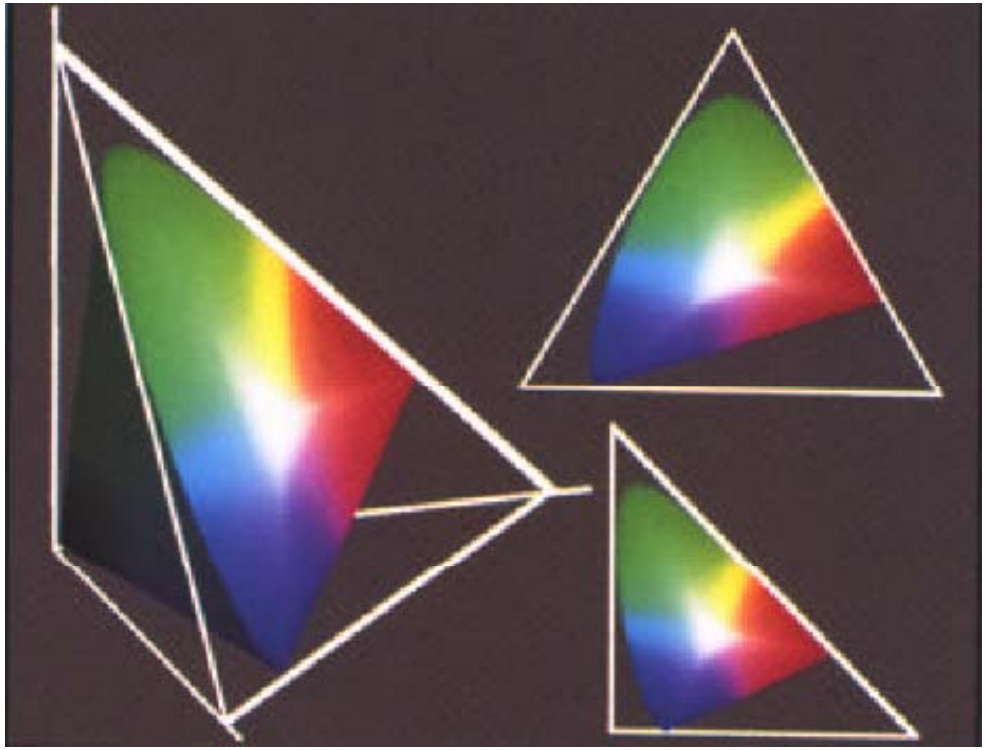
- We can’t yet set its precise definition. The following are scopes of what researchers are exploring in this field.
  - Record a richer visual experience
  - Overcome long-standing limitations of conventional cameras
  - Enable new classes of visual signal
  - Enable synthesis impossible photos

Scope

- Image formation
- Color and color perception

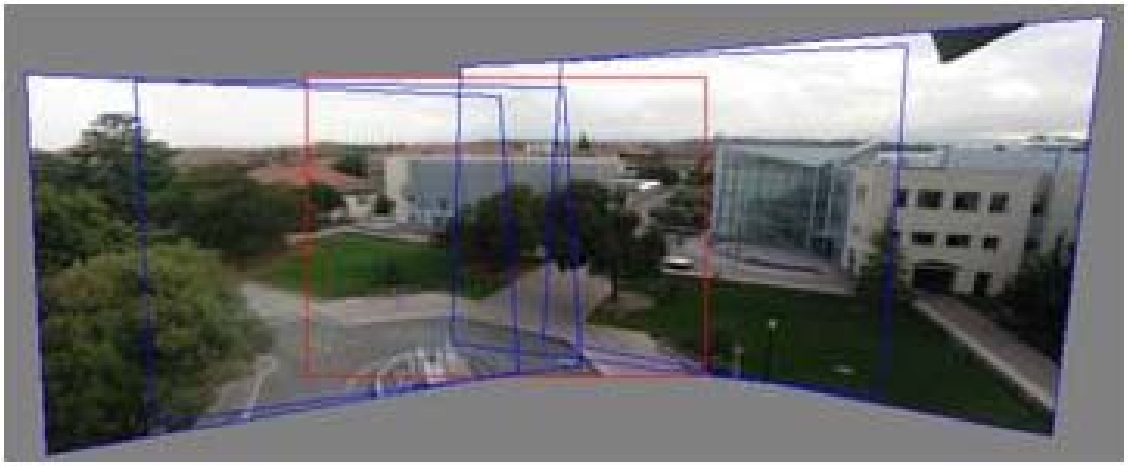




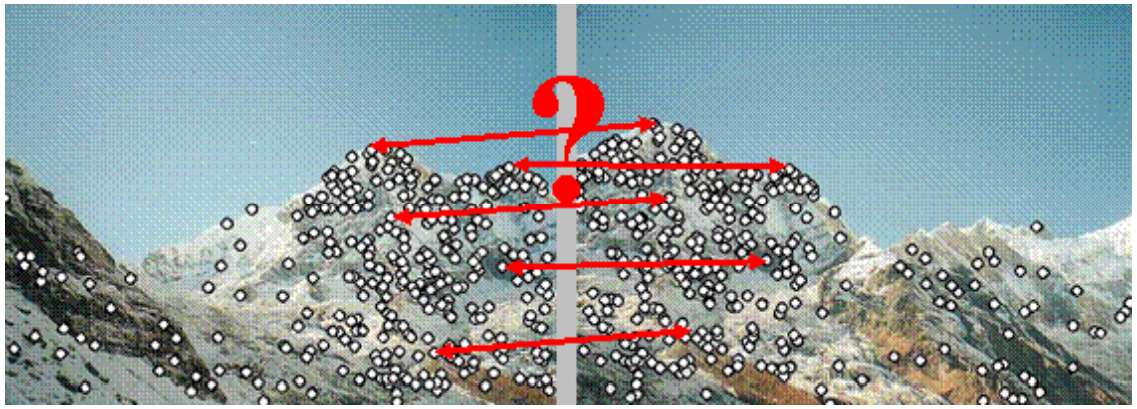


Scope

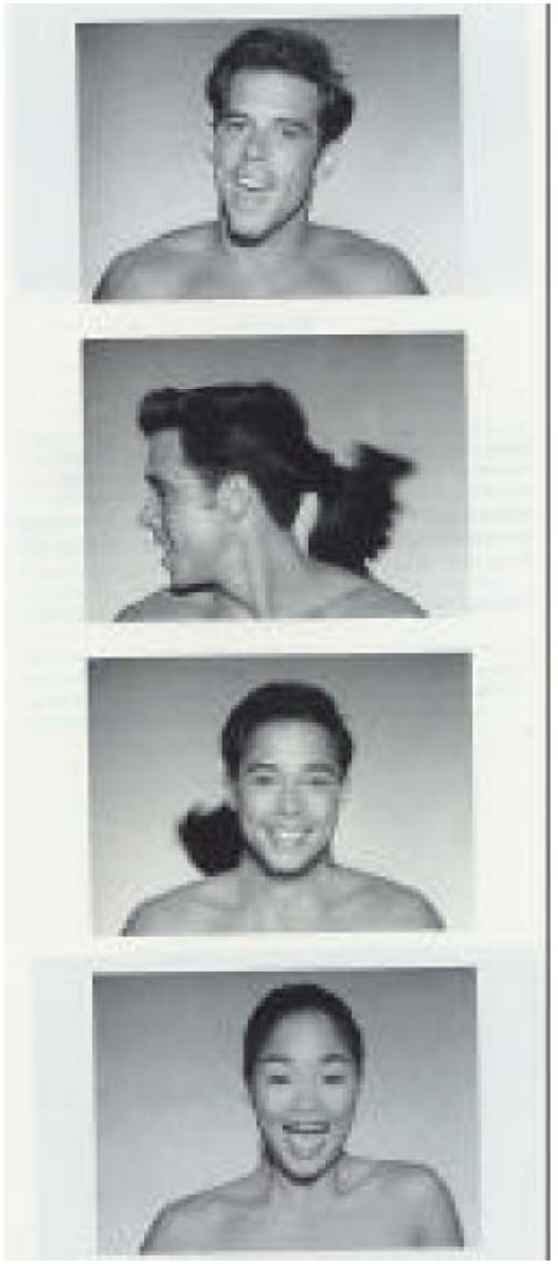
- Panoramic imaging



- Image and video registration



- Spatial warping operations

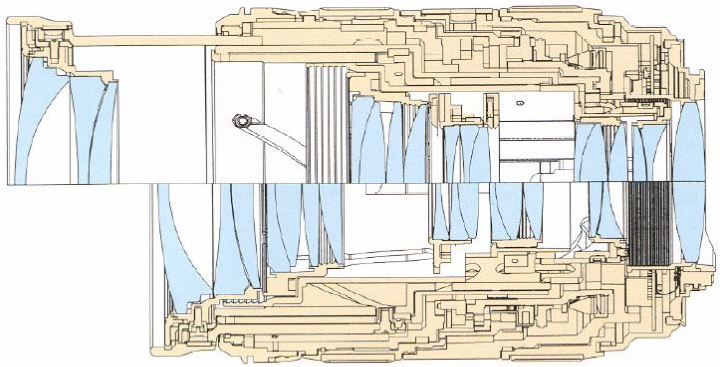


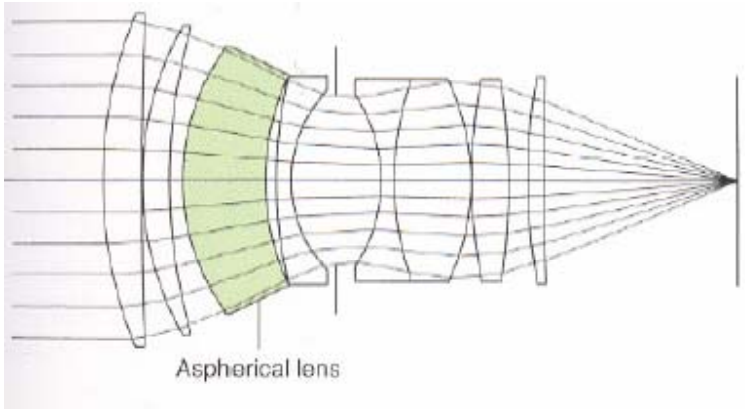
Scope

- High Dynamic Range Imaging
- Bilateral filtering and HDR display
- Matting

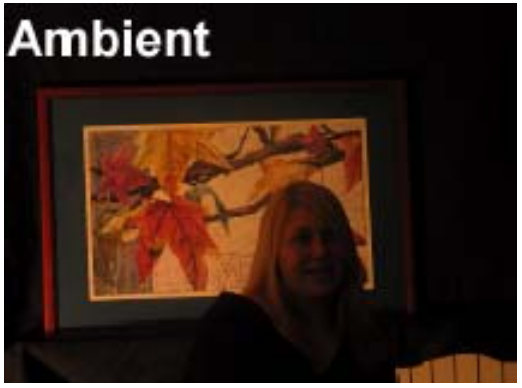
Scope

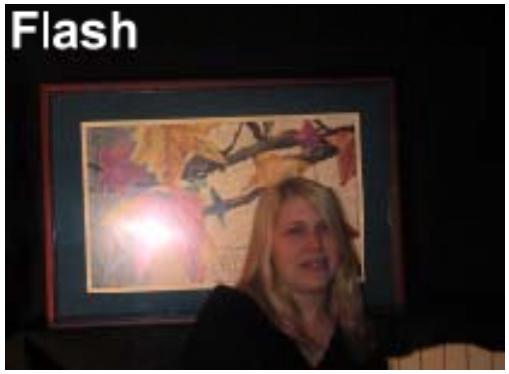
- Active flash methods
- Lens technology
- Depth and defocus

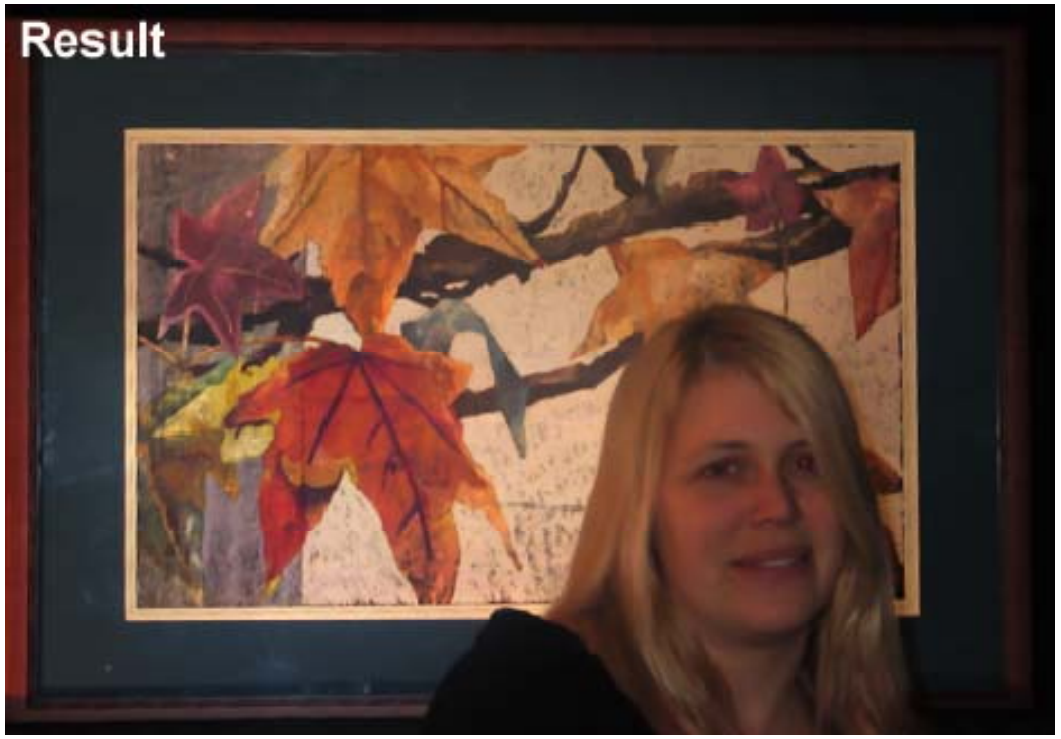




Removing Photography Artifacts using Gradient Projection and Flash-Exposure Sampling







Continuous flash

Flash = 0.0

Flash = 1.0

Flash = 0.3

Flash = 0.7

Flash = 1.4

Flash matting

Depth Edge Detection and Stylized Rendering Using a Multi-Flash Camera

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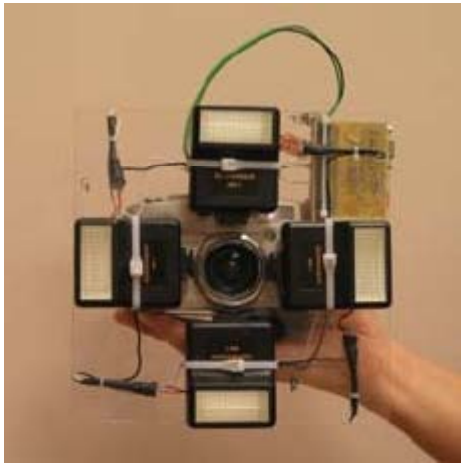
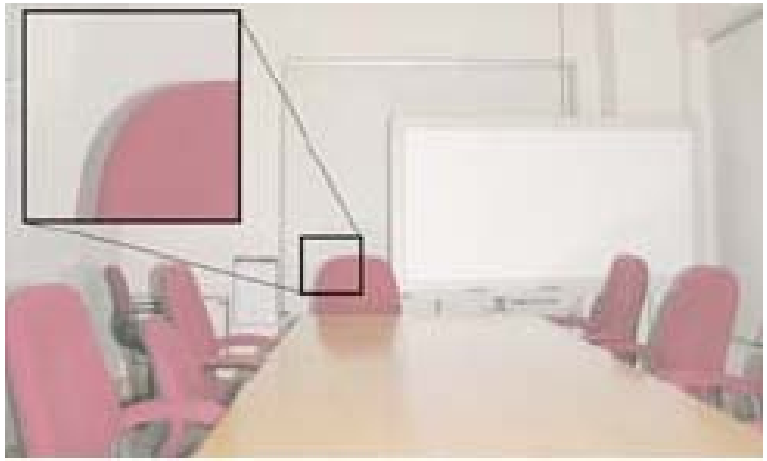
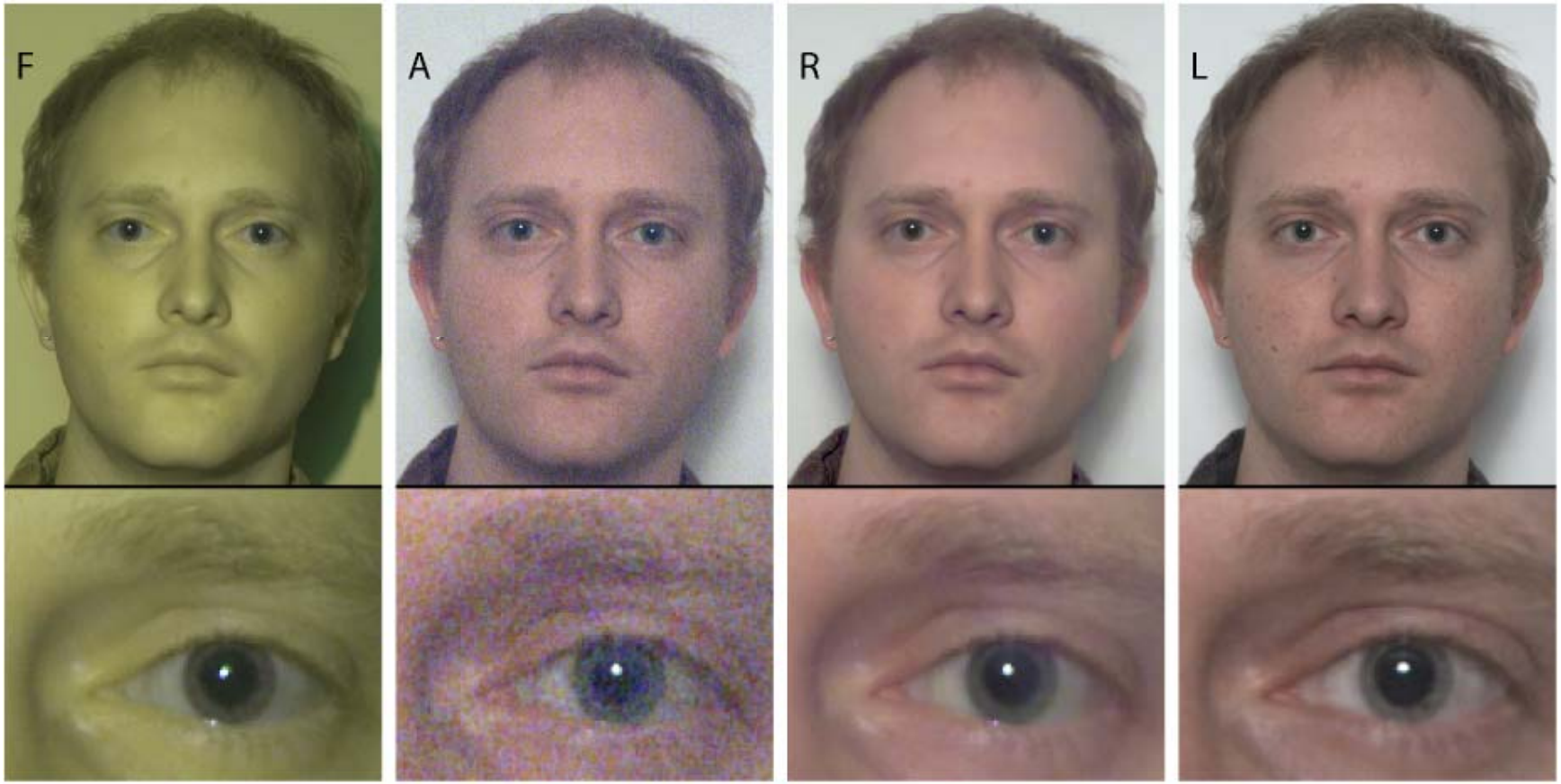
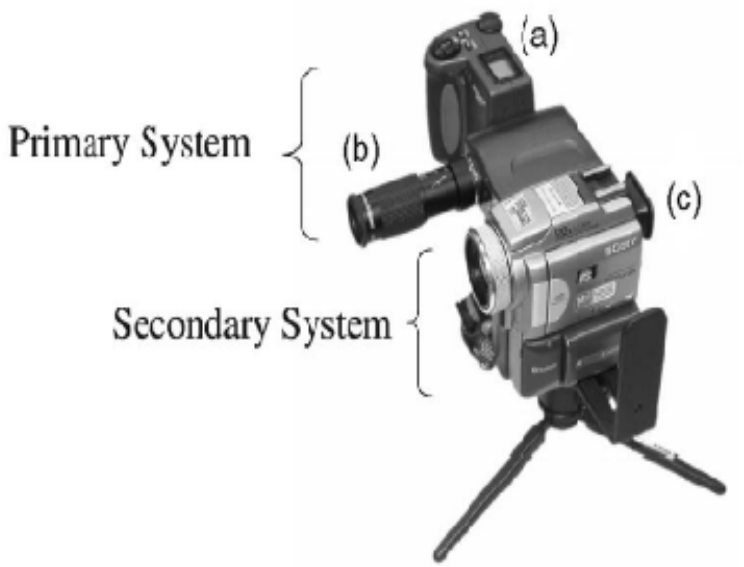




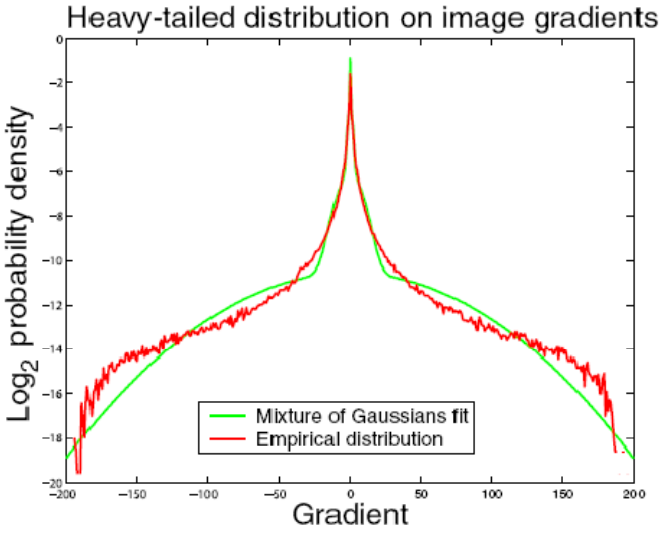
Dark flash photography



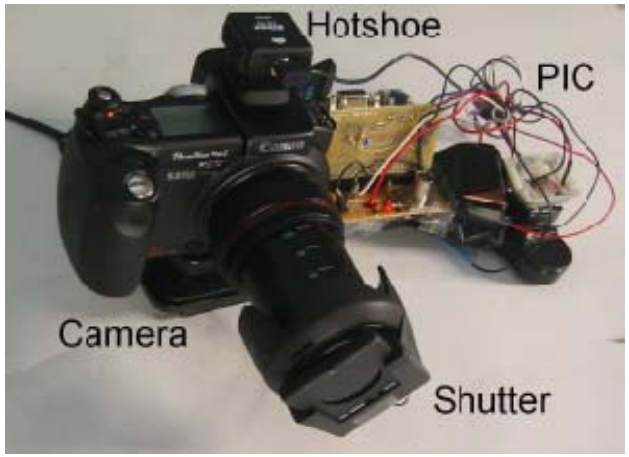
Motion-Based Motion Deblurring

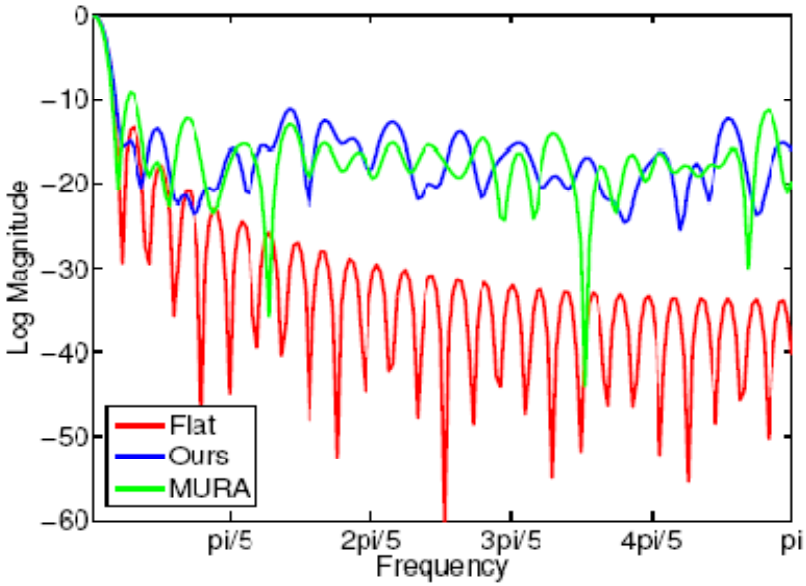


Removing Camera Shake from a Single Photograph



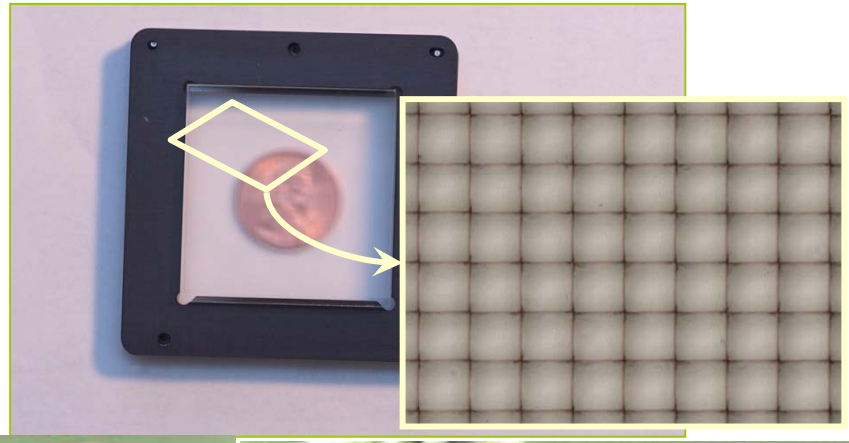
Motion Deblurring using Fluttered Shutter

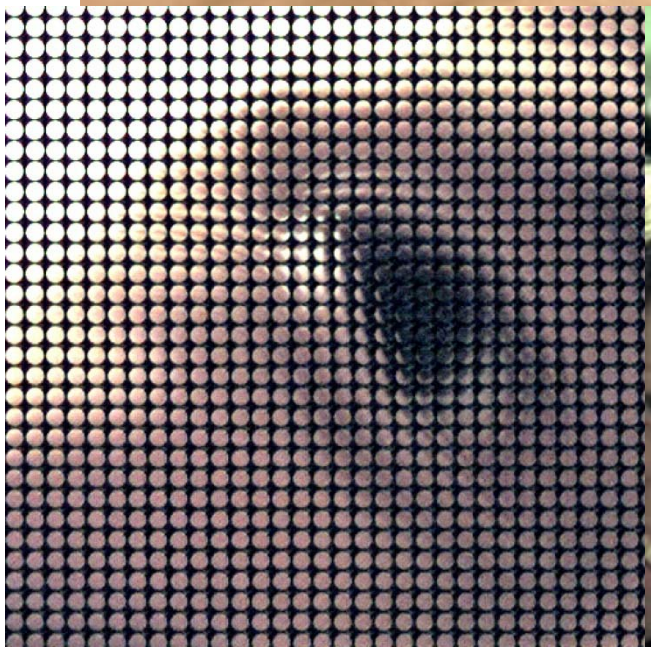




Scope

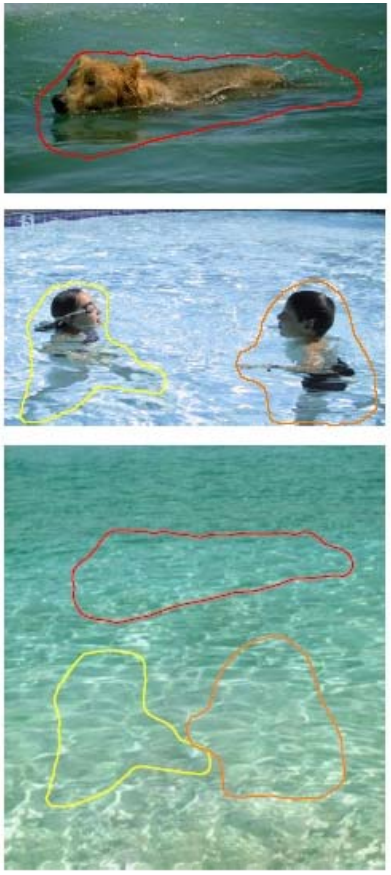
- Future cameras
- Plenoptic function and light fields





Scope

- Gradient image manipulation



sources/destinations

cloning

seamless cloning

Scope

- Taking great pictures

Art Wolfe

Ansel Adams

Scope

- Non-parametric image synthesis, inpainting, analogies

input images quilting results

A A' B B'

Figure 1 An image analogy. Our problem is to compute a new "analogous" image B' that relates to B in "the same way" as A' relates to A. Here, A, A', and B are inputs to our algorithm, and B' is the output. The full-size images are shown in Figures 10 and 11.

Scope

Motion analysis

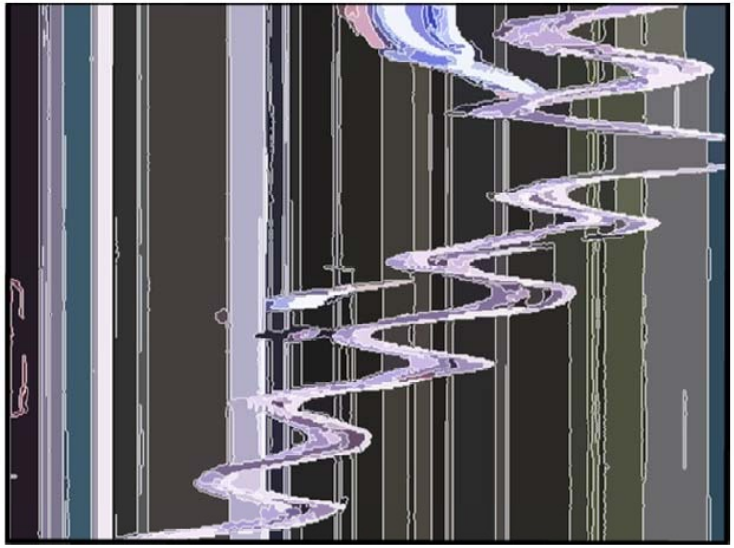


Image Inpainting

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Object Removal by Exemplar-Based Inpainting

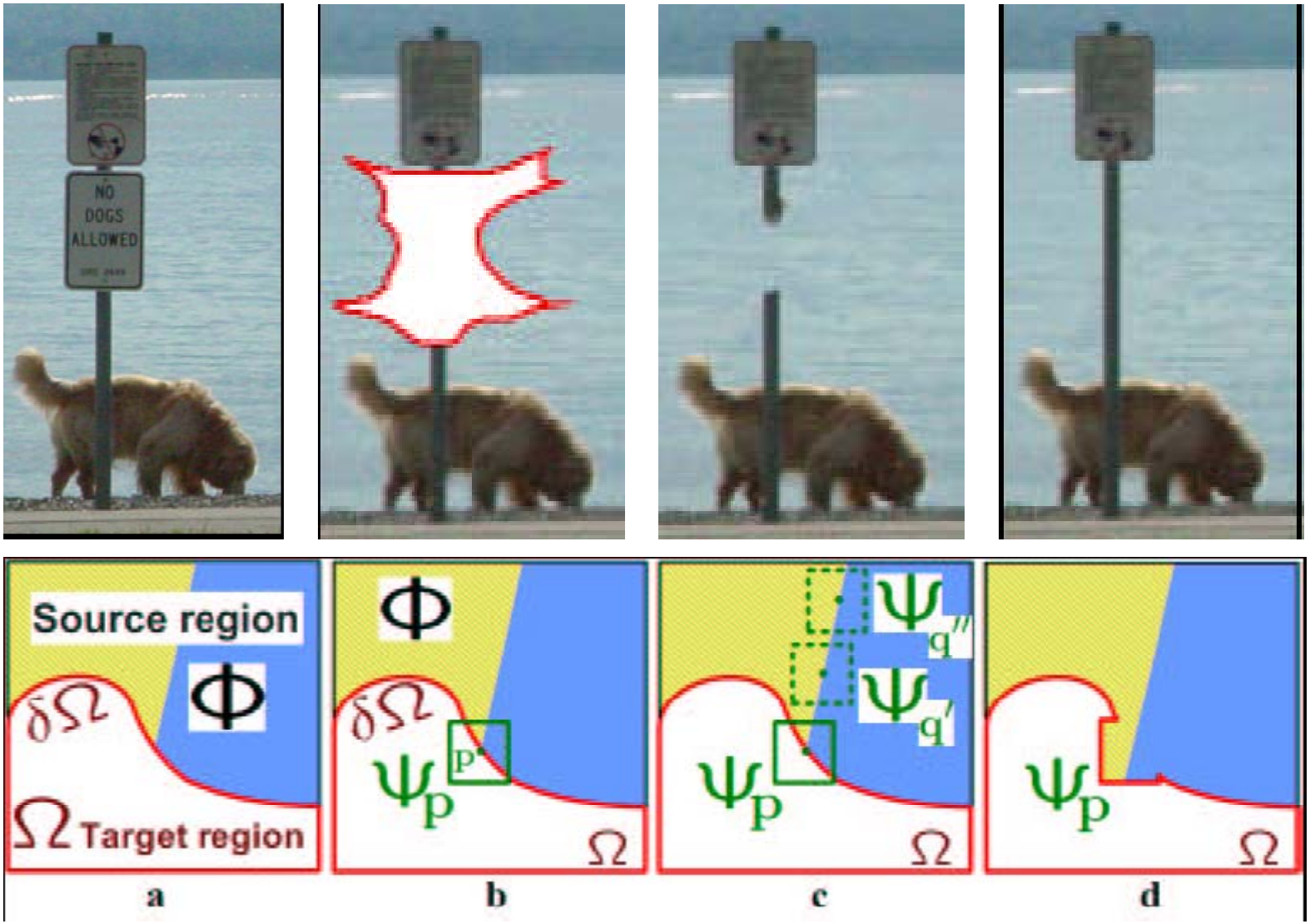

Image Completion with Structure Propagation

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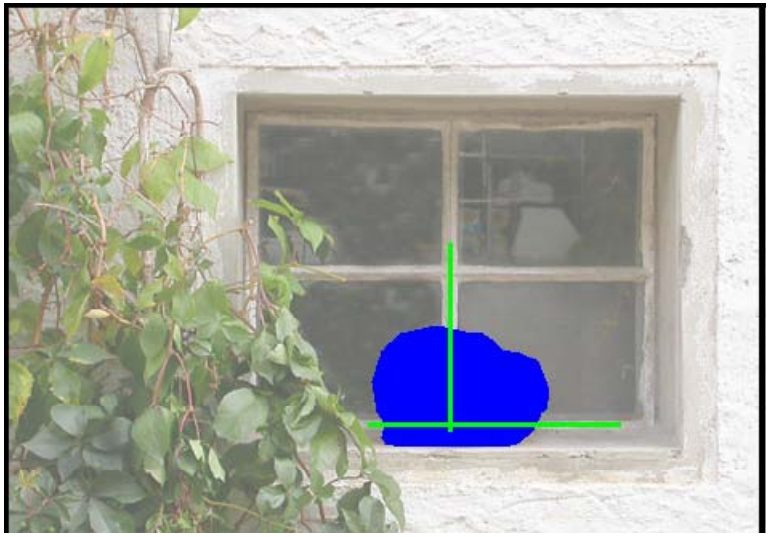
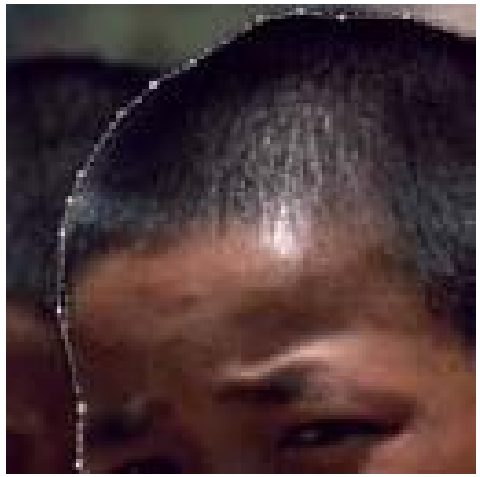
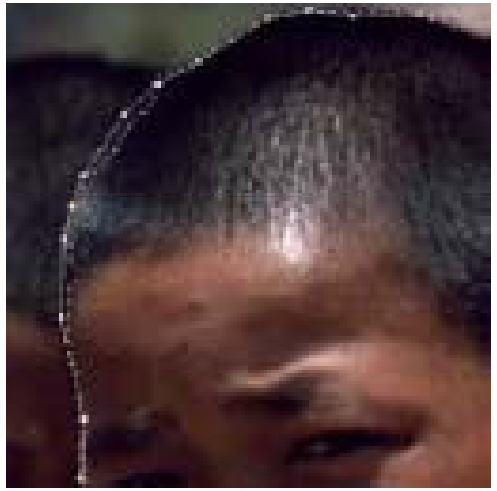


Lazy snapping





Grab Cut - Interactive Foreground Extraction using Iterated Graph Cuts

Tools

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- Graph cuts,
  - Segmentation and mosaicing
- Gradient domain operations,
  - Tone mapping, fusion and matting
- Bilateral filters,
  - Denoising, image enhancement