Camera Culture

Creating new ways to capture and share visual information

MIT Media Lab
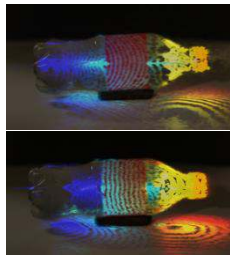**Prof. Ramesh Raskar**
raskar.info

Femto-photography

1. Trillion Frames per Second Imaging

A camera fast enough to capture light pulses moving through objects. We use 'light in motion' to understand reflectance, absorption and scattering properties of materials.

2. Looking Around Corners

Multi-path Analysis

2nd Bounce
1st Bounce
3rd Bounce

▶ Reconstructed Image

Using short laser pulses and a fast detector, we built a device that can look around corners with no imaging device in the line of sight using scattered light and time resolved imaging.

3. Time-of-Flight fluorescence

We repurpose a time-of-flight camera to record nanosecond dynamics of fluorescent materials, and perform fluorescence imaging through turbid layers

Computational Photography

4. Compressive Light Field Camera

A frugal camera design exploiting the fundamental dictionary of light fields for single-shot capture of light fields at full sensor resolution.

### 5. Multi-depth Time-of-Flight Cameras

0.2 ns
12 ns
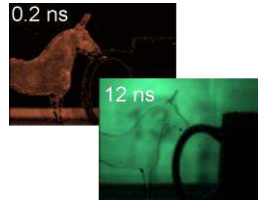
We repurpose a time-of-flight camera using coded illumination to recover time profiles of large-scale scenes and to acquire multiple depths per pixel.

6. Color Primaries

A new camera design with switchable color filter arrays for optimal color fidelity and picture quality on scene geometry, color and illumination.

7. Flutter-Shutter
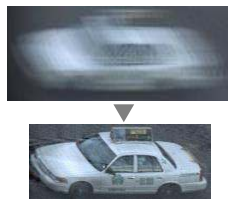
A camera that codes exposure time with a binary pseudo-sequence to deconvolve and remove motion blur in textured backgrounds and partial occluders.

8. Skin Perfusion Photography
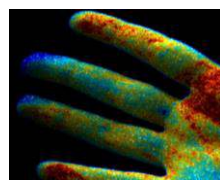
Using computational photography to recover in-vivo blood flow speed in skin tissue.

Computational Displays

### 9. Tensor Display: Glasses-free 3D HDTV

Compressive light field displays employing a stack of time-multiplexed, light-attenuating layers with uniform or directional backlighting. They exhibit increased brightness and refresh rate.

10. Lightfield Projector
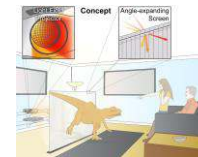
A compressive, glasses-free 3D projection system for the future of home and commercial theater.

11. BIDI Screen
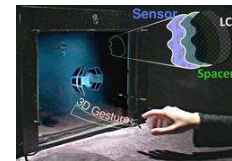
A thin, depth-sensing LCD for 3D interaction using light fields which supports both 2D multi-touch and unencumbered 3D gestures.
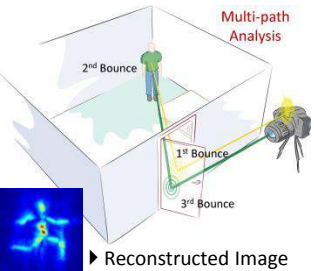
12. 8D Display

By capturing and displaying a 4D light field, it can create arbitrary directional illumination patterns and record their interaction with physical objects.

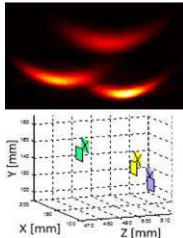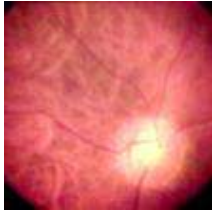### 13. Efficient Rendering for Compressive Displays

Combining sampling, rendering, and display-specific optimization into a single framework, the algorithm facilitates light field synthesis with reduced computational resources.

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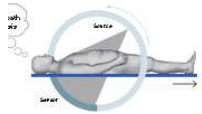
Health & Wellness

14. Retinal Imaging

With simplified optics and clever illumination, we visualize images of the retina in a standalone device easily operated by the end user, enabling disease diagnosis.

15. NETRA/CATRA

Low-cost cell-phone attachments that measure eye-glass prescription and cataract information from the eye.

16. High-speed Tomography

A compact, fast CAT scan machine using no mechanical moving parts or synchronization.

17. Cellphone Microscopy

A platform for computational microscopy and remote healthcare

18. Imaging Through Skin

We utilize high spatio-frequency patterns with state of the art dictionary learning algorithms to enhance vein structures under the skin.
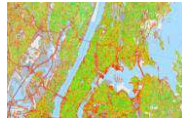
19. Eyeglass Free Tablets

A display that frees the viewer from using glasses and optical corrections while looking at it
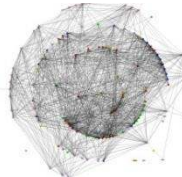
Visual Social Computing & HCI

20. Streetscore

A computer vision algorithm, trained using crowdsourced data, that can predict the perceived safety of streetscapes.
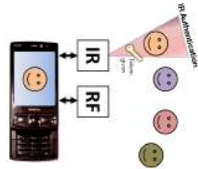
21. Photocloud

A near real-time system for interactively exploring a collectively captured moment without explicit 3D reconstruction.
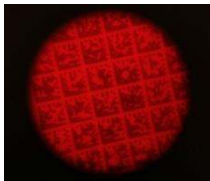
22. Vision Blocks

On-demand, in-browser and mobile, computer vision application-building platform for the wide public. Without prior programming experience, users create and share computer vision applications.
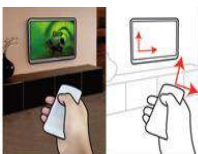
23. Lenschat

LensChat allows users to share mutual photos with friends or borrow the perspective and abilities of many cameras.

24. Bokode

Low-cost, passive optical design so that bar codes can be shrunk to fewer than 1mm and read by ordinary cameras several meters away.
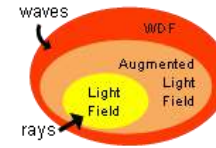
25. Specklesense

Gesture and motion-sensing configurations based on laser speckle analysis for fast, precise, extremely compact, and low cost interactivity.
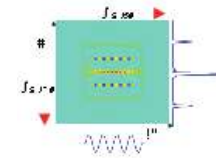
# Theory of Light Propagation

26. Augmented Light Fields

A theoretical framework that expands light field representations to describe phase and diffraction effects by using the Wigner Distribution Function.

27. Holograms vs. Parallax Barriers

We define connections between parallax barrier displays and holographic displays by analyzing their operations and limitations in phase space.

28. Ray-Based Diffraction Model
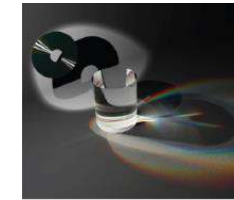
Simplified capture of a diffraction model for computer graphics applications.

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