EE7700 – Computational Photography Spring 2013

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In recent years, the fields of computer graphics, computer vision and photography have converged to give rise to a new and active research area -- Computational Photography. The goal is to overcome the limitations of traditional cameras and obtain additional scene-related information using computational techniques and new imaging systems.

Outline

- Introduction to Camera
  - Optics
    Pinhole camera, lenses, perspective transformation, aperture, shutter, depth of field, aberrations, point spread function
  - Sensors
    Photons to electrons, microlenses, aliasing and antialiasing, noise sources, dynamic range, ISO
- In-camera technologies
  - Focusing and metering
    Auto focusing, metering technology, shooting modes
  - Post-capture pipeline
    Color capture, demosaicking, white balancing, denoising, enhancement, EXIF data
- Extending the dynamic range
    High dynamic range imaging, HDR image capture, tonemapping
- Extending the depth of field
  - Light fields and plenoptic cameras
    Light field theory, light field capture techniques, digital refocusing, 3D display
  - Computational extension of depth of field
    Deconvolution approach, coded apertures, focus sweep, wavefront coding
- Improving illumination
  - Programmable illumination
  - Flash + no-flash imaging
- Removing camera shake and motion blur
  - Optical image stabilization
    In-lens and in-body technologies, fluttered shutter
  - Digital image stabilization
    Blind image deconvolution
- Combining multiple images
  - Panorama creation
    Image registration, warping, blending
  - Super-resolution
    Optical flow estimation, multi-frame restoration
  - Compositing and editing
    Graph cut segmentation, content-aware image resizing

Grading (Tentative)

- Assignments – 30%
- Semester Project – 30%
- Midterm – 20%
- Final – 20%