# New Seminar for Graduate and Undergrad Students!

Looking for a thought-provoking yet 'gently introductory' new seminar for this fall quarter?
This newly-revised introductory seminar now has no prerequisites! All graduate students welcome (EECS 495), and also all undergrads (EECS 395) comfortable with linear algebra and a little C/C++ programming.

## Computational Photography: EECS 395/495

9:30-10:50AM Tues/Thurs, Tech L-150. Instructor: Jack Tumblin (jet@eecs.northwestern.edu)
Assigned readings, discussion and lecture, demonstrations: seminar projects instead of exams.
**No pre-requisites!** Our topics include:

### How, specifically, does Google 'StreetView' work?

http://maps.google.com/intl/en/help/maps/streetview/#utm_campaign=en&utm_medium=van&utm_source=en-van-na-us-gns-svn
Would you like to help build a 'mini-StreetView' that navigates the maze of the Technological Institute? We could do that…

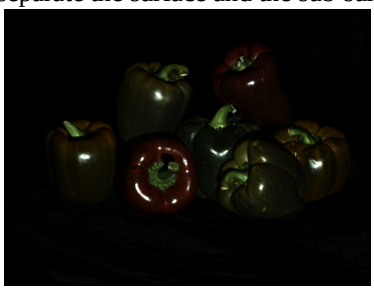
### How can *you* make your own 'Trompe l'Oeil' picture on a walls, floors, or ceilings like these?

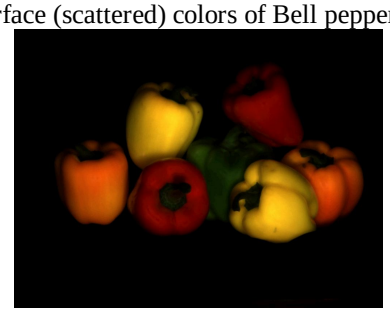
http://www.huffingtonpost.com/2010/03/01/3d-sidwalk-art-that-will_n_478649.html#s71257&title=Rocky_Road
Could you make a computer system that guides and corrects you as you paint your own accurate Trompe l'Oeil image, even if (like me) you have no drawing, sketching, or painting skills at all? (Projective Homographies; reflectance cancellations)

### How could you 'erase' a white-board purely by illumination? (HINT: camera + projector + computing)

What methods would permit you to cut, paste, and resize what you see written there, without touching the board at all?
How can we take photographs that separate the surface and the sub-surface (scattered) colors of Bell peppers like these?


a) Original Scene:

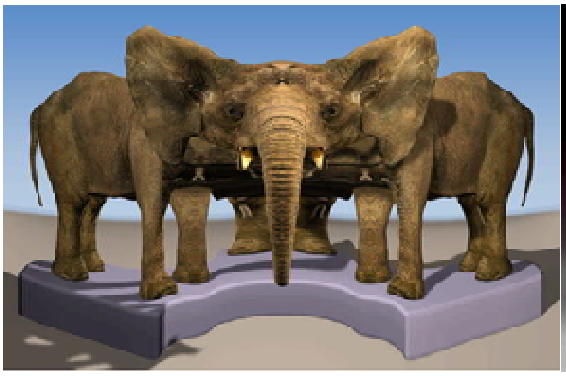

Surface Color: (no scattering):

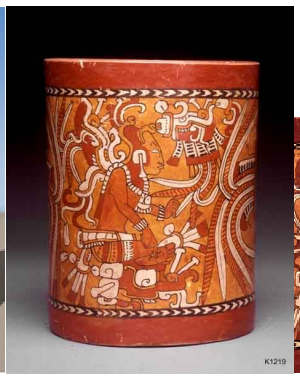

Sub-surface Color: (scattering only)

http://www.cs.columbia.edu/CAVE/projects/separation/images_lg/Peppers_Scene.jpg
http://www.cs.columbia.edu/CAVE/projects/separation/images_lg/Peppers_Direct.jpg
http://www.cs.columbia.edu/CAVE/projects/separation/images_lg/Peppers_Global.jpg

### How can an accurate photo 'wrap around' an object like this taxidermy elephant?

Similarly, how could you 'unwrap' the painting on an ancient vase like this one? (Multi-COP images: 4D ray set edits):






For more details, see the course listing below. I hope you'll join us for this newly-reworked course!

Regards,
-Jack Tumblin

# Computational Photography: What and How

***Spring 2011 EECS 395/495: 9:30-10:50AM Tues/Thurs Tech L-150***

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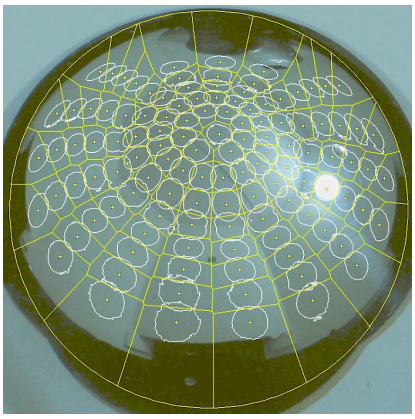
**Instructor:** Jack Tumblin, EECS
**Office address:**. Rm 3.230, Ford Design Center (top floor, southeast corner)
**Phone:** 847-467-2129
**E-mail:** jet@cs.northwestern.edu,
**Enrollment Limit:** 40



Spherical mirror maps incoming illumination (Huang 2009)

**CATALOG DESCRIPTION:**
Seminar to explore computational photography topics by selected readings, lectures on underlying principles, and self-directed projects.

**COURSE DESCRIPTION:** Computational photography combines plentiful low-cost computing, digital sensors, actuators, and lights to escape the limitations of traditional film-like methods. New methods offer unbounded dynamic range and variable focus, lighting, viewpoint, resolution and depth of field; hints about shape, reflectance, and location. Instead of fixed digital snapshots and video playback, computational methods promise more direct interactions to explore what we photograph.

**COURSE GOALS:** Students will learn a wide range of recent techniques, including mosaicking, panorama stitching with lens distortion correction, high dynamic range imaging and tone mapping, digital photomontage, flash/no-flash imaging, separating direct/indirect illumination with high-frequency illumination, image-based relighting, light field photography, all-focus imaging, coded aperture imaging, event-based time-lapse video and more. We will gain understanding of the underlying principles and mathematical tools involved, including lens basics, radiometry, projective geometry in 2D and 3D, paraxial ray descriptions of 4D light fields and 8-D reflectance fields, SVD, homographies (DLT), bilateral filtering, graph cuts, seam carving, and how to apply tomography to collections of photographs. We will learn to use some free/open source computational photography tools such as Hugin (panoramas), HDRshop/PFStools (tone map), Voodoo (Camera Tracking), etc. We will rely on class consensus to pursue greatest depth in topics of greatest interest.

**TEXTBOOK:** None: selected readings, starter code & course notes supplied.
**EVALUATION:** Student-guided projects; in-class presentations; take-home quizzes.
**COURSE COORDINATOR:** Jack Tumblin

**PREREQUISITES:** Linear Algebra, Calculus, Matlab. Recommend OpenGL and C/C++. No prior knowledge of optics, graphics, image processing and computer vision are required, but may prove helpful. Most students will need (and want) their own digital cameras for this course. We have only a few (3) for 2-day loans for student projects.