

Computational Photography (CS 498) – Fall 2010

Instructor: Derek Hoiem (dhoiem at uiuc ; Siebel Center 3312)

Office Hours: Mondays 10-11am + drop-ins

Class Time and Place: Tues and Thurs 11-12:15pm at Siebel Center 1103

Q&A Guru: Kevin Karsch (karsch1 at uiuc, Graphics Lab 3rd floor SC)

Syllabus

Take-home problems (updated 10/07)

Online Resources

Online Discussion: <http://groups.google.com/group/cs498-cp-uiuc>

Textbook: Computer Vision: Algorithms and Applications by Rick Szeliski (draft)

Matlab: Helpful Tutorials and References ; Writing Fast Code



Projects

Project 1: Hybrid Images



See [Results](#)

Class choice awards:

Project: [Jia-Bin Huang](#)
[Charles Park](#)

Result: [W. Liu: Underware Woman/Lion](#)
[G. Charwat: Who's sitting here?](#)
[S. Melnicki: Brimeley and Cat](#)

Project 2: Image Alignment



See [Results](#)

Class choice awards:

[Jia-bin Huang](#)
[Gunther Charwat](#)

Project 3: Gradient Domain Fusion



See [Results](#)

Class choice awards:

[Jia-bin Huang](#)
[Brett Jones](#)
[RJ Marsan](#)
[Brian Tran](#)

Project 4: Face Morphing



See [Results](#)

Class choice awards (multiway ties):

[Raj Sodhi](#) [Jia-Bin Huang](#)
[Brett Jones](#)
[Gunther Charwat](#) [Charles Park](#)

Project 5: Automatic Photo Stitching



See [Results](#)

Class choice award: TBA

Class Schedule (subject to change)

Date	Topic	Link	Reading/Notes
Aug 24 (Tues)	Introduction	ppt ; pdf	<i>S=Szeliski book</i>
	Basics of Working with Images		
Aug 26 (Thurs)	Pixels and image filters	ppt ; pdf	S3.2 (linear filtering) S3.3 (non-linear filtering)
Aug 31 (Tues)	Thinking in frequency	ppt ; pdf	S3.4 (fourier transforms) S2.3.3 (compression)

Sept 2 (Thurs)	Templates and image pyramids	ppt ; pdf	Extra office hours: 2-3pm S3.5.2 (image pyramids) S8.1.1 (pyramid alignment) Other reading: Burt Adelson 1983 – The Laplacian Pyramid
<i>Sept 6 (Mon)</i>	<i>Project 1 (Hybrid images) due</i>		DH in Greece (Sept 4-12)
Sept 7 (Tues)	Guest Lecture: David Forsyth Topic: Color and lighting	slides	S2.2 (light), S2.3.2 (color) or Forsyth and Ponce Ch 6
Sept 9 (Thurs)	Guest Lecture: David Forsyth Topic: Tone mapping	slides	S3.1 (histograms and color adjustment)
	The Digital Canvas: Coloring, Blending, Cutting, Synthesizing, and Warping Images		
Sept 14 (Tues)	Cutting: Intelligent Scissors and Graph Cuts	ppt ; pdf	Intelligent Scissors – Mortenson Barret (1995) GrabCut – Rother et al. (2004)
Sept 16 (Thurs)	Growing: Texture synthesis and hole filling	ppt ; pdf	Texture Synthesis – Efros Leung (1999) Image Quilting – Efros Freeman (2001) Image Analogies – Hertzmann et al. (2001)
<i>Sept 20 (Mon)</i>	<i>Project 2 (Image alignment) due</i>		
Sept 21 (Tues)	Pasting: Compositing and blending	ppt ; pdf	<i>Project 3 released</i> GradientShop Poisson Image Editing – Perez et al. (2003) Burt and Adelson, A multiresolution spline with application to image mosaics. ACM ToG (1983)
Sept 23 (Thurs)	Image warping (translation, rotation, scale, etc)	ppt ; pdf	S3.6 (warping)
Sept 28 (Tues)	Image morphing	ppt ; pdf	
Sept 30 (Thurs)	Guest Lecture: Ali Farhadi Topic: Fun with Faces	ppt ; pdf	DH in Pittsburgh (Sept 29 – Oct 2)
<i>Oct 4 (Mon)</i>	<i>Project 3 (Gradient domain fusion) due</i>		
Oct 5 (Tues)	The Pinhole Camera	ppt ; pdf	<i>Project 4 released</i> Derek's Scene Geometry Notes
Oct 7 (Thurs)	Single-view Metrology	ppt ; pdf	
Oct 12 (Tues)	Single-view 3D Reconstruction	ppt ; pdf	<i>Project 4 Face Labels Due</i> Tour into the picture (Horry et al. 1997)
	Working with Photo Collections		
Oct 14 (Thurs)	Matching and alignment with interest points	ppt ; pdf	Grauman/Leibe Draft Chapter on Local Features Optional: Lowe - SIFT paper
Oct 19 (Tues)	Automatic Photo Stitching and RANSAC	ppt ; pdf	Brown Lowe 2007 ; S9 (stitching); slides ; Szeliski Tutorial Draft
Oct 21 (Thurs)	Object recognition, retrieval, and augmented reality	ppt ; pdf	Grauman/Leibe Draft Visual Vocabularies ; S14.3
<i>Oct 25 (Mon)</i>	<i>Project 4 (Face morphing) due</i>		
Oct 26 (Tues)	Guest Lecture: Kevin Karsch Topic: The Image as a Virtual Stage	ppt ; pdf	<i>Project 5 released</i>
Oct 28 (Thurs)	Face detection and recognition	ppt ; pdf	
Nov 2 (Tues)	Opportunities of scale: texture synthesis, multi-view reconstruction, im2gps, tiny images, etc.	ppt ; pdf	Reading: Hays & Efros. Scene Completion Using Millions of Photographs
Nov 4 (Thurs)	Midterm Review	pdf	
Nov 9 (Tues)	Midterm Exam		
	More Topics of Interest		
Nov 11 (Thurs)	Guest Lecture: Russ Hewett 1) Tomography; 2) Photography; 3) Digital Image Correlation	pdf (1) pdf (2) pdf (3)	
<i>Nov 15 (Mon)</i>	<i>Project 5 (Image stitching) due</i>		
Nov 16 (Tues)	Image-based Lighting: ray tracing, environment maps, light probes	ppt ; pdf	Reading (do read this): Debevec, Image-based Lighting Tutorial (2005)
Nov 18 (Thurs)	Image-based Lighting cont.: HDR light probes, relighting	ppt ; pdf	Optional Reading: Debevec & Malik, "Recovering High Dynamic Range Radiance Maps from Photographs", SIGGRAPH 1997 Debevec, Rendering Synthetic Objects in Real Scenes, 1998
<i>Nov 23, 25</i>	<i>NO CLASS - Thanksgiving Break!</i>		
Nov 30 (Tues)	Computational approaches to cameras		
Dec 2 (Thurs)	Detecting fakes		

Dec 7 (Tues)	Last day – wrap up		
Dec 14 (Tues)	Final Project Presentations (1:30 – 4:30pm)		

Some ideas for special topics:

Students, let me know if there's something you'd especially like to cover.

Some ideas: 1) Background subtraction and alpha matting; 2) Special or Programmable cameras; 3) Environment maps and image-based lighting; 4) What makes a good (or real) photo?; 5) Video textures; 6) Recoloring; 7) Tricks with focus or aperture (e.g. creating HDR images from multiple exposures); 8) Physics-based models (modeling fog, water, etc.); 9) Deconvolution and deblurring; 10) superresolution; 11) Non-photo realistic rendering

Similar Courses in Other Universities

[Computational Photography](#) (Efros, CMU)

[Computational Photography](#) (Hays, Brown)

[Computational Photography SIGGRAPH Course](#) (Raskar & Tumblin)

[Computational Camera and Photography](#) (Raskar, MIT Media Lab)

[Digital and Computational Photography](#) (Durand & Freeman, MIT)

[Computational Photography](#) (Essa, Georgia Tech)

[Computational Photography](#) (Levoy, Adams, Pulli, Stanford)

[Computational Photography](#) (Lazebnik, UNC)

[Computational Photography](#) (Fergus, NYU)

[Internet Vision](#) (T.Berg, SUNY)

[Computer Vision](#) (Seitz & Szeliski, UWashington)

[Introduction to Visual Computing and Visual Modeling](#) (Kutulakos, UToronto)

[Symposium on Computational Photography and Video](#) (May 2005, MIT)

Credits and Course Notes

I am grateful for the many preceding efforts to design excellent courses and course notes for this topic. I am particularly indebted to Alyosha Efros for borrowing much of his course and project design, to Rick Szeliski for making the draft of his book available, to James Hays for course suggestions and materials, and to Steve Seitz, Lana Lazebnik, Silvio Savarese, among others for their slides (as credited within). Anyone who would like to use my slides is more than welcome; please do credit the original sources where appropriate.