CS 684 Multiple View Geometry and 3D Reconstruction From Images, Spring 2005

Time, Location

The course meets TR 03:30PM-04:45PM in FB B13

Introduction

This course will be about the fundamentals of multiple view geometry and automatic 3D reconstruction from images and video. Specifically, all the necessary steps to reconstruct textured surfaces from video will be discussed.

Professor

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Office Hours:

TR 02:30PM - 03:20PM and by appointment
Location: Robotics 514C

Course Materials, Content

You are responsible for obtaining a copy of the textbook (Hartley & Zisserman) listed below. It is unfortunately going to be late into the bookstore, so I recommend buying it directly online. The first chapter is also available online on the books homepage.
If it will take long to get the book online, the authors have promised me to provide the first few chapters in pdf, so let me know if you have trouble getting the book in time.
The course will cover the material in the book with emphasis as described in the schedule below and with additional topics to cover feature detection and matching and methods for dense stereo.
Alternative sources of information, which covers also correspondence extraction and dense stereo is my thesis (can be downloaded from my list of publications), or my colleague Marc Pollefeys' UNC webpage, specifically his tutorial on 3D Modeling.

The webpage http://www.vis.uky.edu/~dnister/Teaching/CS684/cs684.html will be the primary method of distributing information regarding the course.

Main Text:

R. Hartley, A. Zisserman, Multiple View Geometry in Computer Vision, Cambridge University Press, ISBN 0521-54051-8, 2003.

Reference Texts:

M. Pollefeys, Online Tutorial on 3D modeling from images.
D. Nister, PhD Thesis, Automatic dense reconstruction from uncalibrated video sequences.
Press et al, Numerical Recipes in C (or C++).
J. Semple and G. Kneebone, Algebraic Projective Geometry, ISBN 0-19-8503636, 1952.
Y. Ma, S. Soatto, J. Kosecka, S. Sastry, An Invitation to 3-D Vision.
Faugeras and Luong, The Geometry of Multiple Images.

Homeworks

There will be homeworks, a midterm and a final. Detailed instructions for each homework will be made available on the web page. The homeworks are to be completed by each student independently. You may discuss ideas with others, but no sharing of exact solution will be allowed. The University of Kentucky's guidelines regarding academic dishonesty will be strictly enforced. All relevant sources should be cited in the submissions.

Submissions and Deadlines

The homeworks should be submitted to dnister at cs.uky.edu on or before the due-date. The email should have "CS684-<Your name>" as the title. Late submissions will incur a 10% deduction. Submissions more than one week late will incur a 50% deduction.

Grading and Assignment Policies

The grade in CS684 will be determined according to these weights:

Homeworks	40%
Midterm	25%
Final	25%
Participation	10%

Central Educational Objectives

- Single View Geometry
- Two View Geometry
- Robust Estimation
- Correspondence extraction and Dense Stereo Reconstruction

Week	Date	CS 684 Syllabus Spring 2005
1		
	Thu 1/13	Introduction, Overview
2	Tu 1/18	The 3D Estimation 'Pipeline'
	Thu 1/20	Triangulation, Robust Estimation, RANSAC
3	Tu 1/25	LU, QR, SVD, eig, Determinants, Polynomial roots
	Thu 1/27	Bayesian formulations, Maximum Likelihood
4	Tu 2/1	The correspondence problem, Feature Detection Affine Invariant Regions (**Robust Estimation Homework Due)**
	Thu 2/3	**Guest Lecture: Etienne Grossman, Least-Squares 3D reconstruction from one or more views and geometric clues**
5	Tu 2/8	Feature Matching, Normalized Correlation, Descriptors
	Thu 2/10	Planar Projective Geometry, Points, Lines
6	Tu 2/15	3D Projective Geometry, Planes, Lines, Conics, Quadrics
	Thu 2/17	Single View Geometry, Transformations, Homographies
7	Tu 2/22	Calibration, Radial Distortion,
	Thu 2/24	Sampson Approximation
8	Tu 3/1	Iterative Refinement, Levenberg Marquardt
	Thu 3/3	**Midterm**
9	Tu 3/8	Two View Geometry
	Thu 3/10	The Fundamental Matrix (**Single View Homework Due)**
10	Tu 3/15	**Spring Break: No Class**
	Thu 3/17	**Spring Break: No Class**
11	Tu 3/22	The twisted pair, Calibrated vs Uncalibrated
	Thu 3/24	Self-Calibration
12	Tu 3/29	Stereo, Space Carving (**Two View Homework Due)**
	Thu 3/31	Rectification
13	Tu 4/5	Stereo with sharp edges, Optimization schemes
	Thu 4/7	Dynamic Programming, Graph Cuts, Loopy Belief
14	Tu 4/12	Shape from X (Motion, Focus, Texture, Shading)
	Thu 4/14	Iterative refinement, Covariance
15	Tu 4/19	Bundle Adjustment (**Stereo Homework Due)**
	Thu 4/21	Cayley Grassman Algebra, Groebner bases
16	Tu 4/26	Multiview Tensors
	Thu 4/28	View-Dependent Rendering
Final		**Final**