CS 512: Computer Vision

Objectives

- To introduce the fundamental topics in computer vision and the application of statistical estimation techniques to this area.

Prerequisites

- CS 430.

Syllabus

- Introduction 1.5 hours
  - Overview of computer vision, related areas, and applications
- Feature extraction 4.5 hours
  - Detection of edges in images
  - Canny edge detector
  - Detection of corners
  - Harris corner detector
- Probabilistic modeling 4.5 hours
  - Review of probability and Bayes' theorem
  - Principles of probabilistic modeling
  - Estimation paradigms
  - Maximum likelihood estimation (MLE)
  - Bayesian estimation
- Camera calibration 4.5 hours
  - Camera models
  - Intrinsic and extrinsic parameters
  - Radial lens distortion
  - Direct parameter calibration
  - Camera parameters from the projection matrix
- Epipolar geometry 4.5 hours
  - Introduction to projective geometry
  - Epipolar constraints
  - The essential and fundamental matrices
- Statistical estimation 4.5 hours
  - The Expectation-Maximization (EM) algorithm
  - Implementation issues
  - EM variants
- Model reconstruction 4.5 hours
  - Reconstruction by triangulation
  - Reconstruction up to a scale factor
  - Reconstruction up to a projective transformation
- Statistical filtering 4.5 hours
  - Iterated estimation
  - Observability and linear systems
  - The Kalman Filter
  - The Extended Kalman Filter
- Motion Estimation 6.0 hours
  - Motion field of rigid objects
  - Motion parallax
  - Optical flow
  - The image brightness constancy equation
  - Differential techniques
  - Feature-based techniques
- Recognition 6.0 hours
  - Invariants
  - Invariant-based recognition algorithms
  - Image eigenspaces
  - Introduction to object modeling; shape from single image cues

Total 45 hours

Edited March 2006 (**html**, **css** checks)