NICTA

Computer Vision Coursework

Antonio Robles-Kelly

Title of the course: Introductory course in Computer Vision and Image Understanding

Formal Description of course content: This course provides an overview of geometric, statistical and morphological methods in computer vision, pattern recognition and image understanding. The course aims at covering the fundamental principles of image processing, multiple view geometry and probabilistic techniques as related to applications in the scope of robotic and machine vision and image processing by introducing the student to classical problems found in the literature, such as segmentation and grouping, matching, classification and recognition.

Informal Description of course: Recently, techniques from computer vision, image understanding and pattern recognition have been used to develop a powerful array of applications in a number of fields, ranging from health to HCI and security. For instance, computer vision methods have been used for purposes of segmentation and grouping, tracking, image database indexing and retrieval and urban simulation and visualisation. The course is designed to give those students who are working in problems akin to computer vision, image understanding, pattern recognition and robotics an insight into the concepts, methods and tools essential for conducting effective research in machine vision and its applications. Upon successful completion of the course, the student will also have the knowledge required to understand the nature of these methods and the settings in which they are most effective.

Curriculum: This course will be based on excerpts from the following books:

- D. Ballard and C. Brown, Computer Vision, Prentice Hall, 1982.
- B. Horn, Robot Vision, McGraw-Hill, 1986.
- R. C. Gonzalez and R. E. Woods, Digital Image Processing, Prentice Hall, 2002.
- D. A. Forsyth and J. Ponce, Computer Vision: A Modern Approach, Prentice Hall, 2002.
- R. O. Duda and P. E. Hart, Pattern Classification, Wiley Interscience, 2000

Syllabus:

- Overview of Computer Vision, Image Understanding and Pattern Recognition
  - What is Computer Vision?
  - The physics of imaging.
  - Spectral imaging and vision beyond the visible spectrum
  - Representing, acquiring, and displaying images.
- Image processing
  - Introduction to digital image processing
  - Denoising and deblurring
- Paradigms of Computer Vision
  - Pixels, lines, boundaries, regions, local descriptors and object representations
  - Bottom-up vs. top-down approaches.
  - Grouping as a perceptual organisation problem

- Stereo vision and motion
  - 3D view geometry
  - Optical Flow
  - Bundle Adjustment
- "Low-level", "intermediate-level", and "high-level" vision
  - The recovery of elementary of image features, i.e. lines, edges and corners.
  - The recovery of locally invariant image features, i.e. SIFT, MSERs, EBR and HOG.
  - Recognition and identification
- Graph-based structural pattern recognition methods
  - Graph-spectral methods for structural pattern recognition
  - Inference in graphical models: The EM algorithm
  - Statistical methods for classification and graph partitioning
- Applications of computer vision, pattern recognition and image understanding
  - Face and text recognition
  - Tracking
  - Computational Photography

Prerequisites, entry requirements: Working knowledge of probability theory and linear algebra at an undergraduate level. An undergraduate engineering, physics or maths degree is required.

Assumed knowledge of course: Basic probability theory and linear algebra. Basic knowledge of combinatorics is desirable.

Presenter(s): TBA

Important Dates: TBA