ET3112 IMAGE PROCESSING AND MACHINE VISION

Course Outline—January 12, 2024

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1 Introduction

Digital image processing helps us enhance images to make them visually pleasing, or accentuate regions or features of the image to better represent the content. For example, we may wish to enhance the brightness and contrast to make a better print of a photograph, similar to popular photo-processing software. In a magnetic resonance image of the brain, we may want to accentuate a certain region of image intensities to see the certain parts of the brain. Image analysis and computer vision, which go beyond image processing, help us to make decisions based on the contents of the image. Computer vision extensively uses machine learning, particularly deep learning. This course will first give you the basic knowledge required to enter into this exciting field, and equip you with basic tools to do image processing and computer vision. In the latter part of the course, we will learn to apply the knowledge in real problems.

2 Outcomes

Aim: To equip the students with the basic knowledge and tools to process a digital image as done in common image processing software packages and implement simple machine vision algorithms.
After completing this course you will be able to

- Apply image processing algorithms for image enhancement,
- Apply machine vision algorithms for detection and recognition, and
- Design machine vision solutions for common problems.

3 Contents

1. Early vision [Dr. Ranga Rodrigo]
   (a) Point operations, liner filtering, and edge detection
   (b) Cameras, light, and color
   (c) Feature extraction
   (d) Optical flow (briefly)
   (e) Morphological processing
   (f) Frequency domain processing.
2. Mid-level vinson [Dr. Sampath Perera]
   (a) Fitting: least squares, total squares, RANSAC, Hough lines
   (b) Alignment
   (c) Image stitching
3. Multiple-View Geometry [Dr. Ranga Rodrigo]
   (a) Epipolar geometry
   (b) Two-view stereo
   (c) Structure from motion
4. Recognition [Dr. Sampath Perera]
   (a) Basic classification
   (b) Object detection
   (c) Segmentation
   (d) Deep learning in classification and detection

4 Prerequisites

Mathematics. Programming skills in Python.

5 Contact Hours, Course Material, Etc.

Instructors:	Dr. Ranga Rodrigo. ranga@uom.lk, 011 264 0422.
Instructors:	Dr. Sampath Perera. sampathk@uom.lk, 011 264 0422.
Lectures:	2 hours per week.
Labs:	On your own for assignment and projects.

Item	Date	Weight	Minimum	Comments
In-class exercises	In each class	5%	50%	Easy
Assignment 1	To be scheduled	5%	50%	Easy
Assignment 2	To be scheduled	5%	50%	Easy
Assignment 3	To be scheduled	5%	50%	Moderately difficult
Assignment 4	To be scheduled	10%	50%	Moderately difficult
Final examination	To be scheduled	70%	50%	?

6 Books

I will base this course on Prof. Svetlana Lazebnik's course on computer vision (`https://slazebni.cs.illinois.edu/fall22/`). Slides will also be mostly from this course or its earlier versions. Gonzalez and Woods [2008], Forsyth and Ponce [2003], Szeliski [2010], Jain [1986], Sonka et al. [2007], and Goodfellow et al. [2016].

Bibliography

David A. Forsyth and Jean Ponce. *Computer Vision: A Modern Approach*. Prentice Hall, 2003. ISBN 0-12-085198-1.

Rafael C. Gonzalez and Richard E. Woods. *Digital Image Processing*. Prentice-Hall Inc., Upper Saddle River, New Jersey 07458, 3rd edition, 2008. ISBN 978-81-203-3640-7.

Ian Goodfellow, Yoshua Bengio, and Aaron Courville. *Deep Learning*. MIT Press, 2016.

Anil K. Jain. *Fundamentals of Digital Image Processing*. Prentice-Hall Inc., Englewood Cliffs, New Jersey 07632, 1986. ISBN 0-13-336165-9.

Milan Sonka, Vaclav Hlavac, and Roger Boyle. *Image Processing: Analysis and Machine Vision*. HB, 3rd edition, 2007. ISBN ISBN/ISSN 0-495-08252-X.

Richard Szeliski. *Computer Vision: Algorithms and Applications*. Springer, first edition, 2010.