

COURSE DESCRIPTION

Department and Course Number: CSCI 581

Course Title: Special Topics in Computer Science
(Topic described is Digital Image Analysis.)

Current Catalog Description: Special Topics in Computer Science

Total Credits: 3 hours

Coordinator: H. Conrad Cunningham, Chair & Associate Professor of Computer and Information Science. Developer of Digital Image Analysis topic is Xiaojun Qi, Visiting Professor of Computer and Information Science.

Textbook: Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing, 2nd Edition*. Prentice Hall, 2002. ISBN: 0-201-18075-8.

Other required materials: Anil K. Jain, *Fundamentals of Digital Image Processing*. Prentice Hall, 1989. ISBN: 0-133-36165-9. Kenneth R. Castleman, *Digital Image Processing*. Prentice Hall, 1996. ISBN: 0-132-11467-4.

References: <http://www.cs.olemiss.edu/~xqi/ImageProcessing.html>

Course Goals: The topics covered range from some basic processing techniques (enhancement, morphology, and segmentation) to some advanced ones (region formation and edge detection). A new look at image data compression is also introduced. The emphasis is on the application of theory.

This course will give students hands-on experiences on using tools such as Matlab to process digital images, i.e., something beyond the functionalities provided by tools such as Photoshop. The course provides an introduction to basic concepts and methodologies for digital image processing.

Prerequisites by Topic: Consent of instructor. For the Digital Image Analysis topic, computer science students should have completed the equivalent of CSCI 211 and MATH 301. Students in other fields should have familiarity with programming in C, C++, or Java, have completed the undergraduate calculus sequence, and have the permission of the instructor.

Major Topics Covered in the Course:

1. Introduction (3 hours)
2. Digital Images (3 hours)
 - 2.1 Digital Image Definitions and Concepts
 - 2.2 Images as Surfaces
 - 2.3 Multi-channel Images and Color
 - 2.4. Matlab for Image Processing
3. Digital Image Fundamentals (15 hours)
 - 3.1 Image Enhancement
 - 3.1.1 Image Enhancement in the Spatial Domain
 - 3.1.2 Image Enhancement in the Frequency Domain
 - 3.2 Image Morphology (9 hours)
 - 3.2.1 Dilation and Erosion
 - 3.2.2 Opening and Closing
 - 3.2.3 Filters
 - 3.2.4 Transformation
 - 3.2.5 Some Basic Morphological Algorithms
 - 3.3 Basic Image Segmentation (3 hours)

- 3.3.1 Picture Tree
- 3.3.2 Quad Picture Tree
- 3.3.3 Region Adjacency Graph
- 3.3.4 Segmentation Strategies
- 4. Advanced Digital Image Processing (3 hours)
 - 4.1 Watersheds Segmentation Algorithm
 - 4.2 Region-Based Algorithms
- 5. Image Compression (3 hours)

Laboratory projects: None.

Estimate of ABET/CAC Category Content:

	CORE	ADVANCED		CORE	ADVANCED
Data Structures	_____	_____ 1 _____	Computer Organization and Architecture	_____	_____
Algorithms	_____	_____	Concepts of Programming Languages	_____	_____
Software Design	_____	_____	Theoretical	_____	_____ 2 _____

Oral and Written Communications:

Not a significant focus of this course.

Social and Ethical Issues:

Not a significant focus of this course.

Theoretical Content (Foundations):

Theoretical Material	Time Devoted
Digital Image Definitions and Concepts	3 hours
Image Enhancement in the Spatial Domain	12 hours
Morphological Operation: Dilation, Erosion, Opening and Closing	6 hours
Segmentation Strategy	3 hours
Watersheds Segmentation Algorithm and Region-Based Algorithm	3 hours

Problem Analysis:

Students need to do several kinds of analyses, such as histogram analysis, enhancement analysis, morphological analysis and so on, on gray-level digital images.

Solution Design:

Use the Image Processing Toolbox in Matlab to solve several kinds of problems.