ROCHESTER INSTITUTE OF TECHNOLOGY
Rochester, New York

COLLEGE of SCIENCE
Department of IMAGING SCIENCE

REVISED COURSE: 1051-361

1.0 TITLE: DIGITAL IMAGE PROCESSING I
DATE: 28 February 2003
CREDIT HOURS: 4
PREREQUISITE(S): 1016-283, 1016-305, programming language (*e.g.* 1051-211)
COREQUISITE(S): none
COURSE PROPOSED BY: Carl Salvaggio

2.0 COURSE INFORMATION:

	Contact Hours	Maximum Students / Section
Classroom	4	20
Lab	n/a	n/a
Studio	n/a	n/a
Other	n/a	n/a

QUARTER(S) OFFERED:
___Fall ___Winter _x_Spring ___Summer

STUDENTS REQUIRED TO TAKE THIS COURSE:
Imaging Science, 2nd year

STUDENTS WHO MIGHT ELECT TO TAKE THE COURSE:
Imaging and Photographic Technology, Computer Science, Environmental Science, Applied Mathematics, Physics

3.0 GOALS OF THE COURSE:

The goal of this course is to provide the student with an understanding of basic digital image processing concepts and to develop their programming skills so that they can implement these concepts to facilitate application to real imagery.

4.0 COURSE DESCRIPTION:

1051-361 Digital Image Processing I

This course is an introduction to the basic concepts of digital image processing. The student will be exposed to image capture and image formation methodologies, sampling and quantization concepts, statistical descriptors and enhancement techniques based upon the image histogram,

point processing, neighborhood processing, and global processing techniques based upon kernel operations and discrete convolution as well as the frequency domain equivalents, geometrical operations for scale and rotation, and grey-level resampling techniques. Emphasis is placed on applications and efficient algorithmic implementation using the IDL programming language. (1016-253, 1016-305, 1051-211 or equivalent) Class 4, Credit 4 (S)

5.0 POSSIBLE RESOURCES:

- 5.1 Gonzalez, Rafael C. and Richard E. Woods, *Digital Image Processing*, 2nd Edition, Prentice Hall, New Jersey, ISBN: 0-201-18075-8
- 5.2 Student version of IDL for Windows

6.0 TOPICS:

- 6.1 Digital image processing concepts / steps
  - 6.1.1 Image acquisition
  - 6.1.2 Image enhancement
  - 6.1.3 Image restoration
  - 6.1.4 Color image processing
  - 6.1.5 Compression
  - 6.1.6 Morphological processing
  - 6.1.7 Segmentation
- 6.2 Image acquisition systems
  - 6.2.1 Point detectors
  - 6.2.2 Linear arrays
  - 6.2.3 CCD arrays
  - 6.2.4 Line scanners
  - 6.2.5 Wiskbroom scanners
  - 6.2.6 Fourier-transform spectometers
- 6.3 Geometric manipulations
  - 6.3.1 Scale
  - 6.3.2 Rotation
  - 6.3.3 Grey-level resampling
    - 6.3.3.1 Nearest-neighbor
    - 6.3.3.2 Bilinear interpolation
    - 6.3.3.3 Cubic convolution
  - 6.3.4 Mapping via control point selection
    - 6.3.4.1 Control point selection
    - 6.3.4.2 Multiple least squares regression
    - 6.3.4.3 Assessment of the quality of mapping transform
- 6.4 Image enhancement
  - 6.4.1 Grey-level manipulations
  - 6.4.2 Lookup tables
  - 6.4.3 Histogram equalization
  - 6.4.4 Histogram specification
  - 6.4.5 Arithmetic operators
- 6.5 Linear spatial filtering

- 6.5.1 Smoothing / averaging
- 6.5.2 Sharpening
- 6.5.3 Unsharp masking
- 6.5.4 First and second derivative-based operators
- 6.5.5 Gradient operators

6.6 Frequency domain processing
- 6.6.1 Description of frequency domain representation of imagery
- 6.6.2 Fourier transform
- 6.6.3 Fourier series
- 6.6.4 Discrete Fourier transform
  - 6.6.4.1 One-dimensional
  - 6.6.4.2 Two-dimensional
- 6.6.5 Phase and it physical meaning
- 6.6.6 Fast Fourier transform
- 6.6.7 Windowing functions

6.7 Frequency domain filtering
- 6.7.1 Lowpass
- 6.7.2 Highpass
- 6.7.3 Filter types
  - 6.7.3.1 Ideal
  - 6.7.3.2 Butterworth
  - 6.7.3.3 Gaussian
  - 6.7.3.4 Laplacian

7.0 INTENDED LEARNING OUTCOMES AND ASSOCIATED ASSESSMENT METHODS OF THOSE OUTCOMES:

7.1 Ability to use basic digital image processing concepts to perform enhancements to grey-level data (HOMEWORK ASSIGNMENTS / EXAMS)

7.2 Ability to use the IDL environment as an interactive problem solving tool and visualization system (HOMEWORK ASSIGNMENTS)

8.0 PROGRAM OR GENERAL EDUCATION GOALS SUPPORTED BY THIS COURSE:

8.1 The student will have the basic set of tools with which they can perform grey-level image enhancements, spatial and frequency domain operations, and geometric manipulation of image data

8.2 The student will enhance their proficiency in using IDL as an image manipulation/enhancement environment and further their readiness to become active algorithm developers in industry

8.3 The student will apply the mathematic to which they have been exposed in earlier course work to applied image processing problems

9.0 OTHER RELEVANT INFORMATION:

9.1 Course needs to be conducted in a classroom equipped with a high-resolution projector (1280x1024) for classroom instruction

10.0 SUPPLEMENTAL INFORMATION:

none