Rochester Institute of Technology
College of Science

New Course Proposal

TITLE: Advanced Digital Image Processing
1051-786

DATE: January 29, 2002

PROPOSED BY: Harvey Rhody

DEPARTMENT: Imaging Science

PREREQUISITES: 1051-782 Introduction to Digital Image Processing and
1051-726 Computing for Imaging Science,
or permission of instructor.

COREQUISITES: None

DEPARTMENT IN WHICH COURSE WILL BE TAUGHT: Imaging Science

MAXIMUM NUMBER OF STUDENTS PER SECTION:

Lecture: 16

Recitation: 4

Laboratory: 0

QUARTER OR QUARTERS WHEN COURSE WILL BE OFFERED (list hours per week in appropriate column):

The course will be offered in spring quarters on alternate years, e.g. 20013, 20033, etc.

<table>
<thead>
<tr>
<th>FALL</th>
<th>WINTER</th>
<th>SPRING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>Lecture:</td>
<td>Lecture:</td>
</tr>
<tr>
<td></td>
<td>Recitation</td>
<td>Recitation</td>
</tr>
<tr>
<td>Laboratory</td>
<td>Laboratory</td>
<td>Laboratory</td>
</tr>
</tbody>
</table>

STUDENTS REQUIRED TO TAKE THE COURSE: This course will replace 1051-792 Computer Vision in the CIS graduate program as a requirement for students in the Digital Image Processing track of the graduate program. It is expected that advisors for other graduate tracks will recommend the course to certain students.

STUDENTS WHO MAY ELECT COURSE: Graduate students who have taken Introduction to Digital Image Processing or the equivalent and have a working knowledge of the IDL programming language.
JUSTIFICATION FOR THE NEW COURSE: This course has been taught as a seminar course under the 1051-753 listing in 19973 and 19993 as an experimental replacement for the course 1051-792 Computer Vision. The computer vision material is important but requires a background in computer science that is not possessed by most imaging science students. This course covers the image processing techniques needed in many computer vision applications as well as advanced imaging algorithm systems but does not embody the hierarchical systems architecture or artificial intelligence topics. The systems perspective is addressed by the use of a team project format in which term-long projects are conducted by small teams under the guidance (coaching) of the instructor.

SPECIAL NEEDS: Lecture classroom with computer display projector and Web access.
Rochester Institute of Technology
College of Science
Advanced Digital Image Processing
Course Number 1051-786

1.0 COURSE: Advanced Digital Image Processing
1.1 A one quarter course of 4 credit hours
1.2 Two 2 hour lectures per week.
1.3 Prerequisites: Graduate standing, 1051-726 Computing for Imaging Science and 1051-782 Introduction to Digital Image Processing, or permission of instructor
1.4 Corequisites: none

2.0 COURSE DESCRIPTION:

Advanced Digital Image Processing investigates algorithms and techniques for a variety of imaging applications. The techniques build on the background that is established in the course SIMG-782, Introduction to Digital Image Processing, which focuses on basic image processing methods. The course is taught using a lecture and group project format, in which the lectures focus on advanced techniques and provide applications of their use in selected applications. The group projects enable the students to work on substantial designs that require the understanding of the task domain, exploration of solution methods by analysis and prototyping, and implementation of a selected approach. Each team presents a preliminary plan, an approach with feasibility analysis, and a final demonstration.

3.0 COURSE OBJECTIVES

3.1 Understanding of standard advanced image processing algorithms.
3.2 Understanding of image processing system development.
3.3 Understanding of team design techniques.
3.4 Experience in algorithm development and testing.

4.0 COURSE OUTLINE: Topics

The following are examples of image processing algorithms that are presented by the course lectures. Emphasis is modulated by the knowledge and skill needs of the team projects.

4.1 Image Segmentation
4.1.1 Region-based methods
4.1.2 Boundary-based methods

4.2 Image registration and alignment
4.2.1 Feature point detection
4.2.2 Parametric representation of image distortion
4.2.3 Distortion parameter measurement
4.3 Feature Detection & Classification
4.3.1 Statistical decision theory & performance metrics
4.3.2 Lines, edges, corners and other geometric elements
4.3.3 Textures
4.3.4 Pixel classification using spectral techniques
4.3.5 Characters, words and document structure

4.4 Use of Object Models
4.4.1 Geometric relationships between features
4.4.2 Hierarchical models, pyramid representations
4.4.3 Parametric models and model fitting
4.4.4 Shape description
4.4.5 Non-parametric and learning-based techniques

4.5 Analytical Methods
4.5.1 Wavelet analysis
4.5.2 Scale-space techniques
4.5.3 Linear transforms and projections
4.5.4 Fractal representations

5.0 COURSE OUTLINE: Laboratory
No laboratory is involved. However, students do significant designs and algorithm prototyping using computer tools.

6.0 SUGGESTED EVALUATION:

6.1 Homework assignments
6.2 Project Reviews
6.3 Final Exam

7.0 SUGGESTED TEXT: No text is required. Current and classical papers and instructor notes are provided for lecture topics. Students are directed to library research for additional material relating to project topics. Recommended reference: Digital Image Processing, Gonzalez and Woods.