Image Processing With Applications  
Spring 2013, Math563/489/CSCI567

Instructor: Dr. Nikolay Metodiey Sirakov  
Department of Computer Science and Information Systems  
Department of Mathematics, TAMU-Commerce

Day and Time: T 7:20-10:00PM    Room: Bin 301

Meets 1/14/2013 through 5/10/2013


Instructor:  Dr. Nikolay Metodiey Sirakov  
Office: Binnion 322

Office Hours:  W 9:30AM-12:30PM  
F 9AM-11AM  
Additional by appointment

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Student Learning Outcomes (SLO): Students will be able to learn, understand and perform Image enhancement applying mathematical methods in the spatial (1\textsuperscript{st} 2\textsuperscript{nd} derivatives, laplacian and the gradient) and frequency domains (Fourier transformations); Image Restoration; Transformation; the students will learn the fields of application; the students will develop skills for working with image processing (IP) algorithms and tools; the students will know how to develop and code IP algorithms; students will learn how to write research reports and papers as well as how to present them.

Objectives:
1. Classification of the areas in the field, problems and new technologies. To teach students the main IP modalities. Digital image formats, methods for zooming and their mathematical and computer science basis;
2. To teach students the basic image transformation methods: arithmetic, averaging, log, power, histogram processing, statistical, logic (including fuzzy logic);
3. To teach students about image statistics, correlation, convolution, smoothing, sharpening, Gradient and Laplacian operators, and derivatives for objects edge detection;
4. 1D and 2D Fourier transforms, properties, Fast Fourier transform, inverse, main algorithm, Laplacian in frequency domain, The Convolution and Correlation Theorems;
5. To teach students about Filtering, sharpening unsharpening in the frequency domain;
6. To develop the foundations of Image Degradation/Restoration. Noise Modeling, Basic color models; color image processing and transformation;
7. Intro to wavelets: main definitions, functions, transforms and problems to solve.

As an additional activity (out of the course) for the interested and best prepared students an introduction may be given to the most recent Image Analysis methods, automatic tracking objects in video, automatic human activities recognition in video.

Requirements: Integral and Differential Calculus of two variables;  
C++, Java or Computer algebra programming for CS students
List of Lectures

5. Histograms: Processing; Equalization; Matching.
7. Spatial Filters. Convolution, Correlation, Smoothing, Sharpening.
10. Fuzzy sets and membership functions to IP.
11. The 1D Fourier Transform and its Inverse.
12. The 2D Fourier Transform and their Inverse. Properties- shifting, periodicity.
13. Filtering in the Frequency Domain. Correspondence between Filtering in the Frequency and Spatial Domains.
17. The Convolution and Correlation Theorems.

NOTE: Lectures 23 and 24 will be given upon time permission.
Some assignments will include Lab work, algorithms design and performing experiments with real images and existing software tools.

COURSE EVALUATION

Basis for Evaluation:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Mid Term Exam</td>
<td>24%</td>
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<tr>
<td>Final Exam (Project Presentation)</td>
<td>22%</td>
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<tr>
<td>HW</td>
<td>20%</td>
</tr>
<tr>
<td>Project</td>
<td>22%</td>
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<tr>
<td>Lab, and in class problems</td>
<td>12%</td>
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</tbody>
</table>

Grading Policy:

- **A:** 100% - 90%
- **B:** 89% - 80%
- **C:** 79% - 70%
- **D:** 69% - 60%
- **F:** Less than 59%

The professor reserves the rights to reward students for continuous hard work.
Additional Activities: Experiments; Home Practice Problems; Extra Credit Problems

<table>
<thead>
<tr>
<th>Final Test</th>
<th>Date: Tuesday - May 08</th>
<th>Time: 7:30PM-10PM</th>
</tr>
</thead>
</table>

**COURSE POLICIES**

**In-class activity:** Problems to be solved during the class period.

**HW:** problems, which involve theoretical and practical skills above the average level. Some of the HW could be assigned as team works.

**Mid term comprehensive exam:** Is to be given around mid semester. It will take 2/3 of a class period.

**Makeup:** Except in the case of a formal institutional excuse, no individual makeup test will be permitted.

**Project (most likely group):** closed itself innovative problem, whose development includes: survey of the present state of the art; development of a theoretical model; numerical analysis of the implementation; algorithm design and coding; performing experiment and deriving conclusions.

Students requesting accommodations for disabilities must go through the Academic Support Committee. For more information, please contact the Director of Disability Resources & Services, Halladay Student Services Bldg., Room 303D, 903 886 5835.

All students enrolled at the University shall follow the tents of common decency and acceptable behavior conducive to a positive learning environment (See Student’s Guide Handbook, Polices and Procedures, Conduct).

The road that will lead you to find a good job is the road of learning and writing a very good project.

Commerce, Texas
January 11, 2013

Dr. Nikolay Metodiey Sirakov