

COURSE TITLE

DIGITAL IMAGE PROCESSING II (1051.462)

INSTRUCTOR INFORMATION

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TEACHING ASSISTANT INFORMATION

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COURSE DESCRIPTION

This course is an introduction to the more advanced concepts of digital image processing. The student will be exposed to image reconstruction, noise sources and techniques for noise removal, information theory, image compression, video compression, wavelet transformations and the basics of digital image watermarking. Emphasis is placed on applications and efficient algorithmic implementation using the IDL programming language. Prerequisites: (1051-461) Class 4, Credit 4

LEARNING OUTCOMES/METHOD OF EVALUATION

- Ability to put into practice the basic image processing concepts presented in 1051-461 to perform more advance image processing techniques such as restoration, compression and information hiding (HOMEWORK/PROGRAMMING ASSIGNMENTS / EXAMS)
- Ability to use IDL as an interactive problem solving tool and visualization system (HOMEWORK/PROGRAMMING ASSIGNMENTS)

MEETING TIMES

Tuesday, Thursday / 8:00-9:50AM / Room 76:1235

READING MATERIALS

- Gonzalez, R.C. and R.E. Woods, Digital Image Processing, Second Edition, Prentice Hall, Upper Saddle River, New Jersey, 2002 (ISBN: 0-201-18075-8)

- Y. Zheng, S. Lin, and J. Yang, Color filter array demosaicking with local color distribution linearity
- C.S. Hsu and Y.C. Hou, Copyright protection scheme for digital images using visual cryptography and sampling methods
- C. Honsinger and M. Rabbani, Data embedding using phase dispersion (PDF)
- H. Xie et. al., An IDL/ENVI implementation of the FFT-based algorithm for automatic image registration
- M. Rabbani and R. Joshi, Coding of still pictures: An overview of the JPEG2000 still image compression standard, July 2001
- E. Bodden, M. Clasen, and J. Kneis, Arithmetic coding revealed: A guided tour from theory to praxis, May 2004

COURSE MECHANICS

60% Programming Assignments

20% Oral Examination 1

20% Oral Examination 2

TOPICAL OUTLINE

Image reconstruction

- Image degradation model
- Noise functions
 - Gaussian
 - Rayleigh
 - Erlang or Gamma
 - Exponential
 - Uniform
 - Impulse
- Noise removal filters
 - Arithmetic mean
 - Geometric mean
 - Harmonic mean
 - Contraharmonic mean
 - Median
 - Minimum
 - Maximum
 - Adaptive local
 - Adaptive mean
 - Periodic
 - Band pass
 - Band reject
 - Notch pass
 - Notch reject
 - Inverse
 - Weiner
- Removal of noise from a real-world imaging system

Image compression

- Basic metrics for compression effectiveness
 - Relative data redundancy
 - Compression ratio
- Types of redundancy
 - Coding
 - Interpixel
 - Psychovisual
- Encoder/decoder models
- Basic metrics for compression/decompression performance
 - Root-mean-square error
 - Mean-square signal-to-noise ratio
- Information theory
 - Information content in an event
 - The information channel
 - Using information theory to reduce message size
 - Shannon's first theorem
- Predictive coding
 - Lossless DPCM
 - Lossy DPCM
- Variable length coding
 - Shannon-Fano
 - Huffman
 - Arithmetic
 - Image pyramids
 - Kodak PhotoCD
 - LZW
- Transform coding
 - Discrete cosine transform (DCT)
- JPEG
- Windows BMP

ORAL EXAMINATION 1

Video compression

- MPEG-1
- MPEG-3

Wavelet transformations

- Basis functions
- Use in image compression

Digital watermarking/information hiding

- Visual cryptography
- Encryption
- Phase dispersion
- Algorithm robustness

ORAL EXAMINATION 2