AEEE419 - Image Processing

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<tr><td>Course Title</td><td colspan="5">Image Processing</td></tr>
<tr><td>Course Code</td><td colspan="5">AEEE419</td></tr>
<tr><td>Course Type</td><td colspan="5">Technical Elective</td></tr>
<tr><td>Level</td><td colspan="5">BSc (Level 1)</td></tr>
<tr><td>Year / Semester</td><td colspan="5">4 (Spring)</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">Prof Michael Komodromos</td></tr>
<tr><td>ECTS</td><td>6</td><td>Lectures / week</td><td>3</td><td>Laboratories/week</td><td></td></tr>
<tr><td>Course Purpose</td><td colspan="5">The aim of the course is to familiarize students with the basics of images, their characteristics and their representation. Understand the concept of an image processing system and define the various areas of image processing. Elaborate on image enhancement techniques and understand the principles and the need for image restoration. Comprehend the concepts of image coding and compression.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">By the end of the course, students must be able to:
1. Discuss the historical development of image processing and identify the various areas of image processing. Explain the basics of light and describe simple visual phenomena. Define the basic components of a general-purpose image processing system and the fundamental steps in digital image processing. Explain the characteristics of the various types of image sensors. Relate image acquisition, sampling, quantization and encoding to the two-dimensional representation of a gray scale image.
2. Compare and contrast the various image enhancement techniques in the spatial domain. Use gray level transformation functions for contrast enhancement and stretching such as negative, logarithmic and power functions and their related applications. Generate histogram equalization and histogram matching and perform image subtraction. Appraise the resulting images.
3. Define mask filtering and identify the need for it. Apply mask filtering. Evaluate an image and determine the appropriate mask for a specific enhancement requirement. Describe the benefits of smoothing filters, Laplacian filters and high boost filters and discuss where they are used. Describe the use of order statistics filtering, median filtering, and max-min filtering. Define edge detection techniques and image interpolation.
4. Distinguish among the various image restoration techniques such as reduction of noise and Wiener filtering. Discuss reduction of signal dependent noise and frame averaging. Evaluate the results of the various image enhancement and image restoration techniques.
5. List the benefits of image coding and compression and differentiate between the various types of redundancy and describe the general</td></tr>
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	compression system model. Calculate data redundancy and compression ratio.		
Prerequisites	None	Corequisites	None
Course Content	**Introduction and Basics:** Light and visual phenomena. Fields using image processing based on the EM spectrum. Fundamental steps in image processing. Components of image processing (IP) systems. Applications of IP. **Signals and Processing Systems:** Image sensing and acquisition. Sampling, quantization, encoding and gray level resolution. Representation of digital images. Basic relationships between pixels. **Image Enhancement:** Gray scale modification, high pass and low pass filtering of image signals, homomorphic processing, noise reduction and smoothing. Edge detection techniques and image interpolation. **Image Restoration:** Reduction of noise, Wiener filtering and additive image processing. Reduction of image blurring, inverse filtering and blind deconvolution. Reduction of signal-dependent noise and frame averaging. **Image Coding and Compression:** Coding and coding redundancy. Source encoders and decoders. Channel encoder and decoder. Information measures. Information channels. Fundamental coding theorems. Image compression. **Advances in Technology and Current Trends in Research:** Examine and discuss the current state of the technology in image processing systems and new applications. Overview current trends in research and new technological and scientific challenges in image processing.		
Teaching Methodology	Teaching of the course is based on lectures (3 hours per week) in a classroom, using a mixture of traditional teaching with notes on the white board and slide presentations using a projector where appropriate. Topic notes are compiled by students, during the lectures which serve to cover the material of the course. Students are urged to use the textbook assigned to the course. Homework problems are assigned from the textbook as a turn-in assignment or for interactive homework practice. Additionally, students are advised to use the reference books for further reading and practice in solving related exercises. Example problems are solved during lectures or privately during the lecturer's office hours. Students are assessed continuously and their knowledge is checked through tests and assignments.		
Bibliography	**<u>Textbook:</u>** R. Gonzales and R. Woods, *Digital Image Processing,* Prentice Hall, 4th edition, 2018. **<u>References:</u>** R. Gonzales et al., *Digital Image Processing Using MATLAB*, 2nd edition Addison-Wesley Books 2009. L. Shapiro, *<u>Computer Vision</u>*, Prentice Hall, 2001.		

Assessment	The students are assessed via continuous assessment throughout the duration of the Semester, which forms the Coursework grade and the final written exam. The coursework and the final exam grades are weighted 40% and 60%, respectively, and compose the final grade of the course. The continuous assessment of the students is achieved through assignments and tests. An indicative weighted continuous assessment of the course is shown below: • Assignments 25% • Design Project 15% • Exams and Quizzes 60% Students are prepared for the final exam through revisions on the material taught, problem solving and concept testing. The final assessment of the students is formative and summative and is assured to comply with the subject's expected learning outcomes and the quality of the course.
Language	**English**