Digital Image Processing and Analysis

5 ECTS   **UJM semester 1**

Course instructor: Ass. Prof. Hubert Konik
Language of instruction: English

Overview

The aim of image processing is to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. This field is nowadays growing very rapidly thanks to the progress of sensors, computers and the multitude of images that are captured for professional or personal purposes every day. In this course, the fundamentals of image processing and analysis, field continually evolving and more particularly during these last decades, will be presented.

More particularly, this course introduces basics, challenges and fundamentals of digital image processing and analysis. It emphasizes general principles of image processing as well as precise applications. It covers topics such as digital image definition, basic transformations, point operations, filtering, transforms and histogram processing, image segmentation, analysis, features extraction and recognition tasks. To develop their practical and analytical skills, students have to work on practical applications chosen in industrial problems or new behaviours in our digital daily life. For practical works students use MATLAB and the Image Processing Toolbox, but each method will lead to algorithmic consideration so that other computer languages and/or software packages could be used.

Learning outcomes

On successful completion of this course, students should have the skills and knowledge to:

- Understand the fundamentals, principles, applications, limits, relationships, of all concepts and topics covered by this course;
- Applicate, analyze, synthesize and evaluate skills of the main concepts and topics covered by this course;
- Apply/implement concepts and principles introduced in the lectures on practical tasks and on industrial study cases;
- Able to self-learn, to understand some problems and to suggest/find solutions to solve these problems.

Content

- (topic 1) Introduction and overview of image processing; digital images format; pixel transformations
- (topic 2) Histogram processing; moments; thresholding
- (topic 3) Spatial filtering; gradient and other derivative filters; Point, line and edge detectors
- (topic 4) Image segmentation; quadtree and pyramidal tools; k-means clustering
- (topic 5) Image analysis; features extraction; shape descriptors
- (topic 6) Pattern recognition; objects recognition

Teaching methods

- Lectures: 12 hours in order to introduce concepts
- Practical work: 12 hours in order to implement concepts introduced in the lectures, to practice on real applications and to train students
- Project work: 6 hours in order to make a more complex project in autonomy using most of the previously acquired notions

Study materials

- Digital Image Processing, 3rd Edition (DIP/3e), by Rafael C. Gonzalez and Richard E. Woods, Prentice Hall (2008)
- Digital Image Processing Using MATLAB (DIPUM), by Rafael C. Gonzalez, Richard E. Woods, and Steven L. Eddins, Prentice Hall (2004).
- The Image Processing Handbook, Fifth Edition (Image Processing Handbook), by John C. Russ, CRC (2006)
- Tutorials, lectures and notes provided by the course instructor.

Assumed Knowledge

- Basic calculus, linear algebra and basic probability theory.
- Entry-level computer programming experience in either Matlab, or C/C++.
- Previous knowledge of digital image processing will be helpful, but is not essential.

Evaluation criteria

- Written exam 40%
- Written assignments / Labs 20%
- Project work 20%