

DIGITAL SIGNAL PROCESSING 2

Course code	1CHS
Duration	11 weeks each
Prerequisite course(s)	None
Teaching staff (the first has overall responsibility)	Dr B Porr (telephone 5237, email B.Porr@elec.gla.ac.uk) Dr C Millar (telephone 4792, email: C.Millar@elec.gla.ac.uk)
Approximate size of class	15 students
Semester	2

Aims

To introduce the application of digital signal processing techniques to digital image processing, image analysis and pattern recognition. To gain hands on skills in image processing by using state of the art image processing application.

Objectives*Understanding*

The different representations of digital images. That many image enhancement functions may be implemented by simple linear filters. How the important features in an image may be related to significant abstractions from the raw image and how they can be used to detect objects in images. How modern image compression algorithms work and the artifacts they cause.

Knowledge

The course provides a grounding in digital filter and transform techniques for image processing, feature extraction and object detection. The course provides an introduction to the software packages openCV for image processing.

Skills

Ability to use state of the art image processing software in C (openCV) and to solve typical problems of image processing such as image enhancement, manipulation, segmentation and object recognition.

Syllabus

10-11 lectures

1. Digital Representation of Images

Image acquisition. Aliasing. Quantization. Colour spaces (RGB, HSV, YCrCb). Colour subsampling (4:2:0, etc).

2. OpenCV image manipulation software

Introduction into the most important functions, practical aspects such as compilation, linking. Processing of films. How to add 3D objects with OpenGL..

3. Digital Image Processing

Contrast and dynamic range. Equalization. Noise. Edge detection. Image interpolation. Digital filter techniques. Convolution masks / kernels (Gaussian, Haar, Wavelets, ...).

4. Mathematical Morphology

Dilation. Erosion. Opening. Closing. Thinning and thickening.

5. Introduction to Pattern/Object Recognition: feature space

Haar features. Wavelet features. Difference of Gaussian. High/low level features.

6. Introduction to Pattern/Object Recognition: machine learning

Weak / strong classifiers, boosting, Adaboost.

7. Image Transforms

Hough transform. Fourier Transform. Cosine Transform. Wavelet transform.

8. Segmentation

Regions. Background subtraction. Codebook algorithm. Watershed algorithm.

9-10. Image compression

MPEG-2 image compression, H264 (MPEG4) image compression, JPEG2000 image compression

Assignments

2 assignments

- Green screen exercise (separate the green screen from the foreground)
- Marker tracking on the green screen (attach the background image to the marker)

Syllabus

The assignments will directly deal with practical problems encountered in the media industry. The teaching is problem based which means that you will improve your understanding of the subject matter by working on the assignments. Consequently, the practical assignments are an integral part of this course. Note that the exam will have questions about the assignments. Each assignment requires a report prepared independently and submitted for assessment. Details will be given during the course and will also appear on the notified web site.

Laboratory work

High definition camera equipment and Linux computers will be available to record films for the assignment and to do the video processing.

Recommended books

Authors	Title, edition	Publisher	Year	ISBN	Code
Gary Bradski & Adrian Kaehler	Learning OpenCV	O'Reilly	2008	978-0-596-51613-0	A
J Proakis & D Manolakis	Digital Signal Processing	Macmillan	1992	002396815X	C

Codes : A = compulsory; B = strongly recommended; C = recommended; D = wider reading.

Study times

Type	Details
Assignments	2.5 hours per week
Lectures/Tutorials	2 hours per week
Self study	6 hours per week
Report Writing	2 hours per week

These times are a rough estimate of the work required outside formal classes by a typical student. There will be wide variations between individuals, but you will run a grave risk of failure if you spend significantly less time on this course than these guidelines suggest.

Assessment

%	Type	Details
30	Practical assignments	See above.
70	Degree examination	2 hour paper.

The examination is held in April/May and the reassessment is held in August