Digital Image Analysis (U01427)

also

Theory of Image Processing (P00809)

Course Structure and Admin

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Lectures: Tuesday and Friday 12.10-13.00 in Room 3218

Digital Image Analysis

Synopsis: An introductory course on digital image processing techniques concentrating on the mathematical and physical models underlying the processing operations. Digital image representation and sampling aspects are followed by various processing techniques including point by point operations, noise models, filtering and de-convolution techniques.

- 12 Lectures on the physical and mathematical basis of Digital Image Analyis
- Mini programming project starting in week 6, contributes 35% to assessment.
- 4 problem solving workshops.
- 1 project support workshop.(outwith timetabled hours in CPLab)
- 2 hour examination in April/May.

Learning Objectives

- linear image formation and its underlying assumptions,
- digital representation of image, the discrete Fourier Transform, its properties and implementation, Shannon sampling theorem, interpolation to zeroth and first order,
- first order image statistics, point-by-point processing and histogram manipulation,
- fixed pattern noise and random noise including underlying physics of Gaussian additive noise and methods of it estimation,
- linear filtering in real and Fourier space, non-linear filters including shrink and expand, average threshold and median,
- image restoration by inverse and Weiner filter, outline of CLEAN and maximum entropy restoration,
- tomographic system and reconstruction by Fourier inversion and filtered back projection, outline of fan-beam system.

Theory of Image Processing

Synopsis: A theory based course on Image Processing techniques concentrating on the mathematical and physical models underlying the processing operations. Digital image representation and sampling aspects are followed by various processing techniques including point by point operations, noise models, filtering and de-convolution techniques, edge and line detection, stereo imaging, target tracking and elementary pattern recognition.

- 16 Lectures on the physical and mathematical basis of Image Processing (first 12 in common with DIA).
- Theory based assignment handed out in week 6, contribute 20% to assessment.
- 4 problem solving workshop (in common with DIA)
- 1 Revision workshop (outwith timetabled hours)
- 1.5 hour examination in December diet.

Learning Objectives

- linear image formation and its underlying assumptions,
- digital representation of image, the discrete Fourier Transform, its properties and implementation, Shannon sampling theorem, interpolation to zeroth and first order,
- first order image statistics, point-by-point processing and histogram manipulation,
- fixed pattern noise and random noise including underlying physics of Gaussian additive noise and methods of it estimation,
- linear filtering in real and Fourier space, non-linear filters including shrink and expand, average threshold and median,
- image restoration by inverse and Weiner filter, outline of CLEAN and maximum entropy restoration,
- tomographic system and reconstruction by Fourier inversion and filtered back projection, outline of fan-beam system.
- edge and line detection by first and second order differential edge detection, Hough Transform and its applications,
- stereo imaging in parallel and converging geometry, outline of automated depth extraction techniques,
- tracking by correlation, basic of statistical pattern recognition, examples of simple classifiers.

Resources

Course Web sites:

DIA site `http://www.ph.ed.ac.uk/~wjh/teaching/dia/`
TOIP site `http://www.ph.ed.ac.uk/~wjh/teaching/toip/`

(actually the same site!)

These sites contain

- All course handouts.
- Workshop solutions.
- All slides
- Links to support code (for DIA)
- Links to examples
- Growing set of links to external sites

almost everything in PDF format from LaTeX source.

Note: Courses undergoing a revision, broken links will work in due course!!!.

Resources I

Textbook:
Best book at this level:

- RC Gonzalez& RE Woods, *Digital Image Processing*, Addison-Wesley (2003)

many *application* books in library.

On-Line Tutorial:
Good on-line tutorial from Bob Fisher, School of Informatics, at:

`http://homepages.inf.ed.ac.uk/rbf/HIPR2/`

also linked from course web sites.

Resources II

Fourier Theory Background: Booklet *The Fourier Transform, (what you need to know)*. See also

`http://www.ph.ed.ac.uk/~wjh/teaching/Fourier/`

Next lecture will cover this: repeat of lecture from *optics* last year.