

Professor Maria S. Millán
Technical University of Catalonia

Course on Information Optics

Opto-digital image processing. Advanced applications in industry and medicine

Scope: The course focuses on image processing algorithms and architectures, as well as implementation techniques. It overviews the fundamental principles on Fourier optics, spatial filtering and opto-electronic processors. Hybrid optical-digital operations are reviewed. The course covers modern advances in image processing systems, pattern matching, 3D imaging, multidimensional information security systems, industrial inspection by machine vision, and applications in ophthalmology.

1. Basics of optical and digital techniques for image processing (7 XI)

Fourier transform properties of lenses. Fourier transform geometries. Optical correlation. Spatial filtering. 4f and Joint Transform Correlator. Pattern matching. Digital imaging. Digital operations inspired on optical transformations. Basics of digital image analysis.

2. Applications to industry: Automatic inspection and quality assessment of materials (14 XI)

Pattern recognition in almost periodic structures. Structural defect detection. Local defect detection. Filter design for unsupervised defect detection in periodic and non-periodic structures. Advantages of near infrared imaging. Examples in textile and paper.

3. Optical security (21 XI)

Optical data encryption and decryption. Double phase random encryption and variations. Image retrieval and recognition. Multifactor security. Biometrics in optical security.

4. Applications to ophthalmology: Eye fundus image analysis and Intraocular lenses (28 XI)

Eye fundus imaging and digital analysis. Common algorithm sequences. Main tasks in e-Health and tele-care. Examples of assistance in diagnosis of damage or risk of Glaucoma and Age Macular Degeneration. Intraocular lenses: principle and design. Power calculations. New trends in intraocular lens design.

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