COURSE DETAIL

COMPUTER VISION AND IMAGE PROCESSING
Country Italy
Host Institution University of Bologna
Program(s) University of Bologna
UCEAP Course Level Upper Division
UCEAP Subject Area(s) Computer Science
UCEAP Course Number 182
UCEAP Course Suffix
UCEAP Official Title COMPUTER VISION AND IMAGE PROCESSING
UCEAP Transcript Title COMPUTER VISION
UCEAP Quarter Units 6.00
UCEAP Semester Units 4.00

Course Description

This course is part of the Laurea Magistrale program. The course is intended for advanced level students only. Enrollment is by consent of the instructor. At the end of the course students know the basic principles of computer vision and image processing algorithms. Thus, they are able to understand and apply a variety of algorithms and operators aimed at either extracting relevant semantic information from digital images or improving image quality. They also understand the diverse challenges and design choices characterizing the main applications and acquire familiarity with software tools widely adopted in these scenarios. Course topics: Basic definitions related to image processing and computer vision–an overview across major application domains: Image Formation and Acquisition–geometry of image formation, pinhole camera and perspective projection, geometry of stereopsis, using lenses, field of view and depth of field, projective coordinates and perspective projection matrix; Camera calibration: intrinsic and extrinsic parameters, lens distortion, camera calibration based on planar targets and homography estimation (Zhang's algorithm); Image rectification and stereo calibration, basic notions on image sensing, sampling, and quantization; Intensity Transformations–image histogram, linear and non-linear contrast stretching, histogram equalization; Spatial Filtering– linear shift-invariant operators, convolution, and correlation; mean and Gaussian filtering, median filtering, bilateral filtering, non-local means; Image Segmentation–binarization by global thresholding, automatic threshold estimation, spatially adaptive binarization, color-based segmentation; Binary Morphology–dilation and erosion, opening and closing-hit-and-miss; Blob Analysis–distances on the image plane and connectivity, labeling of connected components, basic descriptors: area, perimeter, compactness, circularity, orientation and bounding-box, form factor and related descriptors, Euler number, image moments, invariant moments; Edge Detection–image gradient. smooth derivatives: Prewitt, Sobel, Frei-Chen, non-maxima suppression, Laplacian of Gaussion, canny edge detector; Local Invariant Features–detectors and descriptors, Harris Corners, scale invariant features, SIFT features, efficient feature matching by kd-trees; Object Detection–pattern matching by SSD, SAD, NCC and ZNCC, fast pattern matching, shape-based matching, Hough Transform for analytic

shapes, Generalized Hough Transform, object detection by local invariant features, Hough-based voting, least-squares similarity estimation. The theoretical part of the course is complemented with assisted hands-on lab sessions based on Python and the OpenCV library. Lab sessions cover selected topics such as intensity transformations, spatial filtering, camera calibration, motion estimation and local invariant features.

Language(s) of Instruction
English

Host Institution Course Number
73302

Host Institution Course Title
COMPUTER VISION AND IMAGE PROCESSING

Host Institution Campus
INGEGNERIA E ARCHITETTURA

Host Institution Faculty

Host Institution Degree

Host Institution Department
Ingegneria informatica

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