CSIE 2018 Fall - Computer Vision: From Theory to Application

Instructor: Jenn-Jier James Lien (連 震 杰), Professor, jjlien@csie.ncku.edu.tw, Ext. 62540.

Website: http://robotics.csie.ncku.edu.tw/course.html

Class Time/Location: 09:10 ~ 12:00 Thursday/ room CSIE65405/ for graduate students

Spoken Language: English **Prerequisites:** C, C++ or Python

Syllabus: (W: Week - Ch: Szeliski's book chapter)

Computer Vision	01-01	Introduction to **industry 4.0** - Intelligent robotics and automation: Sensors, machine vision, deep learning, big data and IoT (Internet of Things).
	01-02.1, 03.6	Sensor - **Camera model**: Geometric transformations between 2D and 3D.
	02-06.3	Sensor - **Camera calibration**: Optimization process and **AR** (Augmented reality).
	03-11.1, 11.3	Sensor - **3D**: 1) **Stereo**, 2) ToF (Time-Of-Flight: Kinect 2, SoftKinetic), and
	12.1, 12.2	3) Structured light (Kinect 1: DLP projector). **OpenCV assignment 1**
	04-B.	From **AI** (artificial intelligence) to **ML** (machine learning), to **DP** (deep learning): -From **Bayes' Rule** (posterior probability) to Gaussian model, to similarity measure (likelihood probability: Mahalanobis distance, SSD (sum of squared differences) and correlation (or **pattern matching**)), to PCA (linear combination). -From supervised、unsupervised、semi-supervised learning, to DP - Reinforcement
	05-04.1	**SIFT** (and brief HOG): Feature extraction.
	06-05.3.1, 12.6.4	**Background subtraction/modeling**: Real-time motion detection using **GMM**.
	07-08.1	**Optical flow**: Real-time motion estimation (or feature tracking) for facial expression extraction. **OpenCV assignment 2**
Machine Learning	08-14.2, A.1	**PCA** (principal component analysis, dimensionality reduction, domain knowledge): Real-time face detection (eigenfeature), face recognition (eigenface) and facial expression recognition (eigenflow).
	09-14.2	**LDA** (linear discriminant analysis): Linear classification for face recognition.
	10-	**Midterm exam.** (from W01~08)
	11-14.1	**AdaBoost**: Face detection.
	12-14.1	**SVM** (support vector machines): Non-linear classification.
	13-05.3.1	**VQ** (vector quantization): Clustering and K-means.
	13-03.7	**HMM** (discrete-time hidden Markov model): Facial expression recognition in
	14-03.7	video. **OpenCV assignment 3**
Deep Learning	15-	Deep learning: From BPNN (back propagation neural networks) to deep learning.
	16-	Deep learning:
	17-	Deep learning:
	18-	**Final exam.** (from W01~17)

Textbooks/Reference Books:

1. Textbook: Class lecture notes.
2. Ref1. Computer Vision: Algorithms and Applications by Richard Szeliski, Springer, 2010.
3. Ref2. Learning OpenCV, Computer Vision with the OpenCV Library by Gary Bradski and Adrian Kaebler, O'Reilly, 2008.

Grading:

Assignment x 3: 20% x 3 = 60%, Exam x 2: 20% x 2 = 40%.