



3D Data Processing

Course Syllabus

2023.03.06

Department of Software Convergence

Hyoseok Hwang

General Information



- Lecture time & method
 - Mon, Wed 15:00 ~ 16:15, (217)
- Instructor
 - Prof. Hyoseok Hwang (SWCON, Robot Vision Track)
 - Office: 318 @ college of software
 - Phone: 031-201-3749
 - E-mail: hyoseok@khu.ac.kr
 - Office hours: any time by appointment
- TA
 - 유근혁 (geunhyeok@khu.ac.kr)

General Information



- Prerequisite courses
 - Mathematics: Linear algebra, probability
 - Programming language: python
- You should have good knowledge of the above prerequisites
- This class is the first to open. However, it is based on robot sensor data processing.

General Information

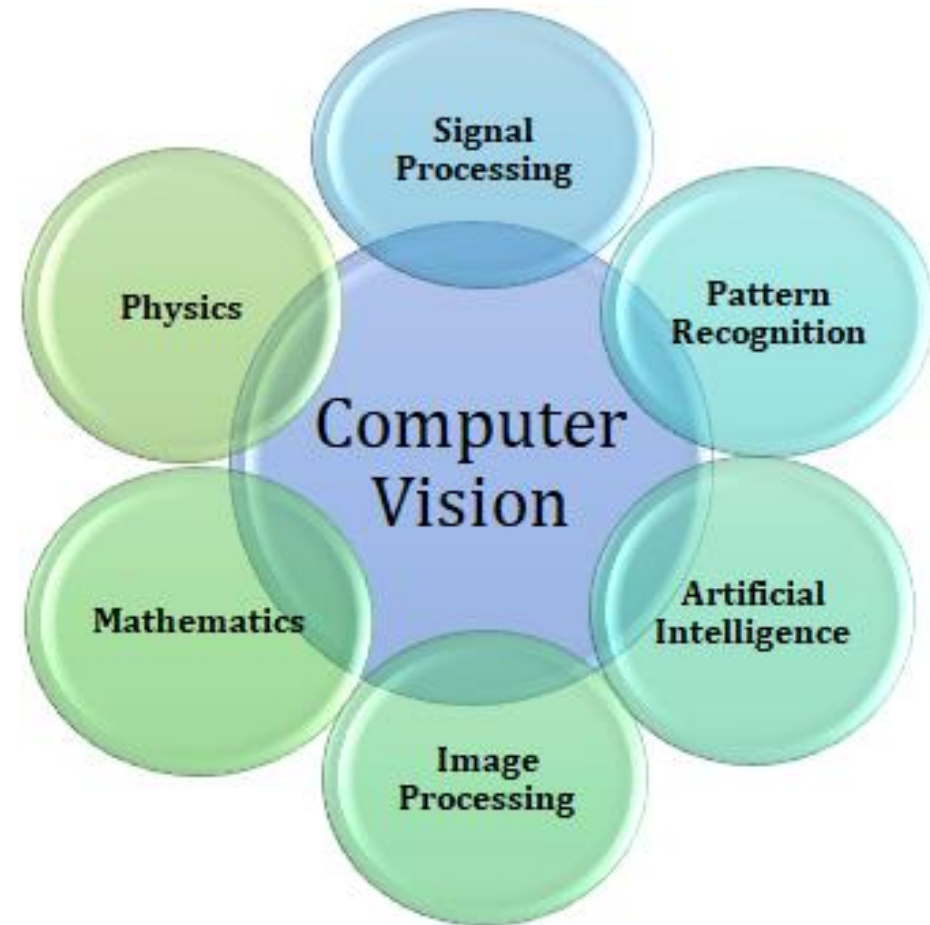
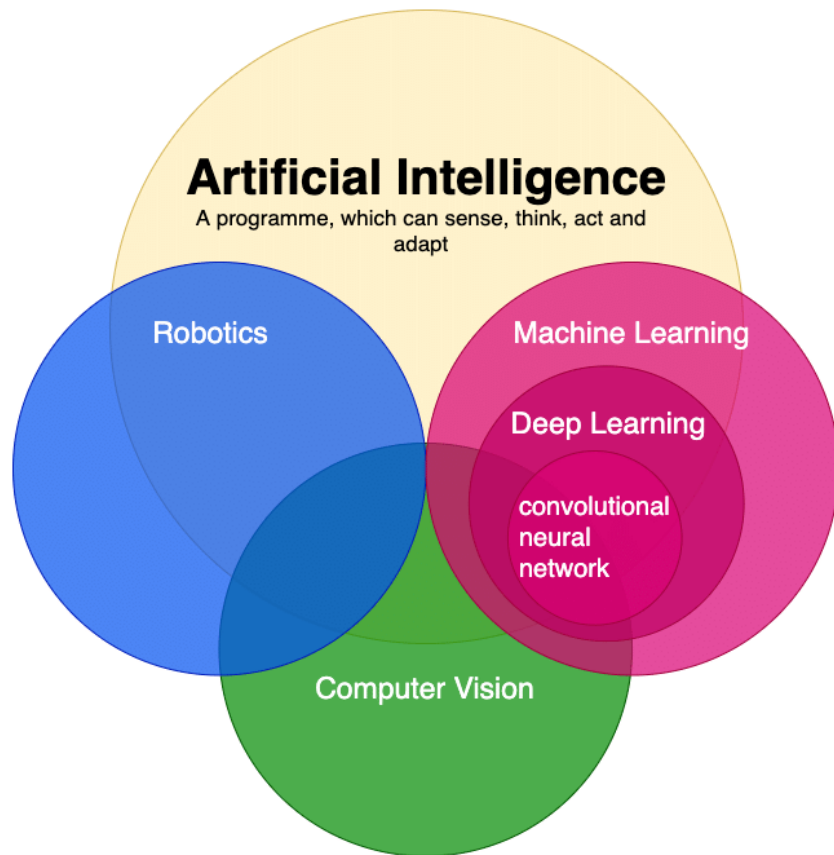


- Class time
 - Theory: 70~80 %
 - Practice: 20~30 %
- Using library
 - Python 3 (Colab or NotePC)
 - OpenCV (Image Processing)
 - Open3D (Point Clouds Processing, Visualization)
 - (PCL: Point Cloud Library)

Goals of this course



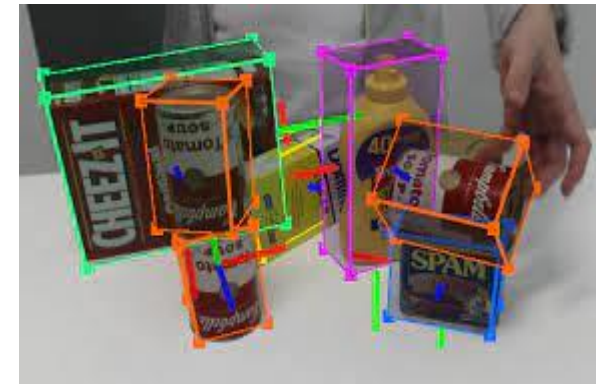
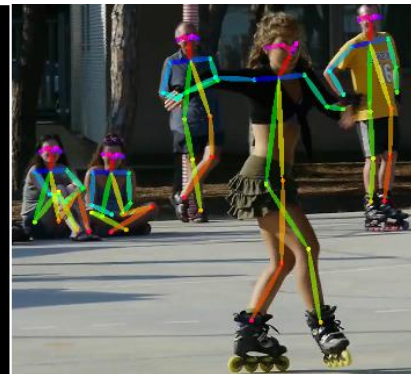
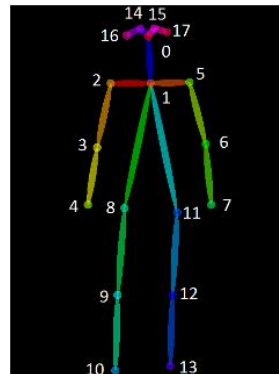
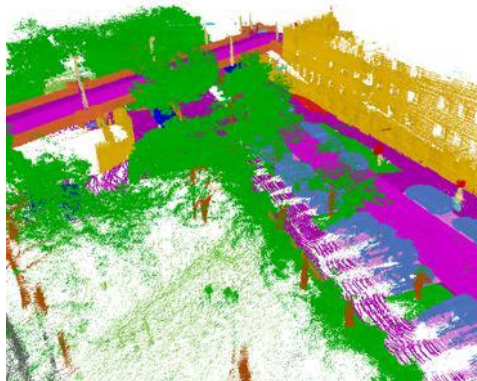
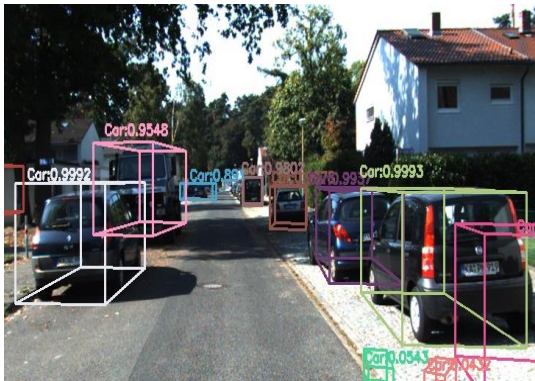
- Understanding fundamental components of sensors and 3D data processing



Goals of this course



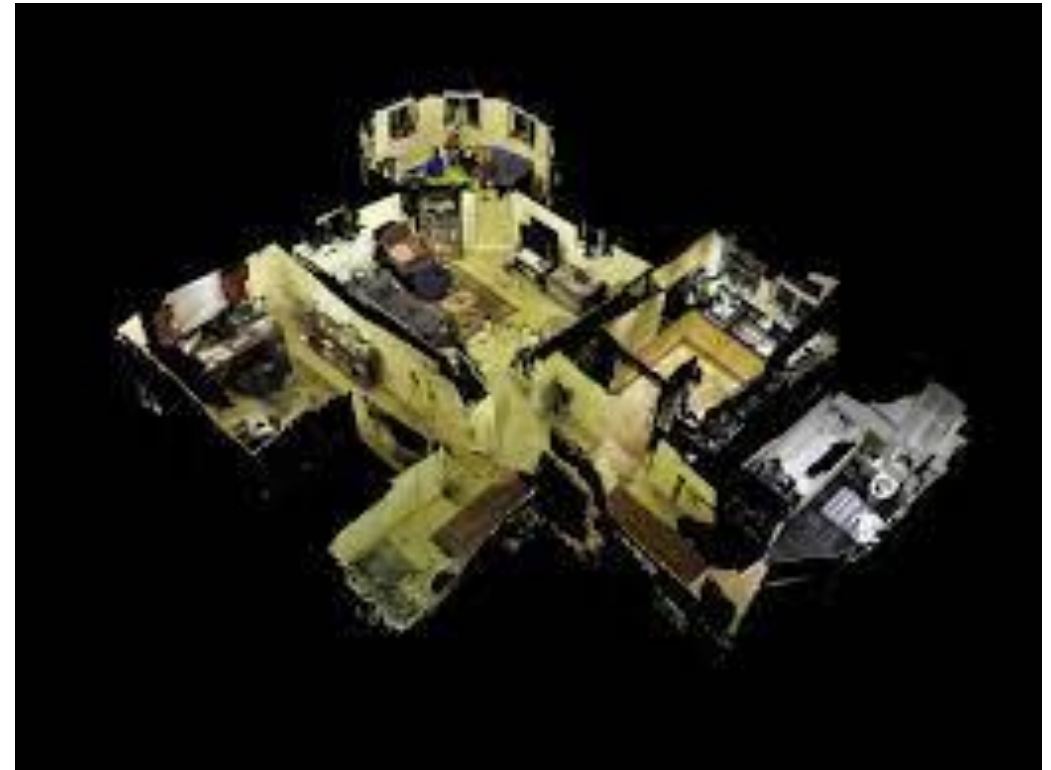
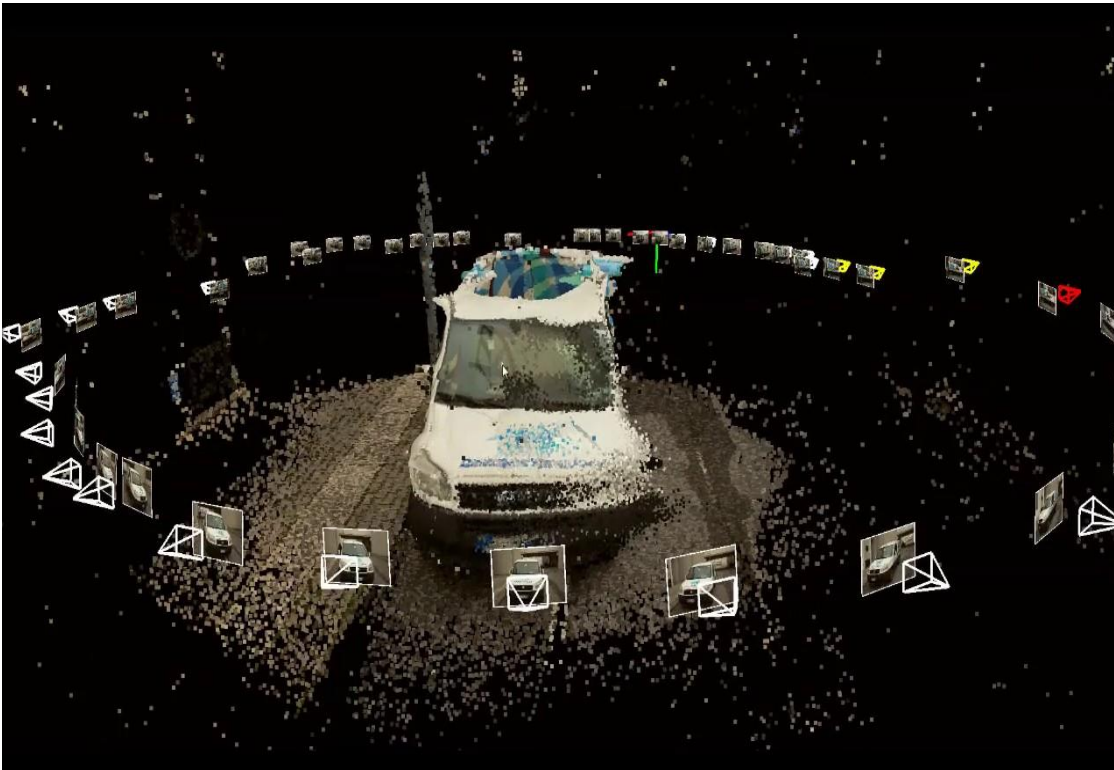
- 3D Perception
 - Detection: detect pre-defined class and its boundary
 - Segmentation: classify all pixel(voxel) in the scene
 - Pose estimation: estimate 6-DOF pose (object, human)



Goals of this course



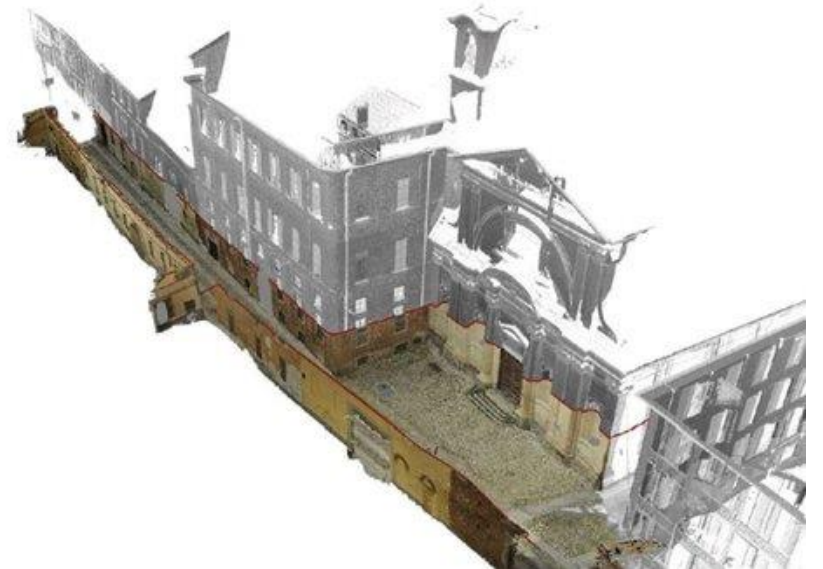
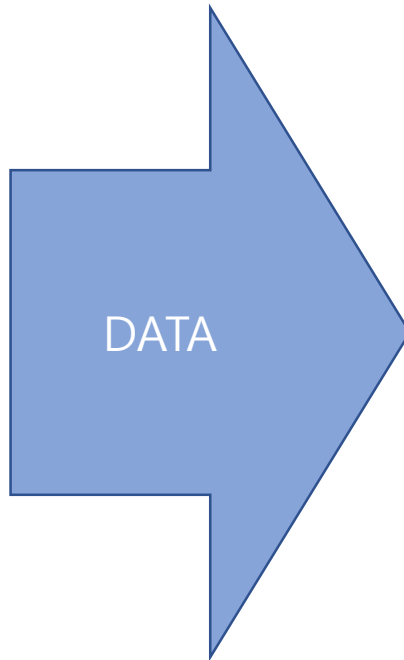
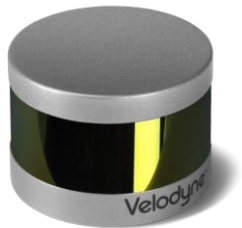
- 3D Reconstruction
 - Build 3D structure from 2D images or partial 3D data



Goals of this course



- 3D data processing



Goals of this course



- Understanding fundamental components of sensors and data processing
- Most of 3D vision algorithms are perception and reconstructing information from raw data
 - Sensors: camera, lidar, RGBD sensor
 - Data processing: signal processing, image processing, geometric transform
 - High level algorithm: Structure from motion, registration

Goals of this course



- Establish a basic foundation for dealing with robots and autonomous driving algorithms.
- Sensors and data
 - Camera: image processing, camera geometry
 - Lidar, RGBD: point cloud, registration
- Image processing
- 3D Geometry
- Basic concept for feature matching, 3D reconstruction
 - Feature points, descriptors, matching, tracking, 3D reconstruction

Goals of this course



- Improve programming skills to process visual sensor data.
- Basic programming
 - Python 3.X
- Using common library for visual data processing
 - OpenCV, PCL(Point Cloud Library), Open3D
- Using cloud-based computational environment
 - Google Colab.
 - Local PC (Notebook) is allowed
- DNNs are not including in this course!!

Lecture Plan (1/2)



차시	날짜	강의주제 및 내용	비고 (주차별 수업방법, 과제 등)
1주	3/2 ~ 3/8	Course introduction Introduction of 3D Data Processing	course materials: Installing Python, OpenCV, Pytorch in Google Colab.
2주	3/9 ~ 3/15	Linear Algebra #1,2	
3주	3/16 ~ 3/22	Sensors - Camera Sensors - Lidar Radar	
4주	3/23 ~ 3/29	2D Image - image processing	HW1
5주	3/30 ~ 4/5	2D Feature - feature extraction	
6주	4/6 ~ 4/12	2D Feature - descriptor	HW2
7주	4/13 ~ 4/19	2D Feature - calibration (intrinsic, extrinsic)	HW3
8주	4/20 ~ 4/26	Midterm Exam.	

Lecture Plan (2/2)



차시	날짜	강의주제 및 내용	비고 (주차별 수업방법, 과제 등)
9주	4/27 ~ 5/3	3D image - RGBD, Lidar (voxel) 3D image - Depthmap, point clouds	HW4
10주	5/4 ~ 5/10	3D image - Triangulation 3D image - Stereo matching	HW5
11주	5/11 ~ 5/17	3D image - Optical flow, Photometric 3D image - RGBD reconstruction	
12주	5/18 ~ 5/24	3D image - 3D Point Clouds processing 3D image - Registration	HW6
13주	5/25 ~ 5/31	3D image - Registration	HW7
		Structure from Motion- multiview RGB	
14주	6/1 ~ 6/7	Structure from Motion- multiview RGB SfM - Multi RGBD	HW8
15주	6/8 ~ 6/14	SfM - Multi RGBD SfM - Lidar	
16주	6/15 ~ 6/21	Final Exam.	

Course organization



- Grade Policies
 - Midterm examination: 30%
 - Final examination (off-line): 30%
 - Homework/reports: 30%
 - Attendance: 10%
- Midterm examination can be replaced by assignments.

Tips of this course



- Don't be afraid or shy
 - This class is for students **who do not know about Computer Vision at all.**
 - The only purpose of this course is to make you understand
- Use your Prof. and T.A.
 - That's why they are