AuE 8200: Machine Perception and Intelligence

Lecture: Course Introduction

Instructor: Bing Li, Ph.D.
bli4@clemson.edu

Assistant Professor
Department of Automotive Engineering
Clemson University International Center for
Automotive Research (CU-ICAR)

Course Introduction

- Machine Perception & Intelligence
  - Syllabus: https://tinyurl.com/syllabus-perception
  - with Zoom link, outline, policies, office hours etc.

- Instructor
  - Bing Li, Ph.D., Assistant Professor
  - <bli4@clemson.edu>

- Teaching Assistants
  - Ziyue Feng <zfeng@clemson.edu>
  - Zack Yang <zongmiy@clemson.edu>

Course Introduction

- Our objectives: (in *Generic* as well as *Autonomous Driving* context)
  - 1D/2D/3D sensor data (signals) analysis first principle
  - 1D/2D/3D sensor data (signals) AI recognition

- Attention:
  - Course participation: every attendance is required.
  - Canvas notification for announcement.
  - Slides/lecture recording will be uploaded to Canvas after each class.
  - Your hands-on with computational thinking is essential

- Submission
  - All assignments, material and submissions use Canvas only.
  - Instructor/TA are not responsible to check email submissions.
  - Late submission will be docked, referring to syllabus.

Books and References

- Lecture notes (slides) on Canvas
  - content self-contain;

- Digital Image Processing
  - Rafael Gonzalez et al, Pearson Press
- Computer Vision: Algorithms and Applications
  - Richard Szeliski, Springer
- Deep Learning
  - Ian Goodfellow et al, MIT Press
- Matlab online tutorials *(MathWorks certificate)*
  - https://matlabacademy.mathworks.com/#signal-processing
  - https://matlabacademy.mathworks.com/#ai

- Other online references and code …

Prerequisite

- Linear Algebra, Trigonometry or Geometry
- Probability or Statistics is preferred
- Programming Experience (Matlab/Python/C++)
  - Survey?

- Reading Literature (A little bit, for your projects)

- An Inquisitive Nature (Curiosity)
- Embrace the new learning

Course Content Topics

- Vehicle sensors and signals
  - 1D signal processing

- Vehicle visual perception
  - 2D image and processing
  - 3D vision and geometry

- Vehicle visual SLAM

- Machine learning and deep learning
  - for perceptual engineering problems

Grading & Final Project

Refer to syllabus: ***Academic Integrity Statement***

- Homework: 40%
  - Finish independently
- Team-Project Implementation/Presentation: 30%
  - Independently + collaboratively
- Team-Project Report: 30%
  - Independently + collaboratively

- Final Team Project:
  - option 1 – Your team proposes a topic
  - option 2 – Choose one from the pool

Final Project: option 3 – Matlab Program

MathWorks Excellence in Innovation Projects (link)

- Are you looking for a design or research project idea with real industry relevance?

- This is a list of inspiring projects based on industry trends for student projects.

- These projects help you learn about technology trends while becoming an important and valued contributor to the advancement of technical computing and Model-Based Design with MATLAB and Simulink.

- Even more, you gain official recognition for your problem-solving skills from technology leaders at MathWorks.

- Projects in below tracks:
  - Autonomous Vehicles
  - Robotics
  - Industry 4.0
  - Sustainability and Renewable Energy
  - ......

- Each project webpage shows:
  - Motivation
  - Project Description
  - Background Material
  - Impact
  - Dedicated discussion forum

(MathWorks certificate)

MathWorks
Excellence in Innovation
Certificate of Accomplishment

This is to certify that

Your name

successfully completed the project

Path Planning for Autonomous Race Cars

Roberto G. Valenti, PhD
Program Manager, Senior Research Scientist
Advanced Research & Technology Office

August 10, 2021
Date

Andy Grace, PhD
Vice President of Engineering
Design Automation

Programming Languages

- To be used: Matlab, Python, C++ or any
- Computing platforms: Your local PC, Matlab online via your Browser, or Clemson Palmetto Cluster Cloud Computing

- Matlab
  - An interactive environment for numerical computation
  - Good rapid prototyping environment
  - Matlab resource introduction ([video introduction](#))
    - https://matlabacademy.mathworks.com/#signal-processing
    - https://matlabacademy.mathworks.com/#ai

- Python
  - Object-oriented, Interactive & Interpreted
  - Extensive support libraries (for image processing, computer vision, data science, machine/deep learning)
  - Extensible in C++ & C
  - Support most of the mainstream deep learning frameworks

- Libraries
  - You may use high-level libraries (OpenCV, PCL, et al) for your project, but not for your homeworks unless certain questions allow.

- Submissions for homework and project
  - Source code file, which can be run directly under regular PC or Cloud settings;
  - Word/PDF document(s) explain your solution and show code result;
  - The TA will/might check and run your code;

Palmetto Platform

https://www.palmetto.clemson.edu/palmetto/training/schedule/

https://www.palmetto.clemson.edu/palmetto/training/workshop/

Your account creation requests have been submitted.

https://www.palmetto.clemson.edu/palmetto/basic/new/

Obtaining Bulk Account for course

Faculty who conducts course that required Palmetto account for all students, please submit the Bulk Account request instead of having student submititng individually:

1. Access the new ITHelp Portal at https://clemson.cherwellondemand.com/CherwellPortal
2. After Logging in Select "Browse Our Services"
3. Select Research > Research Computing > High Perf Computing and Storage
4. Under High Perf Computing and Storage, select "Request Bulk Account"
5. Enter the **list of Clemson user ID**, not the name.
6. Once the form is complete, press the "Submit" button.

Course Outlook

What makes Machine Perception interesting?

- Sensing Physical World

- Sensor Data Modeling and Analysis
  - Sources of knowledge in perception
  - Higher levels of abstraction

  First Principle

  and/vs

  Magic AI

- Machine Intelligence
  - Let computer to understand (sensor) data
  - Conventional and/vs learning approaches

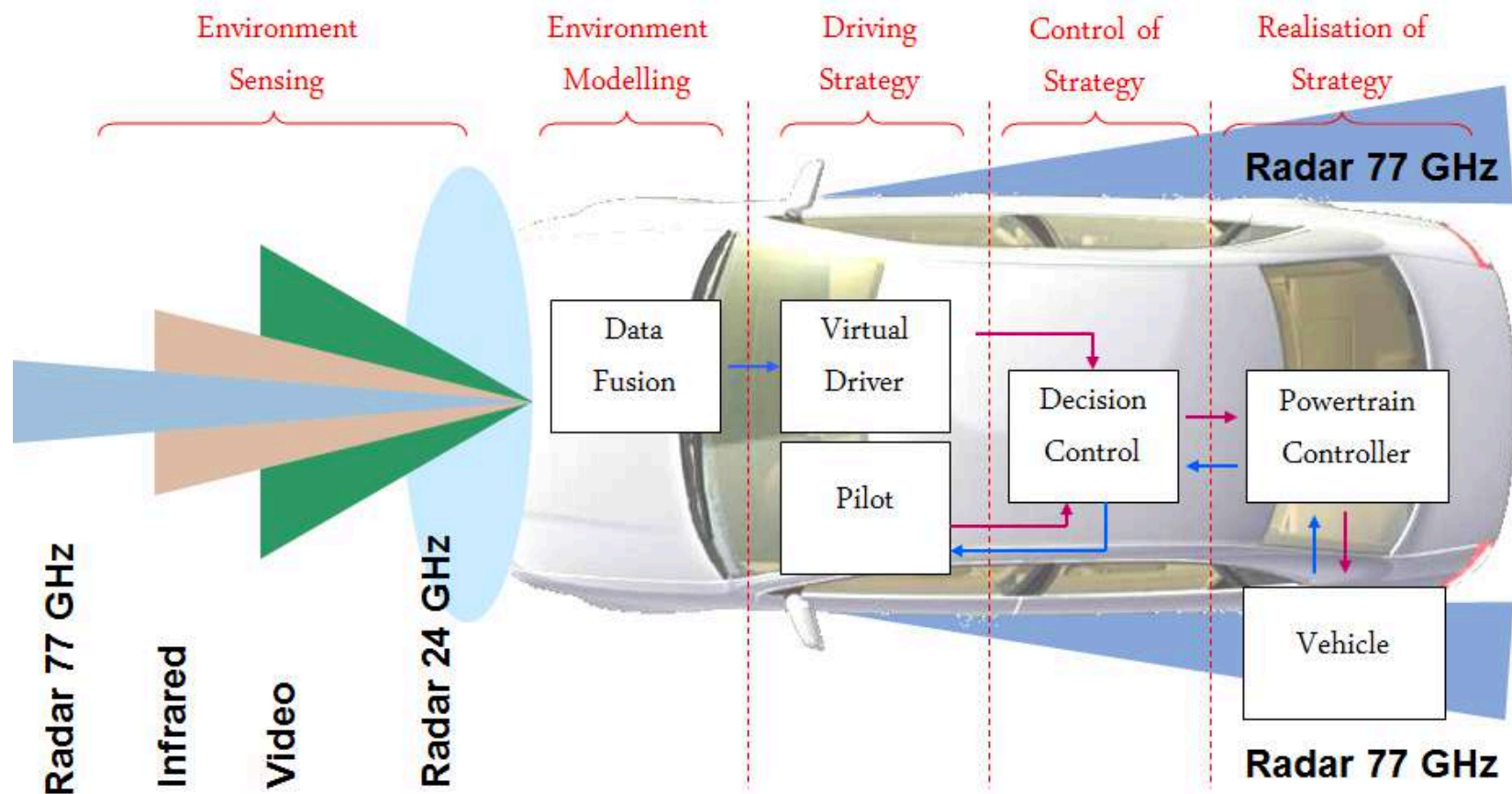# Course Outlook

Vehicle Perception …

Course Outlook

Discover the Streets of Paris Through the 'Eyes' of Tesla Autopilot