

Introduction to Intelligent Vehicles

[0. Course Introduction]

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Enrollment

❑ If you have not enrolled this course...

➤ Visit the NTU enrollment system

Introduction to Myself

❑ B.S. Student

- 2001.09--2005.06, CSIE Department, NTU

❑ M.S. Student

- 2005.09--2007.06, GIEE (EDA Group), NTU

❑ Ph.D. Student

- 2009.08--2015.08, EECS Department, UC Berkeley

❑ Researcher

- 2015.09--2018.07, Systems and Software Division, Toyota InfoTechnology Center (Mountain View, CA)

❑ Assistant Professor

- 2018.08--2021.07, CSIE Department, NTU

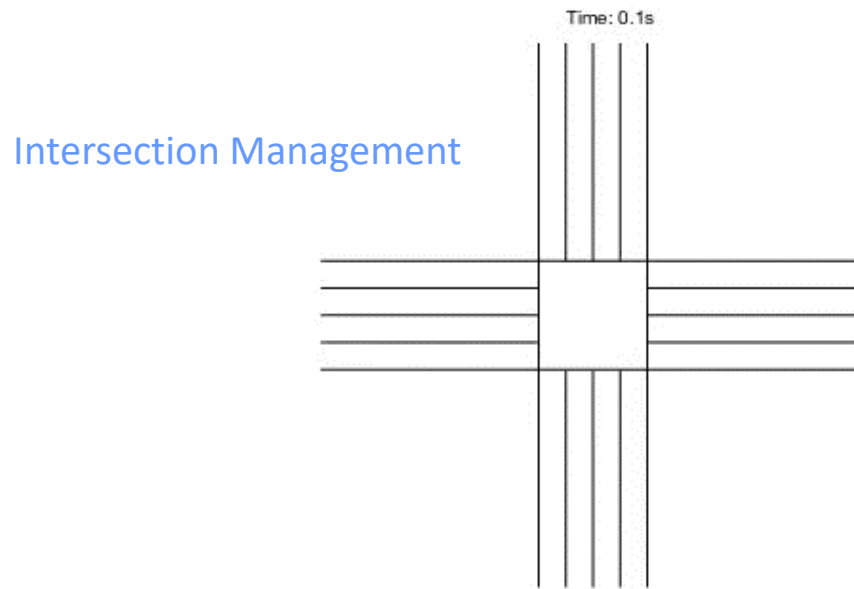
❑ Associate Professor

- 2021.08--, CSIE Department, NTU

Intelligent Vehicles

❑ Connected and Autonomous Vehicles (CAV)

- A good application may need both of "connectivity" and "autonomy"



- What if the intersection management does not have connectivity?
- What if the intersection management does not have autonomy?

Learning Goals (1/2)

❑ Skills in

➤ Modeling

- We will work (design and analyze) upon models rather than real vehicles

➤ Design

- We will optimize some objectives (performance, robustness, security, etc.)

➤ Analysis

- How good are the designs?

❑ Philosophy behind technology (which may expire soon)

➤ Example

- The Controller Area Network (CAN) is old and slow (~500kbps)
- Why is it still the most popular in-vehicular network protocol?

Learning Goals (2/2)

❑ NOT covered in this course

- The mechanics of vehicles
- The physics of vehicles
- The chemistry of vehicles
- Electric vehicles

❑ Covered a little in this course

- Machine learning



<https://www.thehenryford.org/>



<https://www.formula1.com>

Calendar (Tentative)

W1	Feb 20	[0] Course Introduction [1] System Architecture	
W2	Feb 27	[2] Timing Analysis I	HW1 Posted
W3	Mar 5	[3] Timing Analysis II	
W4	Mar 12	[4] System Design	
W5	Mar 19	[5] Advanced Driver-Assistance Systems [6] Intersection Management	HW1 Due HW2 Posted
W6	Mar 26	[6] Intersection Management	
W7	Apr 2	[7] Connectivity	HW2 Due
W8	Apr 9	Midterm	
W9	Apr 16	[8] Sensing and Perception [9] Planning and Control	
W10	Apr 23	[10] Verification	
W11	Apr 30	[11] Security	
W12	May 7	[12] Edge Computing [13] Certification [14] Summary	
W13	May 14	Quiz / Project Presentation	
W14	May 21	Project Presentation	
W15	May 28	Project Presentation	
W16	Jun 4	Project Presentation	Project Report Due

Lecture Plan

❑ Four parts in sequence

- [Part 1] Preliminary
- [Part 2] Applications
- [Part 3] Intelligent Technology
- [Part 4] Advanced Topics

❑ However, please expect that topics will be "discrete"

Grading

- ❑ Homework 1: 5% [Week 5]
- ❑ Homework 2: 5% [Week 7]
- ❑ Midterm: 30% [Week 8]
- ❑ Quiz: 15% [Week 13]
- ❑ Project presentation: 10% [Weeks 13, 14, 15, 16]
 - Earlier? (you do not need to complete your work to present)
- ❑ Project report: 35% [Week 16]
- ❑ Grading philosophy
 - Academic dishonesty leads to failing by default
 - There are difficult questions in exams
 - Final letter grades will be adjusted but not negotiable

Websites and TAs

❑ Basic information, slides, homework assignments, homework solutions, announcement, and discussion

- NTU COOL: <https://cool.ntu.edu.tw/courses/33221>
- You are mandatory to check the announcement there

❑ Homework submission and grading

- Gradescope: we will register you later

❑ TAs

- Kuang-Liang Tseng
- Chien-Yi Chien

Homework

☐ Homework is due at noon

➤ No late homework is accepted

- Though the submission site will be open until 1pm

➤ Exception: you email Chung-Wei and get the approval before the deadline (noon)

☐ You will need to do some programming

➤ Example: read numbers from files and compute something

☐ You are encouraged to work on homework in study groups, but you must write up the solutions on your own

Midterm and Quiz

❑ Dates

- April 9
- May 14

❑ You can ask (= challenge) for regrading (based on problems) before a deadline, and then we will regrade them

- For each problem
 - If your score becomes higher, you win the challenge
 - Otherwise, you lose the challenge
- Starting from the 3rd failed challenge, you get additional deduction

Project

- ❑ A team can have 1 up to 4 members
 - More members, higher expectation
 - The contribution of each member needs to be specified clearly in the report
- ❑ A project can be survey, implementation, or research
 - You can propose your own topic
 - Of course, it must be related to intelligent vehicles
- ❑ It is highly encouraged to combine your project with your current research, your thesis, or another course project (if the instructor agrees)
 - This must be specified clearly in the report
 - Anything you have completed before the semester is not counted

Selection of Project Topics

☐ Survey

- If you want to have the safest choice

☐ Implementation

- If you are a programming enthusiast

☐ Research

- If you are a graduate student or thinking to pursue Ph.D. abroad

Examples of Project Topics (1/3)

❑ Machine learning

- Behavior prediction
- Image recognition, traffic sign recognition
- Pedestrian recognition, objective detection
- Play around some data (check <https://www.its.dot.gov/data/>)

❑ Applications

- Advanced Driver-Assistance Systems (ADAS)
- Cooperative Adaptive Cruise Control (CACC)
- Intersection management
- Realization of Pui Pui Molcar

Examples of Project Topics (2/3)

❑ Networking

- Performance evaluation
- Comparison between different communication protocols

❑ Security

- Adversary classification
- Intrusion detection
- Applications of blockchain

❑ Human-computer interaction

- Augmented reality and virtual reality
- "Safe" interface
- Language understanding

Examples of Project Topics (3/3)

❑ Software architecture and engineering

- Edge computing
- Architecture (<https://local.iteris.com/arc-it/>)
- Open source software

❑ Theory

- Scheduling
- Timing analysis
- Game theory analysis

❑ Design methodology and tools

- Simulation environment (e.g., Simulink, Unity)
- Data collection and creation
- Modeling, optimization, formal verification

Q&A