9th July 2024



Introduction of ITS laboratory and state-of-the-art of Intelligent Vehicles

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Contents

- Self introduction
- Introduction of our department
- Introduction of ITS laboratory
- What is ITS
- Potential of Intelligent Vehicles
- Practical status of autonomous vehicles
- Towards the future





Self-introduction

 <u>Sep. 2008</u>: Doctor of Engineering, Kyoto University (Supervised by Prof. Ryuichi Kitamura and Prof. Toshio Yoshii)



- Oct. 2008: Assistant professor at Department of Urban Management, Graduate School of Engineering, Kyoto University
- <u>Apr. 2011 to Mar. 2012</u>: Visiting researcher in TU Delft **TUDelft**
- <u>Apr. 2012 to now</u>: Lecturer (Mar. 2014), Associate professor (~Mar. 2022), and Professor at Ritsumeikan University **RITSUMEIKAN**
- Nov. 2021 to Aug. 2022: Visiting researcher in TU Delft



Departments in College of Science and Engineering

- Mathematics and Physics Major
 - Department of Mathematics
 - Department of Physics
- Electronic Systems Major
 - Department of Electrical and Electronic Engineering
 - Department of Eletronic and Computer Engineering
- Mechanical Systems Major
 - Department of Mechanical Engineering
 - Department of Robotics
- Urban Systems Major
 - Department of Civil and Environmental Engineering
 - Department of Architecture and Urban Design



Department of Civil and Environmental Engineering

• Create the safe, secure, comfortable and sustainable society.



Waste treatment



water supp





Faculties: Civil engineering



Prof. Izuno, K. Disaster prevention system lab.

Prof. Wells, J.C. Fluid dynamics lab.

> Prof. Kobayashi, T. Soil systems lab.

Prof. Satobuka, Y. Watershed design lab.

Prof. Nozaka, Y. Steel structure lab.



Prof. Nomura, Y. Applied informatics lab.

Assoc. Prof. Kawasaki, Y. Infrastructure material lab.

> Assoc. Prof. Fujimoto, M. Environment Management and Disaster Mitigation lab.

Dr. Ito, S. Soil informatics lab.

Dr. Tang, J. Soil systems lab.



Faculties: Environmental engineering



Prof. Ichiki, A.

Environmental planning and policy lab.

Prof. Kamiko, N. Environmental sanitation engineering lab.

Prof. Soda, S.

Water environmental engineering lab.

Prof. Hashimoto, S.

Sustainable resource and waste management lab.

Prof. Higuchi, T.

Air quality and malodors lab.



Assoc. Prof. Sato, K. Watershed environment information lab. Assoc. Prof. Shigetomi, Y. Sustainable lifestyle lab.



Dr. Shen, S. Environmental microbiology lab.

Dr. Miura, Y. Water circulation lab.





Faculties: Urban, transport, disaster prevention planning



Prof. Okubo, T. Disaster mitigation and town planning lab.

Prof. Okai, Y. Urban Planning lab.

Prof. Ogawa, K. Urban transportation lab.

Prof. Shiomi. Y. ITS lab.

Assoc. Prof. Kim, D. Urban design lab.







Research areas

Freeway operation & management



Public transportation planning



Intersection design and traffic signal operation



Human behaviors

Public transportation management

• Traffic simulation in Minami-Kusatsu Area and physical twin system





Public transportation management

• Traffic simulation in Minami-Kusatsu Area and physical twin system





Driving Behavior Analysis

Accostic stimuli to prevent drowsiness driving





Intersection design

AI to distinguish road area



Automatic path findings of tractor-trailer vehicles





Freeway operation and management

Optical stimuli to mitigate traffic congestion





Lab members

- Visiting Prof:
 - Takashi Shimada
 - Nobuto Kanbe
- Visiting Assoc. Prof.
 - An Minh Ngoc
- Doctor : 1
- M2:4
- M1:7
- B4:9









- Intelligent Transportation Systems
 - Enable various users to be better informed and make safer, more coordinated, and 'smarter' use of transport networks on the basis of information and communication technologies.





Application of ITS





Future of ITS

Intelligent Vehicles (IV)



Connected

- Internet based personal and social connectivity to be enabled in the car
- Innovation in high speed connectivity such as 5G offers platforms for new applications of connectivity



Autonomous

- L1 and L2 autonomous driving technology has resulted in radically improved safety
- Advanced sensor suite and machine learning powered AI is expected to accelerate advent of fully autonomous driving



to disrupt rental car

industry





Electric/Electrified

- Scale and innovation based cost reduction of raw materials is enabling EVs to achieve cost parity with ICE vehicles
- Environmental regulations across the globe are expected to further catalyze EV transformation



What can IVs potentially do?





Dissipation of stop-and-go traffic waves via control of a single autonomous vehicle

TILLINOIS RUTGERS TEMPLE



What can IVs potentially do?





IVs?









Theory and Practice





Social problems related to transportations







• All traffic congestion in Japan :

3.8 billion hours, equivalent to 100 billion euro

• Traffic congestion on motorways in Japan :

190 million hours, 4.4 billion euro





Traffic crashes

- SDGs Target 3.6
 - By 2030, halve the number of global deaths and injuries from road traffic accidents.
- The number of traffic accident deaths in the world
 - 115 million (2000) and 135 million (2016).
- Urgent needs for the appropriate policies and technologies on road traffic safety







Driver shortfall

Driver overtime cap introduced asJapan to face 36% truck driverworker shortage worsensshortfall in FY 2030: think tank

KYODO NEWS - Apr 1, 2024 - 10:04 | All, Japan



TOKYO – An overtime limit of around 18 hours per week for drivers of trucks, taxis and buses took effect on Monday, as Japan looks to improve standard work conditions in an industry struggling with an acute labor shortage.

While the move seeks to address the widespread practice of driver overwork, the change has raised concerns about a drop in transport delivery capacity. The logistics shortfall, brought about by the new overtime restriction, is known in the industry as the "2024 problem."

Restricting the number of hours drivers can work may lead to customers experiencing poorer service and longer delivery times.

Japan is already facing a shortage of drivers due to an aging workforce, poor wages in the industry and difficult working hours, while demand for package delivery is increasing.



People board a bus in Yokohama on April 1, 2024. (Kyodo)

KYODO NEWS - Jun 22, 2024 - 09:16 | All, Japan

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TOKYO – Japan will have 36 percent fewer truck drivers than required to meet the country's logistical demands in fiscal 2030 due to its graying population and the introduction this year of reforms aimed at curbing overwork, according to a recent study

The country's road freight volume in the fiscal year ending March 2031 is projected to be 1.40 billion tons, declining slightly from 1.43 billion tons in fiscal 2020, the Nomura Research Institute said.

Meanwhile, the number of truck drivers is expected to fall drastically from 660,000 in fiscal 2020 to 480,000 in fiscal 2030, 36 percent short of the workforce required to delive 1.40 billion tons of cargo, the think tank said.



File photo taken on Dec. 14, 2023, shows trucks at a logistics center in the southwestern Japan city of Fukuoka. (Kyodo) ==Kyodo

Taxi Industry Employing Up to 80 Years Old in Japan



-- (193





Assumption of diffusion process

• Different process is assumed between service cars and owner cars

Level of automation





Learn more here: sae.org/standards/content/j3016_202104

SAE **J3016**[™] LEVELS OF DRIVING AUTOMATION[™]

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SAE: Society of Automotive Engineers



Self-driving on motorways for owner cars

- Honda legend
 - Driver can hand off and take second tasks in the specific condition (traffic jam)
 - Car monitors a driver not to fall a sleep





11:14~



Assumption of diffusion process

• Different process is assumed between service cars and owner cars

Level of automation



Implementation road map









Truck platooning



34

1:29~



A possible solution

• Designated lane, ramps and terminal is under planning.





Blueprint

https://www.mlit.go.jp/policy/shingikai/content/001623770.pdf





Technical challenges

- Technical challenges for Lv 4
 - Road surface marking







– Interaction with surrounding vehicles





• Sakai town, Ibaraki prefecture since Nov. 2020.





• Magnetic Positioning System







Remote monitoring and control





developed by insurance company







Okueigenji in Shiga prefecture





- Technical challenges
 - Reasons of emergent stop of autonomous bus.









- 26 Aug, 2019 (Toyota city)
 Sensor error
- 10 Mar, 2020 (Tokyo)
 Human error after take over
- 30 Aug, 2020 (Otsu city) – Human error after take over
- 14 Dec, 2020 (Hitachi city)
 Operator (not driver) error
- 26 Aug, 2021 (Tokyo Paralympics)
 - Human error after take over





The three fixes for innovation





Questions and comments?

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