



Intelligent Vehicle Technologies & Smart Mobility

Prof Kyandogherye Kyamakya
Prof Jean C. Chedjou

Lecture Overview



INTELLIGENT VEHICLE TECHNOLOGIES & SMART MOBILITY

Definitions

Intelligent Vehicles

aim to fully utilize available technologies to assist drivers by enhancing handling, safety, efficiency, and the comfort of driving.

Smart Mobility

refers to using modes of transportation alongside or even instead of owning a gas-powered vehicle. This can take on many different forms, including ride-sharing, car-sharing, public transportation, walking, biking, and more.



INTELLIGENT VEHICLE TECHNOLOGIES & SMART MOBILITY

- Number of credits
 - A **total of 5 ECTS Credits**
 - 45 hours for the theoretical lecture
 - 30 hours for the practical part: excises, lab, mini-seminars, homeworks
- **Lecture structure**
 - **2 Modules – Theoretical part**
 - MODULE 1: **Intelligent Vehicle Technologies**
 - MODULE 2: **Smart Mobility**
 - **1 Module – Practical part (with 3 Sub-Modules)**
 - MODULE 3.1: **Students mini-seminars**
 - MODULE 3.2: **Experiments with the Simulation tool AUTOWARE**
 - MODULE 3.3: **Experiments with the Simulation tool SUMO**



INTELLIGENT VEHICLE TECHNOLOGIES & SMART MOBILITY

• Teaching Method and Students performance Evaluation

- Theoretical part of the course
 - Frontal **presentations with Slides** by the Teachers (Slides to be placed in Moodle)
 - **Selected videos** fitting the respective chapters (sources: Youtube, online open courses, etc.)
 - Small **weekly assignments**. Weekly solutions to be uploaded in Moodle
- Practical part of the course
 - Students **mini-seminars** in groups of 2 students; 1 topic for each module. 1 Presentation for each mini-seminar. 1 final report of 6-to-8 page for each mini-seminar.
 - Some **simulation experiments using 2 selected Simulation tools**: some simple experiments and one complex project. 1 final report of 6-to-8 page for the complex project.
 - If possible, one **industrial visit** in a company working in one of the relevant fields.
- Evaluation of the course
 - The **weekly assignments** accompanying the theoretical course: 10% of final grade
 - **Mini-seminars, simulation labs** and related presentations and final reports: 60% of final grade
 - **Final written exam**: 30% of final grade



2 Theoretical Modules: Overview

- Contents of Module 1: Intelligent Vehicle Technologies
 - Chapter 1:** General introduction to Intelligent Vehicle Technologies
(ITS overview, core ITS services, General architectures & frameworks)
 - Chapter 2:** Enabling Technologies
(Environment Perception, Positioning & maps, Big data, Prediction and Routing, Control)
 - Chapter 3:** Selected Applications
(Driver Assistance Syst., Cooperative Systems, Automated Driving, Automated Highway Systems)
 - Chapter 4:** Further aspects (incl. social, economic, simulation, and research)
(Human Factors; Law, Ethical and Liability Issues; Acceptance; Socio-Economical Impact; Simulation,...)
- Contents of Module 2: Smart Mobility
 - Chapter 5:** General introduction to Urban Mobility (trends and challenges)
 - Chapter 6:** Fundamentals of Mobility Systems
(Systems and Infrastructures; Monitoring; Modeling and Simulation; Machine Learning Application)
 - Chapter 7:** Mobility systems – Concepts and Technologies
(5 Smart Digital Layers, Smart Cities & Communities, Smart Mobility Concepts, Automation, Human Factors)



1 Practical Module: Overview

- Module 3: Mini-Seminars and Simulations

Part 3.1: Students Mini-seminars

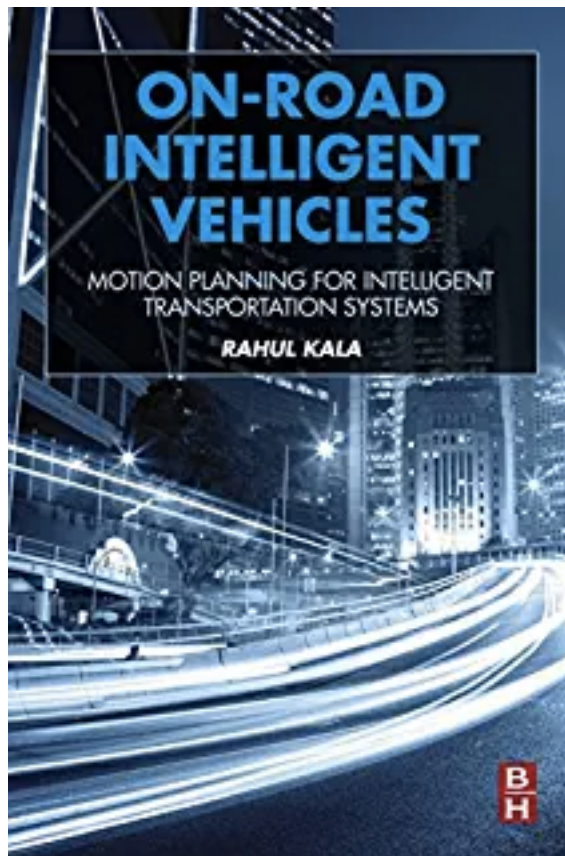
Part 3.2: INTELLIGENT VEHICLES:
Experiments with the Simulation Tool [AUTOWARE](#) (open source)

Part 3.3: SMART MOBILITY:
Experiments with the Simulation Tool [SUMO](#) (open source)



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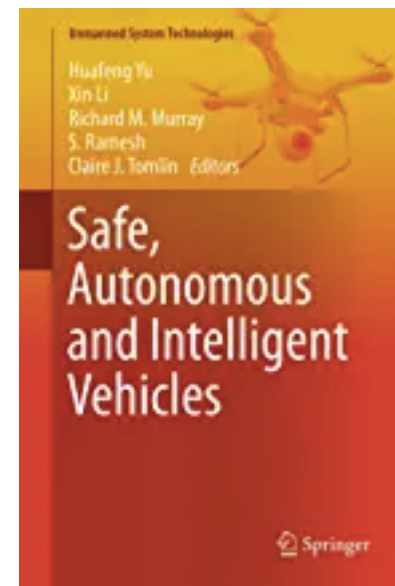
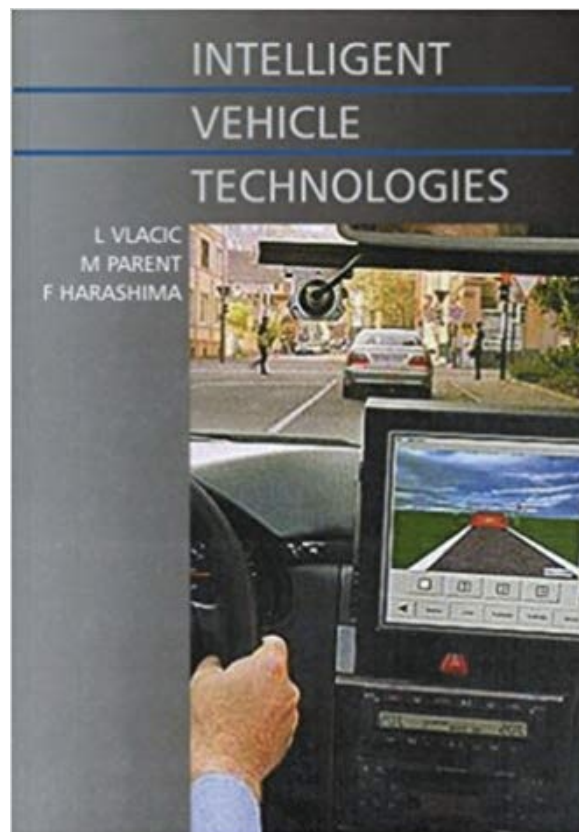
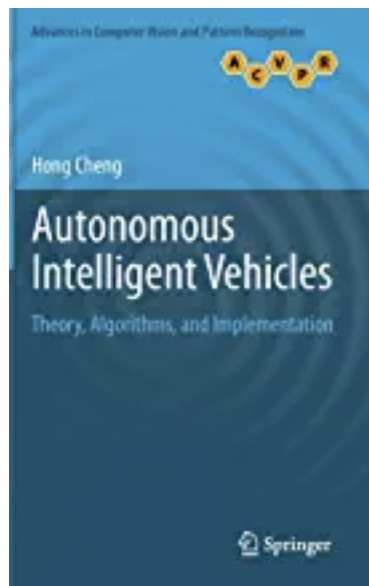
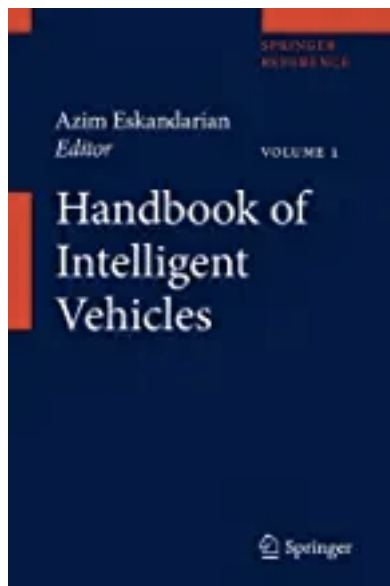
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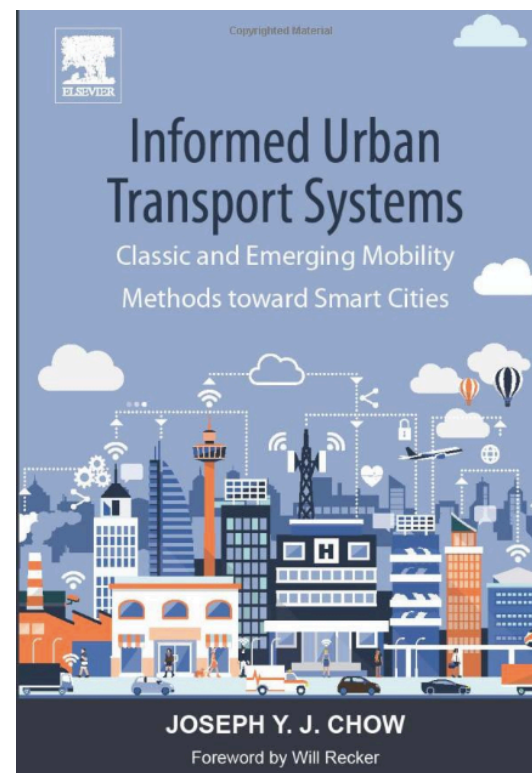
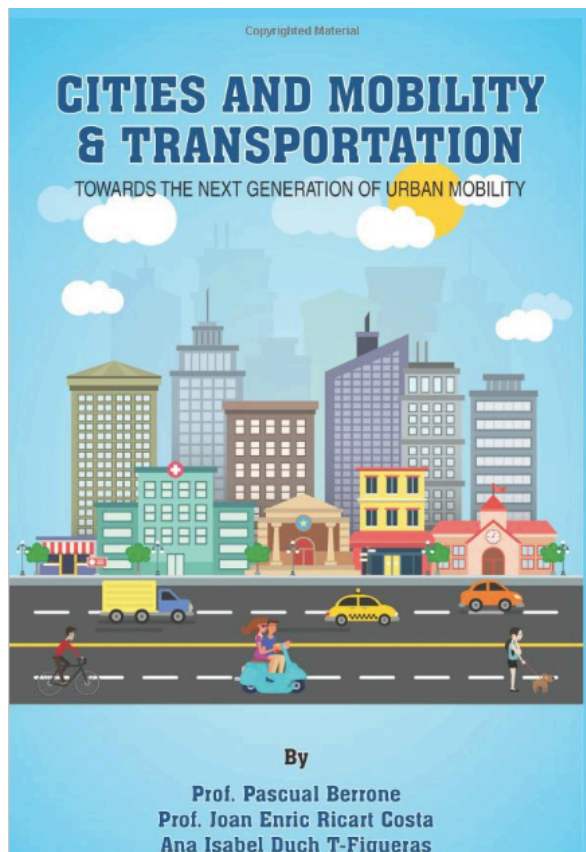
- Bibliographic References





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- Bibliographic References





INTELLIGENT VEHICLE TECHNOLOGIES & SMART MOBILITY

- Some relevant Free Online Course (MOOCS)
 - <https://www.classcentral.com/subject/autonomous>
 - <https://www.classcentral.com/course/electric-vehicles-mobility-9909>
- Some illustrative videos
 - **BEST VIDEO**: it summarizes at best **the big picture around Intelligent Vehicles**
 - <https://www.youtube.com/watch?v=Q8Cn47L8FRQ>
 - **OTHER VIDEOS**
 - <https://www.youtube.com/watch?v=MJiDEDaBGBQ>
 - <https://www.youtube.com/watch?v=imo1kzbHIjY>
 - <https://www.youtube.com/watch?v=fPRYiXZDB7c>
 - <https://www.youtube.com/watch?v=hkYPtWBL4IO>
 - <https://www.youtube.com/watch?v=dhUy-ikmM4s>
 - <https://www.youtube.com/watch?v=VKkqKsQY9pE>
 - <https://www.youtube.com/watch?v=92IJSTQXaZk&t=9s>
 - <https://www.youtube.com/watch?v=F923EuB06CI>
 - <https://www.youtube.com/watch?v=hhUNgfUxDL4>
 - <https://www.youtube.com/watch?v=HT-Y-mihazl&t=406s>
 - <https://www.youtube.com/watch?v=6uV25mTDUFY>

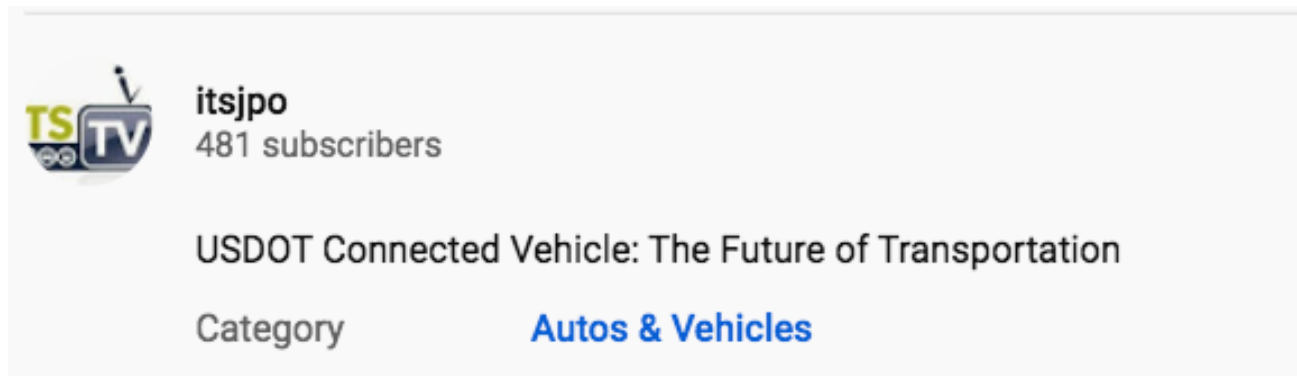



Intelligent Vehicle Technologies & Smart Mobility

Presentation of one illustrative video

Source: Youtube

Link: <https://www.youtube.com/watch?v=Q8Cn47L8FRQ>



 **itsjpo**
481 subscribers

USDOT Connected Vehicle: The Future of Transportation

Category **Autos & Vehicles**



INTELLIGENT VEHICLE TECHNOLOGIES & SMART MOBILITY

Detailed presentation of the 3 Modules



Module 1: Intelligent Vehicles Technologies, Details

- Contents of Module 1

Chapter 1: A General introduction to Intelligent Vehicle Technologies

- ITS (intelligent transport systems) overview
- Intelligent vehicles initiatives in various countries (USA, EUROPE, JAPAN)
- Core ITS services, a brief overview
- General architecture(s) / frameworks for intelligent vehicles
- Five key stages to the processing aspects of a self-driving vehicle

Chapter 2: Enabling Technologies

- Environment perception for intelligent vehicles
- Vehicular communication
- Positioning technologies and digital maps
- Big data in road transportation and mobility research
- Prediction and routing
- Path planning and decision making
- Control of intelligent vehicles



Module 1: Intelligent Vehicle Technologies, Details

- Contents of Module 1

Chapter 3: Selected Applications

- Driver assistance systems and safety systems
- Cooperative systems
- Automated driving
- Automated Highway System (AHS)

Chapter 4: Further Aspects (incl. social, economical, simulation, and research)

- Human factors (human driver behaviors, user interfaces, impact on automated cars on society and mobilities)
- Law, ethics and liability issues (special legal questions, product liability, regulation, risks assessment (technical, legal, and economic))
- Acceptance issues
- Simulation tools (driving simulators, traffic simulation, data for training models, domain adaptation)
- The socio-economic impact of the intelligent vehicles: implementation strategies
- Future perspectives and hot research areas/issues



Module 2: Smart Mobility, Details

- Contents of Module 2

Chapter 5: General Introduction to Urban Mobility

- Urban mobility trends and challenges (traffic congestion, parking problems, traffic accidents, energy consumption, environmental impact)

Chapter 6: Fundamentals of Mobility Systems

- Urban mobility systems and infrastructures
- Monitoring mobility in smart cities
- Modeling and simulation of mobility systems – a brief introduction
- Learning from public information / inverse transportation problems (*machine learning applications in urban transport, inverse transportation problems, multiagent inverse transportation problems, network learning*)



Module 2: Smart Mobility, Details

- Contents of Module 2

Chapter 7: Concepts and Technologies of Mobility Systems

- The 5 smart digital layers (urban layer, sensor layer, connectivity layer, data analytics layer, automation layer)
- Technologies and data transmission in ITS and smart mobility
- Smart cities, smart communities: definitions of the concepts
- Smart mobility in urban/metropolitan areas + case studies (people mobility, transport demand management, urban freight and city logistics, green mobility and low emission zones, other mobility solutions for the future)
- Building blocks of intelligent mobility
- Automation and autonomous driving in mobility systems
- Mobility as a service (MAAS) – a brief overview
- Human factors



Practical Module, Module 3: Details

- Contents of Module 3.1: Mini-Seminars

- Part 3.1: Presentation (by teacher) of possible topics to be selected from
- Part 3.2: Research (2-3 weeks) and preparation of a 30-minutes presentation on the selected topic
- Part 3.3: Formulation (by the student) of a 6 to 8 pages report on the selected mini-seminar topic

- **Selected Examples (just for illustration) of Mini-Seminar Topics**

- INTELLIGENT VEHICLES

- Driver monitoring systems in intelligent vehicles
- Analyzing driver-pedestrian interaction at crosswalks: A contribution to autonomous driving in urban environments
- The role of machine vision for intelligent vehicles
- Graph-Based Modeling, Scheduling, and Verification for Intersection Management of Intelligent Vehicles

- SMART MOBILITY

- User Tracking and Incentive Management in Smart Mobility Systems
- A taxonomy for planning and designing smart mobility services
- Mobile crowd sensing for smart urban mobility



Practical Module, Module 3: Details

- Contents of Module 3.1: Mini-Seminars
 - Part 3.1: Presentation (by teacher) of possible topics to be selected from
 - Part 3.2: Research and preparation of a 30-minutes presentation on the selected topic
 - Part 3.3: Formulation (by the student) of a 6 to 8 pages report on the selected mini-seminar topic
- Contents of Module 3.2: Experiments with the Simulation tool AUTOWARE (open source)
 - Part 3.4: Tutorial (by teacher) on the tool AUTOWARE + some simple exercises
 - Part 3.5: Realise (guided by the teacher): a) some middle-level exercises; and b) a complex simulation project with the tool AUTOWARE
 - Part 3.6: Formulation of a 6 to 8 pages report on the complex simulation project of part 3.5; also a related final a 30-minutes presentation



Practical Module, Module 3: Details

- Contents of Module 3.2: Experiments with the Simulation tool AUTOWARE (open source)

Some important Links on the Tool AUTOWARE

Tutorials:

<https://www.lgsvlsimulator.com/>

Where to download it:

<https://www.lgsvlsimulator.com/>

<https://www.lgsvlsimulator.com/docs/autoware-instructions/>

Overview videos:

<https://www.youtube.com/watch?v=yTjpxhzzWQE>

<https://www.youtube.com/watch?v=cBmliR3jRvE>



Practical Module, Module 3: Details

- Contents of Module 3.3: Experiments with the Simulation tool SUMO (open source)

- Part 3.7: Tutorial (by teacher) on the tool SUMO + some simple exercises
- Part 3.8: Realise (guided by the teacher) a complex simulation project with the tool SUMO + some simple exercises
- Part 3.9: Formulation of a 6 to 8 pages report on complex simulation project of Part 3.8; also a related final a 30-minutes presentation



Practical Module, Module 3: Details

- Contents of Module 3.3: Experiments with the Simulation tool SUMO (open source)

Some important Links on the Tool SUMO

Tutorials:

<https://sumo.dlr.de/docs/Tutorials.html>

[https://sites.psu.edu/huawei/files/2018/05/SUMO an introduction from a beginner-19cmnuf.pdf](https://sites.psu.edu/huawei/files/2018/05/SUMO_an_introduction_from_a_beginner-19cmnuf.pdf)

https://www.youtube.com/watch?v=5ROw6KEAqic&list=PLJc63T23pL3vYHLQ3LOVRG_KzbvO117mM

Where to download it:

<https://sumo.dlr.de/docs/Downloads.html>

Overview videos:

https://www.youtube.com/results?search_query=urban+mobility+simulation



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