LECTURE 1: INTRODUCTION TO “ITS”
My current research focuses on Mobility Modelling and Analytics, Mobility Data mining, Mobile Phone Cellular Network data Analytics and Intelligent Transportation Systems (ITS).

**ITS Lab** research activities are covering four main directions:

- Mobility Analytics
- Advanced Travel Information Systems
- Advanced Driver Assistance Systems
- Vehicular Networking

its.cs.ut.ee
COURSE SYLLABUS

• Lecturer: Amnir Hadachi

• Lab Assistant: Artjom Lind

• Course webpage: https://courses.cs.ut.ee/2020/ITS/fall

• Lectures:
  • Wed. 10h15 -12h00
    • Live stream / Recording
  • Fri. 10h15-12h00
    • Live stream
COURSE SYLLABUS

• Attendance and participation (15%)

• Midterm exam (20%)

• Final exam (20%)

• Projects and presentations: (25%) (two choices)
  • Research paper (individual)
    • Critical review of selected ITS literature
    • Analysis on some topic of interest to you related to ITS
  • Creating a small application (individual or group)
    • Possible application will be discussed during the lab sessions

• Labs: (20%)
  • First part is related to image processing and computer vision in ITS
  • Second part is about traffic simulation and V2V communication
# COURSE SYLLABUS
## TOPICS

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<td>Introduction to ITS: definition, roles and involvement.</td>
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<td>ITS services: Advanced Public Transportation Systems (APTS), Commercial Vehicle Operation (CVO), etc</td>
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INTRO
VIDEOCLIP BY FORUM DE COMPETITIVIDADE DE IOT
INTRO

WHAT IS ITS?

DEFINITION I.1: ITS is about applying well-established technologies of communication, control, electrons, computers (hardware and software) for increasing the safety and efficiency of the existing transportation system.
INTRO

WHY IS “ITS” IMPORTANT?

SAVE LIVES
- Improve trip planning
- Improve delivery time
- Increase reliability

SAVE TIME
- Reduce crashes and fatalities
- Improving security and safety
- Improving emergency response

SAVE MONEY
- Cost avoidance
- Improve productivity
- On-time delivery
- Customer satisfaction

SAVE THE ENVIRONMENT
- Fuel saving
- Reduce pollution

Sources: cvlibs.net, its.cs.ut.ee
“ITS” MAIN OBJECTIVES

• Traffic Monitoring
• Energy consumptions
• Safety on roads
• Pollution on roads
• Fluidity of traffic
• Sufficient parking infrastructure
• Reduce travel time
• Ease of public transport
...
“ITS” ELEMENTS

SOFTWARE
ALGORITHMS
MOBILE APPS
SYSTEMS MANAGEMENT
AND OPERATION
...

HARDWARE
CARS
BUSES
TRAINS
AIRPLANES
DRONE
...

INFRASTRUCTURE
ROAD NETWORK
MOBILE NETWORK (.., 4G/5G)
SENSORS
WIRELESS
INFRASTRUCTURE
...
“ITS” MANIFESTATION

ITS INDUSTRY INVOLVES MANY CATEGORIES, DISCIPLINES AND EXPERTISE

ADVANCED TRAVELER INFORMATION SYSTEMS

VEHICULAR NETWORKING

AUTONOMOUS VEHICLES

ADVANCED DRIVER ASSISTANCE SYSTEMS

ADVANCED TRAFFIC MANAGEMENT SYSTEMS

Collision Avoidance

Collision Detection

Active traffic

Traffic jams

Incidents

Traffic flow

Vehicle-to-Vehicle

Safety Systems

Fleet Management

Safety Systems

Trip Planning

Toll Collection

Adaptive Cruise Control

Traffic Signs

Traffic flow

Travel Time

Navigation

V2V

V2I

V2X
**ITS** MANIFESTATION
ITS INDUSTRY INVOLVES MANY CATEGORIES, DISCIPLINES AND EXPERTISE

**DEFINITION 1.1: ADAS**

Advanced driver assistance system are intelligent systems integrated in the vehicle that assist the drivers to ensure their safety during driving or parking. These systems are based on automated technology or algorithms that uses sensors to detect obstacles, traffic signs, driver errors, and respond accordingly to the situation.

EXAMPLE I.1: Adaptive Headlights

Designed to make driving during the night safer by increasing visibility in curves and over hills.
EXAMPLE I.2: Automated Valet Parking

It is the actions of performing an automatic or driverless parking actions.
DEFINITION I.2: Autonomous Vehicles

Autonomous Vehicles or self-driving car is a vehicle capable of sensing its environment and moving safely with little or no human input.
"ITS" MANIFESTATION
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DEFINITION I.3: Autonomous Vehicles

- **SENSE**: Data collection and gathering from sensors
- **PERCEIVE**: Interpret and understand the sensors data
- **DECIDE**: Action selection in a safely manner
- **ACTUATE**: Action initiation
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DEFINITION I.3: Autonomous Vehicles

Data collection and gathering from sensors

Ontario - Metro

Paris - Metro

Sensible 4 - Shuttle

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DEFINITION I.3: Autonomous Vehicles

PERCEIVE

Interpret and understand the sensors data

Camera

Lidar
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DEFINITION I.3:

ACTION SELECTION IN A SAFELY MANNER

DECIDE → ACTUATE

Action initiation

Action selection in a safely manner
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Deployment reality:

ADAS

LEVEL 1
DRIVER ASSISTANCE
ACC (BRAKING)
LANE KEEPING WARNING
AUTO EMERGENCY BRAKING
PARK ASSIST
EVERYTHING ON
2000

LEVEL 2
PARTIAL AUTOMATION
ACC (STEERING)
LANE CHANGING
TRAFFIC JAM ASSIST
OVERTAKING ASSIST
FEET OFF
2013

LEVEL 3
CONDITIONAL AUTOMATION
HIGHWAY DRIVING (~50MPH)
DRIVER INITIATE LANE CHANGE
AUTOMATED VALET PARK
TRAFFIC JAM CHAUFFEUR
HANDS OFF
2018

LEVEL 4
HIGH AUTOMATION
HIGHWAY DRIVING (~100MPH)
AUTOMATED LANE CHANGE
CRUISE CHAUFFEUR
FREE DRIVE
EYES OFF
2024

LEVEL 5
FULL AUTOMATION
ROBOT-TAXI
AUTOMATED SHUTTLE
ALL DRIVING CONDITIONS
MIND OFF
2027 - 2030

AUTONOMOUS VEHICLES
"ITS" MANIFESTATION
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**DEFINITION 1.4: ATMS**
Advanced Traffic Management Systems are responsible for streaming real-time transport data from the entire traffic infrastructures into one Transport Management Centre (TMC). The TMC is where all the data is processed in order to take intelligent measures for handling traffic jams, increasing mobility efficiency, maintaining and improving safety.

**WHY:**
ATMS helps in:
- Monitor
- Control
- Optimize
- Operate

ATMS are the eyes of Transport Management Centres which acts like a control room for mobility in smart cities.
EXAMPLE I.3: Traffic light Control Systems

Adopted network:
Junction of two roads with four lines each. Each line has two sensors that help in having more accuracy in handling the junctions by the controller.
EXAMPLE 1.4: Traffic Counting

Counting traffic in Junction using Camera and Machine Learning (ML) methods.

Source: Bachelor Thesis by Jorgen Juurik Vehicle Tracking and Speed Estimation in Aerial Footage
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DEFINITION 1.5: ATIS
Advanced Traveler Information Systems are considered to be the core service of intelligent transportation systems and their main role is to support travellers in planning their journey efficiently in order to define their route, estimate travel time and avoid traffic congestions. Therefore, ATIS provides two types of information such as:

- Static information
  - Geographic data of stopped vehicles
  - Transport schedules
  - Etc,
- Dynamic information
  - Schedules
  - Weather conditions
  - Closed roads
  - ETAs
  - Etc,
“ITS” MANIFESTATION
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FUNCTIONS I.1: ATIS operational roles:

- Static and real-time traffic information
- Weather information
- Real-time information about public transport
- Parking information
ITS MANIFESTATION
ITS INDUSTRY INVOLVES MANY CATEGORIES, DISCIPLINES AND EXPERTISE

DEFINITION 1.6: VANETs

Vehicular networks has emerged due to the advancement and development of wireless technologies, ad-hoc networking, and automobile industry. These networks are constructed among moving vehicles, infrastructure (road side units), and pedestrian (mobile devices).
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**EXAMPLE 1.4:** Simulating IoT System for public transport

Step-one is a set of tools developed for the purpose of simulating IoT systems in a smart city scenario.


Git: https://github.com/jaksb/step-one
THANK YOU FOR YOUR ATTENTION

— Intelligent Transportation Systems - MTAT.08.040 - Lecture 1