Introduction to Intelligent Transportation Systems

Basic Knowledge
Intro video
What is ITS

• Application of well-established technologies of communication, control, electronics, computer hardware and computer software in order to increase the safety and efficiency parameters of the actual transportation system.
Intelligent Transportation System

Collection of entities that collaborate in the movement of freight and passengers, and that have the ability to learn, adapt to new situations, and use information/knowledge to enhance operational efficiency
# Class Syllabus (Topics)

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Course Instructors

• Lecturer: Amnir Hadachi
  – Lectures: Tue. 10.15 - 12.00
  – Labs: Tue. 14.15 - 16.00

• Assistant: Artjom Lind
  – Room: Ülikooli 17, room 220
  – Email: amnir.hadachi@ut.ee
Student Requirements

• 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
Student Requirements

• Labs: (20%)
  – First part is related to image processing and computer vision in ITS
  – Second part is concerned about traffic simulation and V2V communication
Why is ITS important?

• Travel:
  – Time Savings
  – Reduced Crashes and Fatalities
  – Improved security and safety
  – Cost Avoidance
  – Increased reliability
  – Improved trip planning
  – Improved emergency response
Why is ITS important?

• Economic:
  – Increased Customer Satisfaction
  – Improved productivity
  – On-time delivery

• Environmental:
  – Fuel saving
  – Reduced air pollution
ITS elements

ITS Objectives

• Manage Congestion on arterial and freeways
• Improve safety
• Increased and higher quality mobility
• Reduce energy use and negative environmental impact
• Increase efficiency
• Increase coordination
• Improved public-private partnerships
• Improved Economic Productivity
ITS Structure

- Sensing
- Communications
- Computing
- Algorithms

Technology

- Vehicle
- Transport infrastructure
- Cameras
- Magnetic loops
- Sensors

Institutions

Systems

ITS benefits public and private sectors
ITS Driving Factors

- Technology
- Resources

Institutional and organizational realities

Issues
- Environmental Issues
- Economic Development
- Quality of Life
- Sustainability
- Social Equity
ITS Scale

ORGANIZATIONAL SCALE
- Integrated Supply Chain
- Intermodal
- Modal

GEOGRAPHIC SCALE
- Urban
- Regional
- National
- Global

TIME SCALE
- Real Time
- Tactical Planning
- Strategic Planning
Impact of ITS

• Provide traffic information to road users during and before a trip through communication technologies.

• Provide Information about public transportation in real time.
  – Scheduling systems
  – Vehicle location systems

• Goods delivery operators can optimize in a efficient way their business.

• Provide information for urban planning and support them in their decision making.
ITS: Simplified Architecture

Data Collection
Planning Analysis
Traffic Control
Traveler Management
Data Collection

- Source of data:
  - Cameras
  - Magnetic loops or induction loops
  - GPS
  - Smartphones
  - Mobile phones network
  - Surveys
  - etc
Planning Analysis

Planning

Traffic management Information system

Performances Management
Traffic Control

Incident Management

Network Control

Network Operations
Response

Traffic lights

VMS

Lane signal
Traveler Management

- Traveler Information Services
  - SMS
  - Portal
  - Mobile
  - Radio or TV

- Demand Management/ Payment Methods
  - Licensing
  - eTicket
  - Parking
  - Road Pricing or Toll
ITS: Subsystems

• Major areas of ITS:
  – Advanced Traffic Management System (ATMS)
  – Advanced Traveller Information Systems (ATIS)
  – Advanced Public Transportation Systems (APTS)
  – Advanced Vehicle Control Systems (AVCS)
  – Commercial Vehicle Operations (CVO)
  – Advanced Rural Transportation systems (ARTS)
ITS: Subsystems

- Advanced Traffic Management System (ATMS)
  - Network management, including incident management, traffic light control, electronic toll collection, congestion prediction and congestion-ameliorating strategies.
ITS: Subsystems

• Advanced Traveller Information Systems (ATIS)
  – Information provided to drivers pre-trip and during the trip in the vehicle. ATMS helps provide real-time network information.
ITS: Subsystems

- Advanced Public Transportation Systems (APTS)
  - Passenger information and technologies to enhance system operations, including fare collection, intermodal transfers, scheduling.
ITS: Subsystems

- Advanced Vehicle Control Systems (AVCS)
  - A set of technologies designed to enhance driver control and vehicle safety.
ITS: Subsystems

- **Commercial Vehicle Operations (CVO)**
  - Technologies to enhance commercial fleet productivity, including weigh-in-motion (WIM), pre-clearance procedures, interstate coordination.
ITS: Subsystems

• Advanced Rural Transportation systems (ARTS)
  – Mostly safety and security technologies for travel in rural areas.
  – NB: Rural Areas are defined as areas with less infrastructure resources access compared to metropolitan areas
ITS global vision

An Intelligent Multi-modal Transportation Vision for Lagos

1. Data Collection (of Traffic)
   - Smart app
   - Cellular
   - Planned Maintenance
   - Call Centre
   - Camera
   - Manual Survey
   - GPS
   - Social Media
   - Citizen Portal

2. Traffic Management Information System
   - Traffic Mgt Information System

3. Transport Planning/Analysis
   - Planning

4. Performance Mgmt
   - 3rd Party SLA
   - Asset Mgt
   - Internal KPI

5. Traffic Control
   - Incident Management (Traffic)
     - Police/Medical/Fire
     - Breakdown/LASMA

6. Traveler Management
   - Mobile
   - Portal
   - SMS
   - Radio/TV

7. Demand Management + Payment Methods
   - eTicket
   - Road Pricing/Toll
   - Licensing
   - Enforce
   - Parking

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ITS Services

• Traveler information;
• Traffic management and operations;
• Vehicle services;
• Freight transport;
• Public transport;
• Emergency;
• Transport-related electronic payment;
• Road transport related personal safety;
• Weather and environmental conditions monitoring;
• Disaster response management and coordination;
ITS Services

- Traveler Information:
  - Pretrip information;
  - On-trip information;
  - Route guidance and navigation pretrip;
  - Route guidance and navigation on-trip;
  - Trip planning support;
  - Travel services information.
ITS Services

• Traffic Management and Operations:
  – Traffic management and control;
  – Transport related incident management;
  – Demand management;
  – Transport infrastructure maintenance management;
  – Policing/enforcing traffic regulations.
ITS Services

• Vehicle Services:
  – Transport-related vision enhancement;
  – Automated vehicle operation;
  – Collision avoidance;
  – Safety readiness;
  – Precrash restraint deployment.
ITS Services

• Freight Transport and Logistics:
  – Administrative functions:
    • Commercial vehicle preclearance;
    • Commercial vehicle administrative processes;
    • Automated roadside safety inspection;
    • Commercial vehicle on-board safety monitoring;
  – Commercial functions:
    • Freight transport fleet management;
    • Intermodal information management;
    • Management and control of intermodal centers;
    • Management of dangerous freight.
ITS Services

• Public Transport:
  – Public transport management;
  – Demand responsive and shared transport.
ITS Services

• Emergency:
  – Transport-related emergency notification and personal security;
  – After theft vehicle recovery;
  – Emergency vehicle management;
  – Emergency vehicle preemption;
  – Emergency vehicle data;
  – Hazardous materials and incident notification.
ITS Services

• Transport-Related Electronic Payment
  – Transport-related electronic financial transactions;
  – Integration of transport-related electronic payment services.