The Future of Urban Mobility: Opportunities and Challenges

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Outline:

• A Historical Review

• Emerging Concepts and Technologies Shaping the Future of Urban Mobility

• An Overview of Transportation Research Activities at the Bobby B. Lyle School of Engineering
The Bronocice Pot

Discovered in Poland in 1974-1976

Dated to around 3400 BC

Image of the oldest well-dated representation of a four-wheeled vehicle in the world
There has been always a room for bold ideas …
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- 1999: FCC 5.9 GHz band to be used by intelligent transportation systems
- 2009: Google’s self-driving Vehicle project started
- 2009: Transportation network companies
- 2010: Crowdsourcing phone applications in transportation
- 2017: Testing self-driving drone taxi in Dubai, UAE

2009: Transportation network companies

Google’s self-driving Vehicle project started

FCC 5.9 GHz band to be used by intelligent transportation systems

Crowdsourcing phone applications in transportation

Testing self-driving drone taxi in Dubai, UAE
Reflecting on the Past …

- Good ideas were adopted at a very large scale.
- Across-domain technology transfer frequently occurred.
- Moore’s law seems to apply.

Q1: Was it hard to anticipate most mobility-related problems that we are facing today?

Q2: Was it possible to consider better policies to avoid today’s congestion problems?
The Cost of Traffic Congestion

• Congestion is estimated to cost U.S. motorists about $300 billion yearly

• Traffic jams cost U.S. drivers an average of $1,200 a year in wasted fuel and time
Driving Forces…

Objectives

Efficiency
Safety
Reliability
Sustainability
Equity
Resiliency
Security

Technologies

Robotics
Machine Learning
Analytics
Cloud Computing
Electrification
Communications
Surveillance
V/A Reality
Shared Economy
Personalization
More Automation …

New In-Vehicle Experience  Autonomous Intersections  Efficient Platooning Automated Highways

Self-Driving Vehicles & Self-Managing Infrastructure
From 2D to 3D & Faster …

Traffic Straddling Bus

Flying Taxi

Hyperloop Systems

High Speed Monorail skyTran

Truck-Drone Integration
More Shared Economy…

Car/Bike Sharing

Learn about Zipcar rates.
Pick the plan that's right for you. Once you’ve joined, you can reserve cars by the hour or day. Driving rates vary by city and car model. (You guessed it, fancy cars are a little more.)

Membership from: $7/mo or $70/yr
Driving rates from: $8-10/hr

Ride Sharing

Parking Sharing

Information Sharing (Crowdsourcing)
Transportation Electrification …

Wireless Vehicle Charging

Renewable Resources

Energy Harvesting
More Personal …

- Number of occupants
- Tone of their voices
- Body language
- Facial expressions
- Choice and volume of music

More than a machine, a partner.
The leader of our CONCEPT-i Series, TOYOTA CONCEPT-i uses artificial intelligence to connect with its driver—learning, protecting and inspiring them on the road ahead.

Human-machine interactions

Providing incentives for travel behavior change

Systems that allow capacity reservation
Living the Virtual World ...

Future Download Seminar

Augmented Reality for Advanced Traveler Information Systems

Classroom of the Future
Business Models

The Amazon Model

Aggregator of Third-Party Services

Develop capabilities as a single point of access to services provided by third parties

The Apple Model

Deep Integration of Services

Develop capabilities to provide all services needed by the user to achieve seamless user experience
Research Highlights

Transportation Research Laboratory
@ Lyle/SMU
Research Highlights

- ITS/Real-Time Traffic Management Systems
- Autonomous and Connected Vehicles
- Crowd Dynamics in Mega Facilities
- Airlines Strategic Planning and Operations Management
Research Highlights (Cont.)

Score-Based Approach for Traffic Management

Integrated Truck-Drone Routing for Delivery Services

On-Demand Mobility: A Shared Economy Approach

Transportation Network Electrification
Real-Time Traffic Network Management Systems

Network State Estimation

Prediction Horizon

Roll

Traffic Management Scheme Evaluator

Network State Prediction and Traffic Management

Traffic Management Scheme

Real-Time Traffic Observations

Evaluated Horizon

Reported Overall Network Performance

SMU | Bobby B. Lyle
SCHOOL OF ENGINEERING
DSS for Proactive-Robust Traffic Network Management
End-to-End Deep Learning for Traffic Management

From Rawest Input

Machine Learning Model

Dog

Computer vision
ML Application

Cat

Image Representative of Traffic Network

E2EDL Neural Network

Full Connected Network

Pool

Feature Maps

Sub-Sample

Traffic Management Scheme

Signal Timing

Dynamic Routing

Rerouting Action Code

50% 0

30% 1

Ramp Metering

1 0 0

To Richest Output
Autonomic Architecture for Traffic Management

Moving the intelligence to the infrastructure side
Conclusion:

• New concepts and technologies present great opportunities and also present great challenges.

• Increasing need for interdisciplinary education/training for the next generation of engineers and researchers.

• Great things are happening in the DFW area. However, we still have a lot of work to do.

While being listed as the fifth most congested city in the U.S. is bad, not being on the top of the list as the most innovative city in fighting this congestion is even worse.
Thank You!!