기계시스템해석
System Dynamics/System Analysis

Spring 2015

Professor Kyongsu Yi

Vehicle Dynamics Control Laboratory
Department of Mechanical Engineering
Seoul National University

Introduction

Instructor: Professor Kyongsu Yi

301-1502

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http://vdcl.snu.ac.kr

Lectures: Tu/Th 09:30-10:45 @301-306

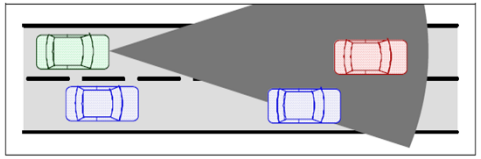
Office hours: Th 11:00 to 12:00 or by appointment

References:

1. **System Dynamics, 4th Ed., K. Ogata, Pearson/Prentice Hall, 2004.**
2. **System Dynamics, 2nd Ed., William J. Palm III, McGraw Hill, 2010.**

Objective: **To provide basic concepts, an overview of dynamic system, modeling, analysis methods and applications to engineering systems**

Mathematical model, analysis in the frequency and time domains and prediction of the dynamics of systems



Grading: **Midterm Exam 30%, Final exam 45%**
Homework 15%, Class attendance 10%

Students absent in a class without instructor's permission prior to the class would be failed.

Homework: **Students will turn in before the end of the class on the due date.**

Late homework will not be accepted.

All homework assignments are to be completed on your own.

You are allowed to consult with other students during the conceptualization of a problem but all written and programming work are to be generated by yourself.

Week	Lecture	Remarks
1	Introduction, Concepts, Terminology	
2	Laplace Transformation	
3	Mathematical modeling of dynamic systems	
4	Transfer Function Approach to Modeling Dynamic Systems	
5	State space Approach to Modeling Dynamic Systems	
6	Fluid Systems and Thermal Systems	
7	Electrical Systems	
8	Midterm exam	Exam
9	Time Domain Analysis of Dynamic Systems	
10	first order/second order systems	
11	transient analysis	
12	analysis with MATLAB	Design exercise with matlab
13	Frequency Domain Analyses of Dynamic Systems	Design exercise with matlab
14	Introduction to control systems Review autonomous vehicle and automated driving	Design exercise with matlab
15	Final Exam	Exam

Exam : 75-minute midterm exam

on April 23 (Th) 9:30-10:45

120-minute final exam

on June 11 (Th) 9:30-11:30 (or 18:00-20:00)

Major Course Contents

Part 1: *Introduction*

Introduction, Concepts, Terminology

Part 2: *Laplace Transform*

Laplace Transform

Part 3: *Modeling*

Mathematical Model of Dynamic Systems

Transfer Function Approach to Modeling Dynamic Systems

State space Approach to Modeling Dynamic Systems

Electrical Systems

hydraulic systems, Fluid Systems and Thermal Systems

Major Course Contents (contd.)

Part 4: ***Analysis***

Time Domain Analysis of Dynamic Systems

First Order / Second Order Systems

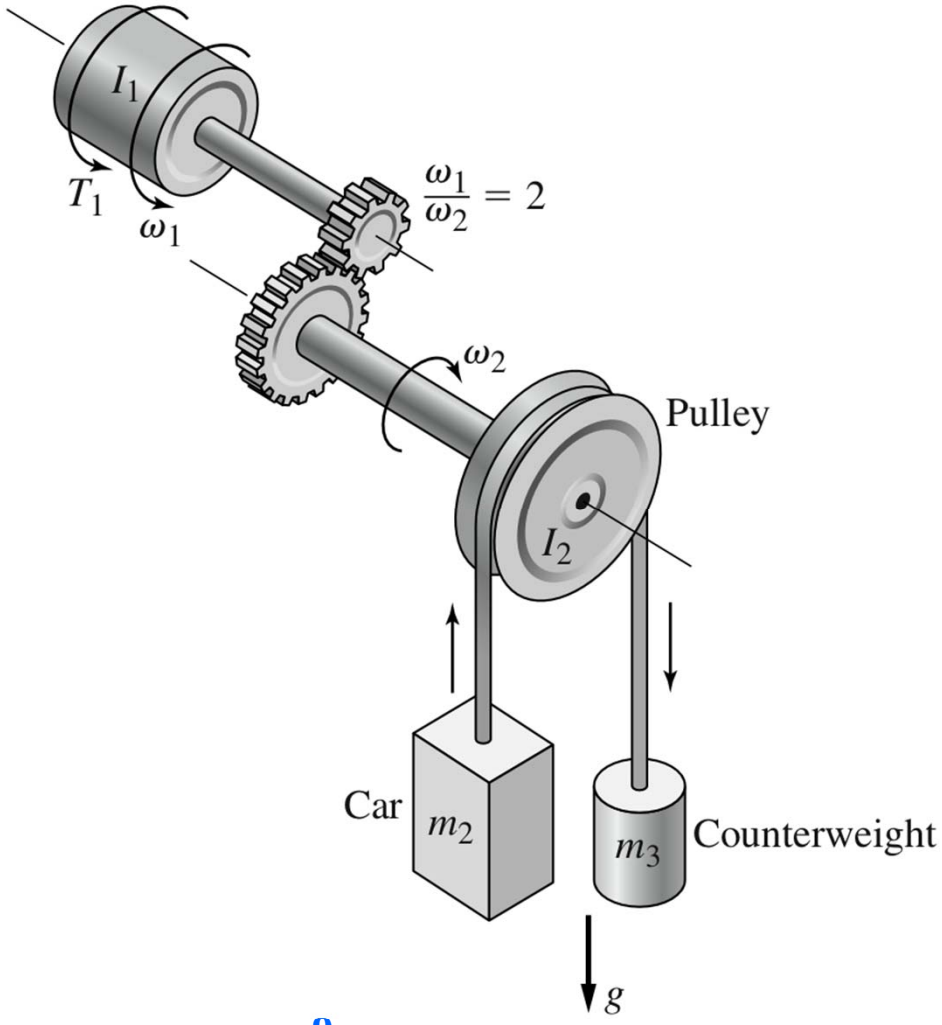
Transient Analysis

Analysis with MATLAB

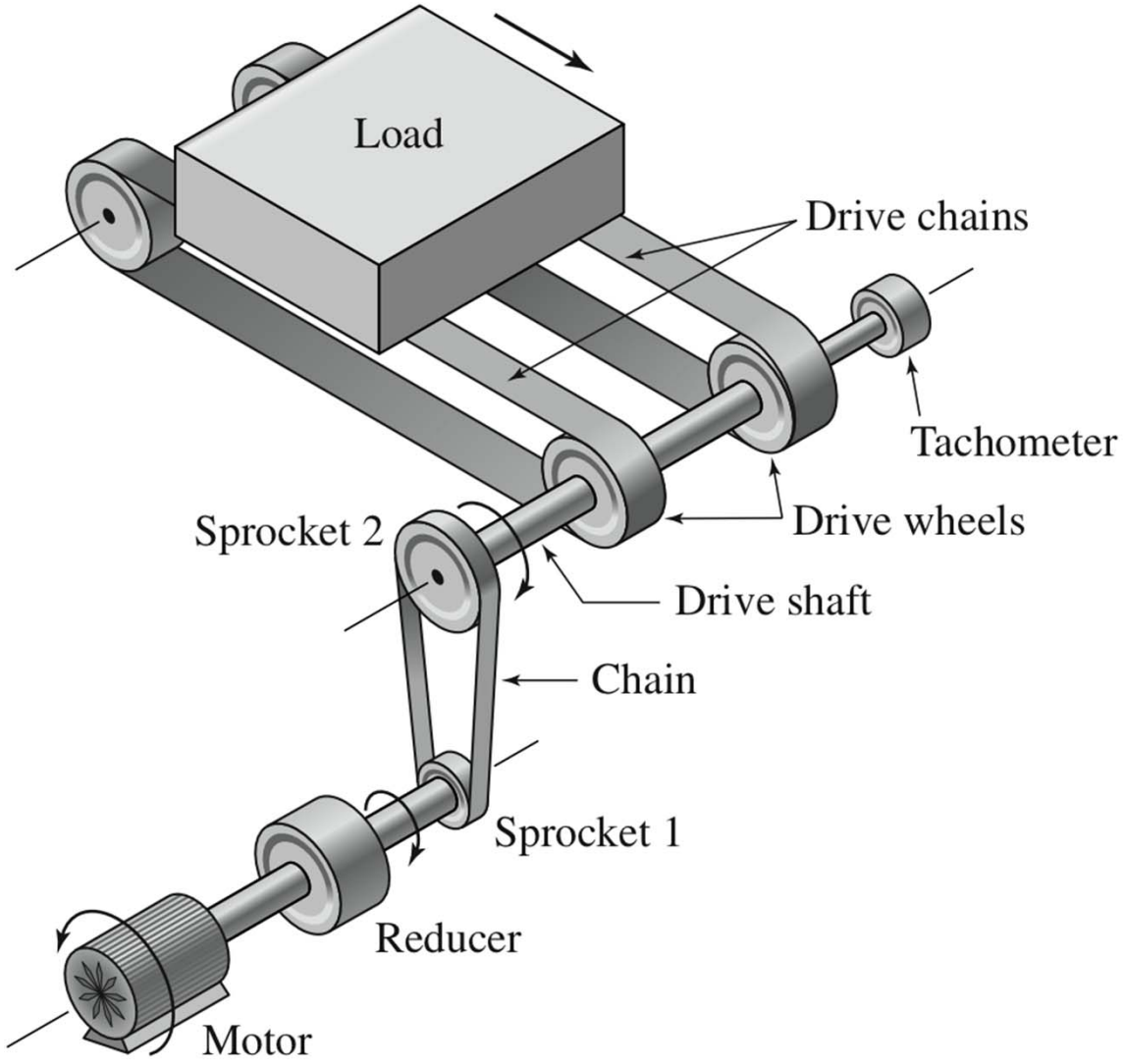
Frequency Domain Analysis of Dynamic Systems

Understanding the underlying physics and being able to construct models of dynamic systems to analyze (and,) predict (and control) engineering systems

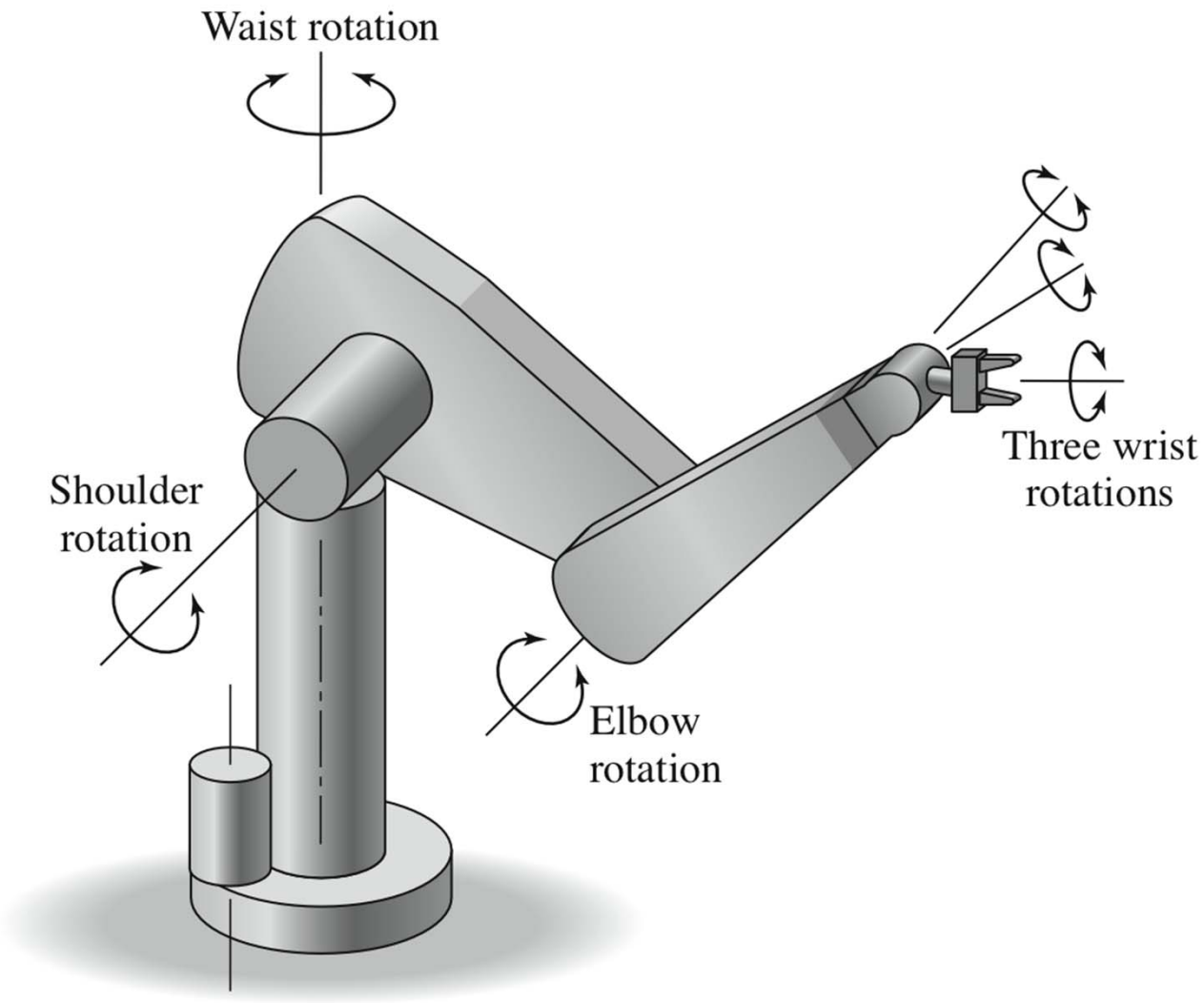
Elevator Systems



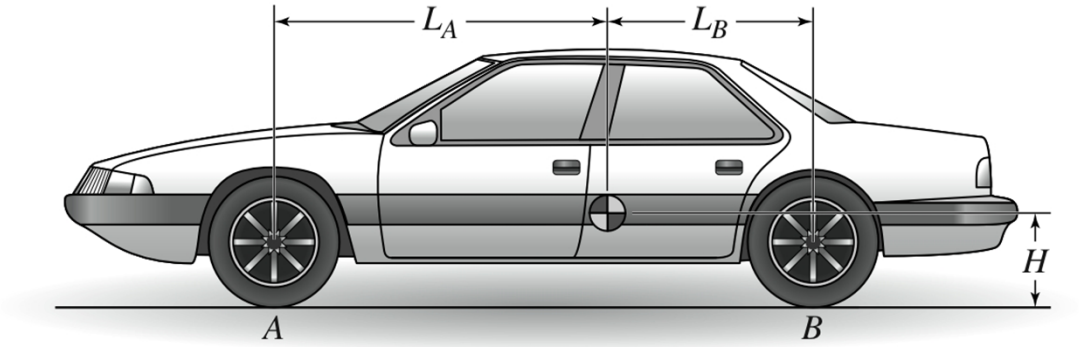
Conveyor systems



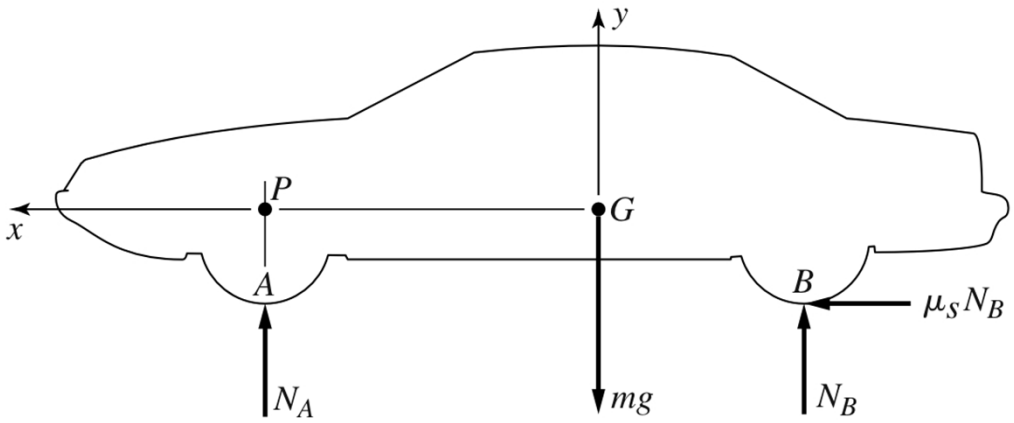
Robot


Waist rotation
Shoulder rotation
Elbow rotation
Three wrist rotations

Vehicle Systems

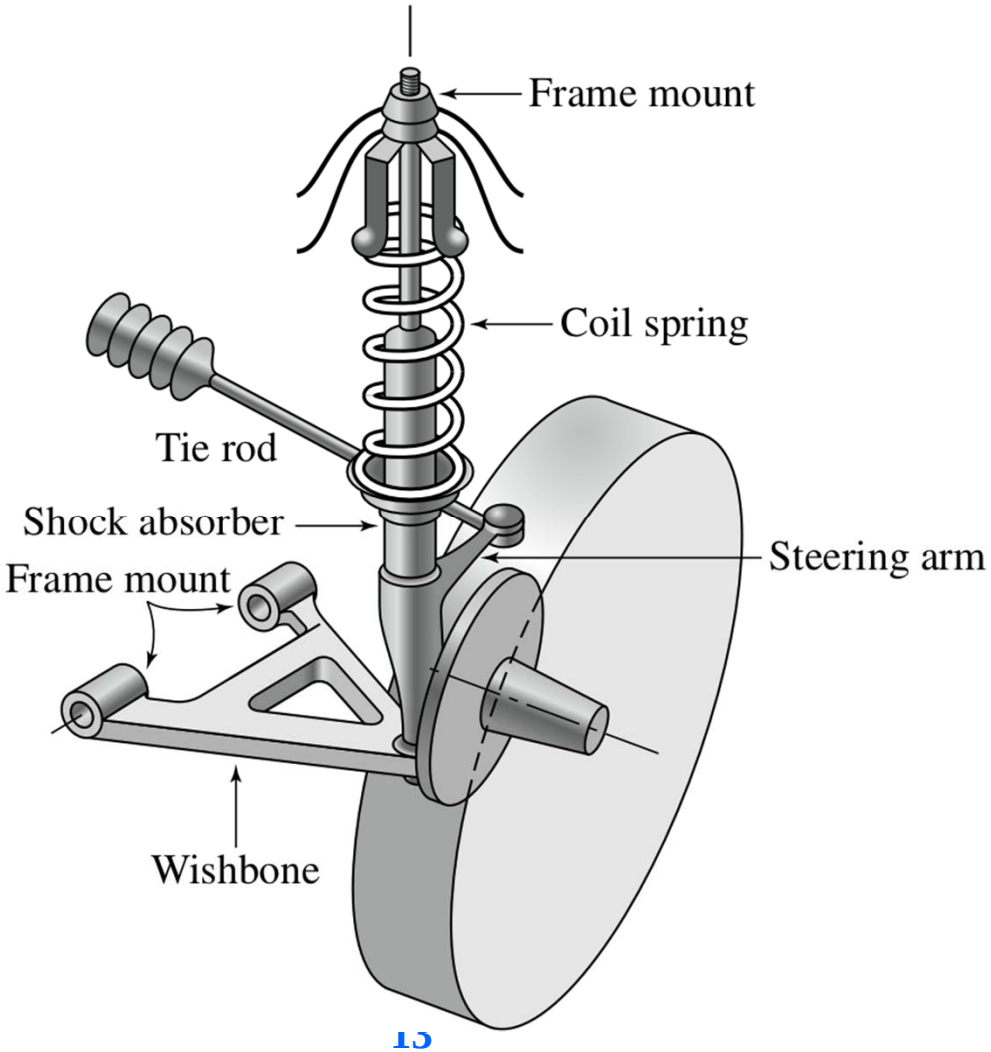


(a)

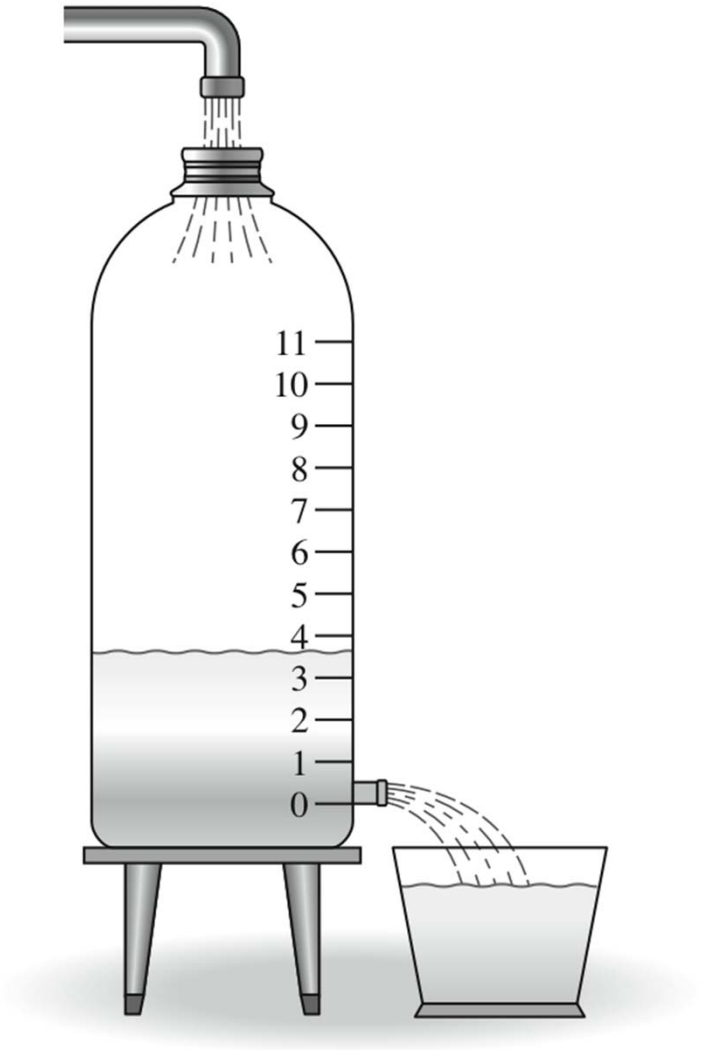


(b)

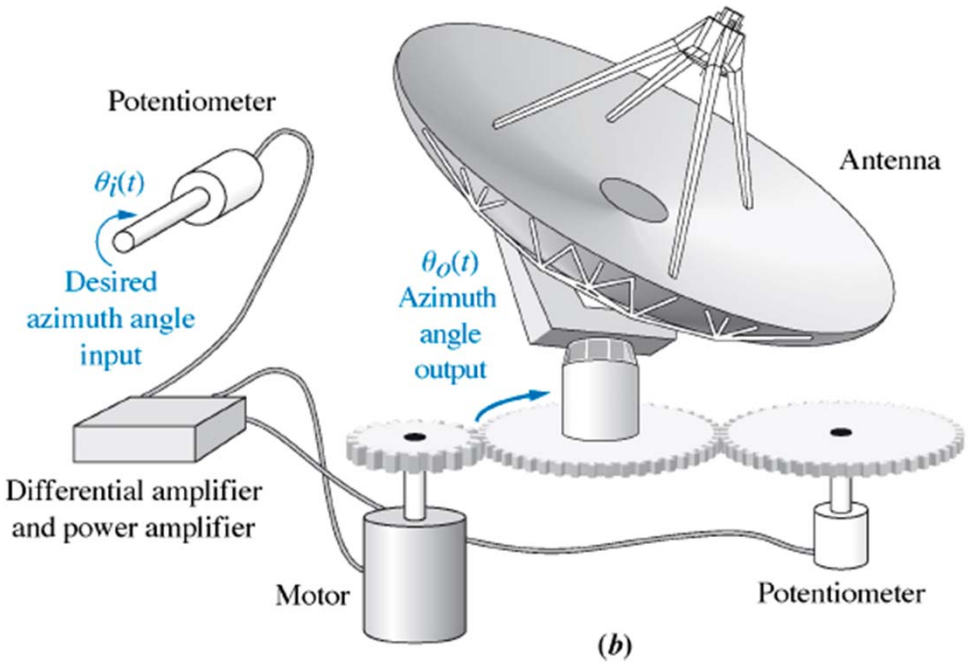
Vehicle Suspension Systems



Water Tank



Antenna azimuth position control system



Aircraft

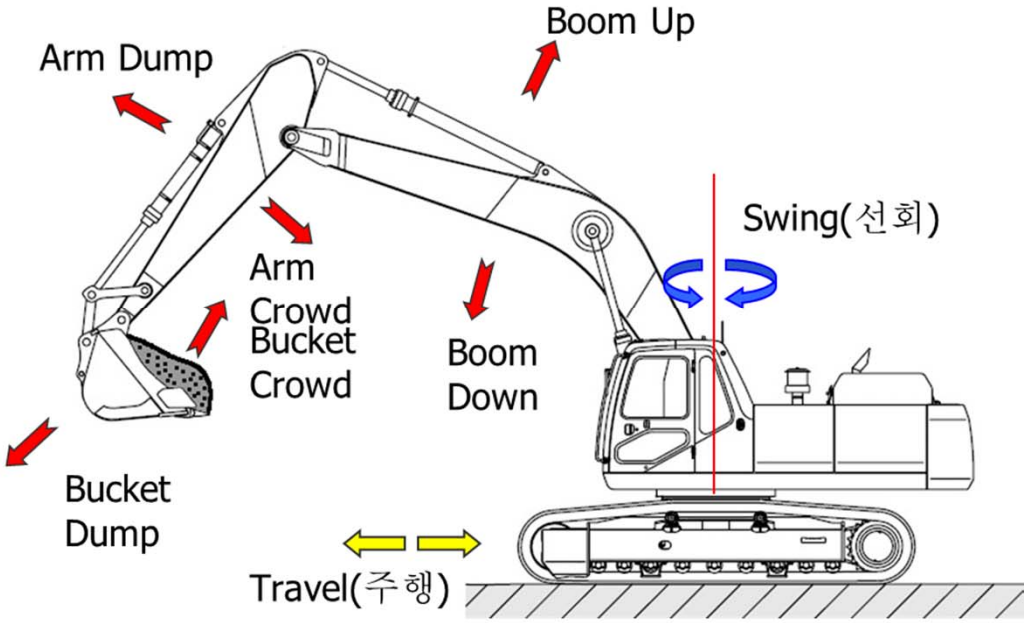
NASA x-29 forward swept wing aircraft

Airbus A320

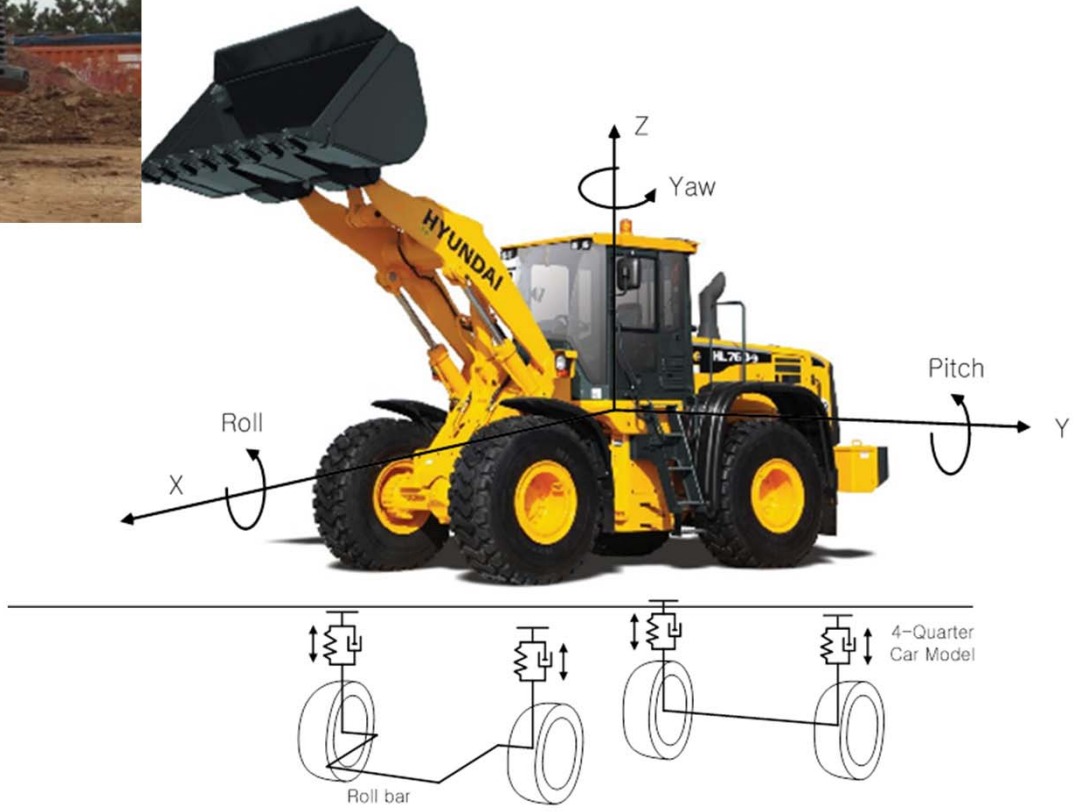
Unstable

Figure 1. *Gripen JAS39 prototype accident on 2 February 1989. The pilot received only minor injuries.*

Fluid power systems : excavators



Wheel loader



MAGLEV (Magnetic Levitation) Vehicle

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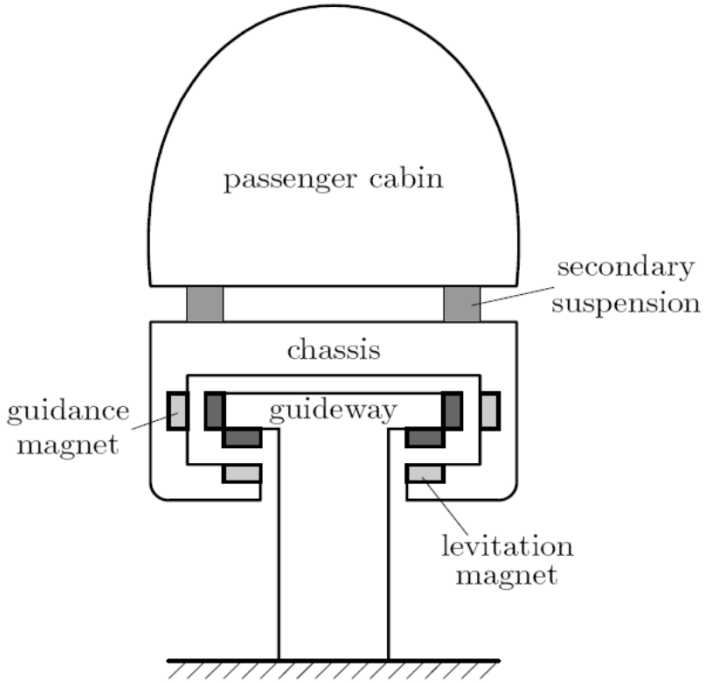
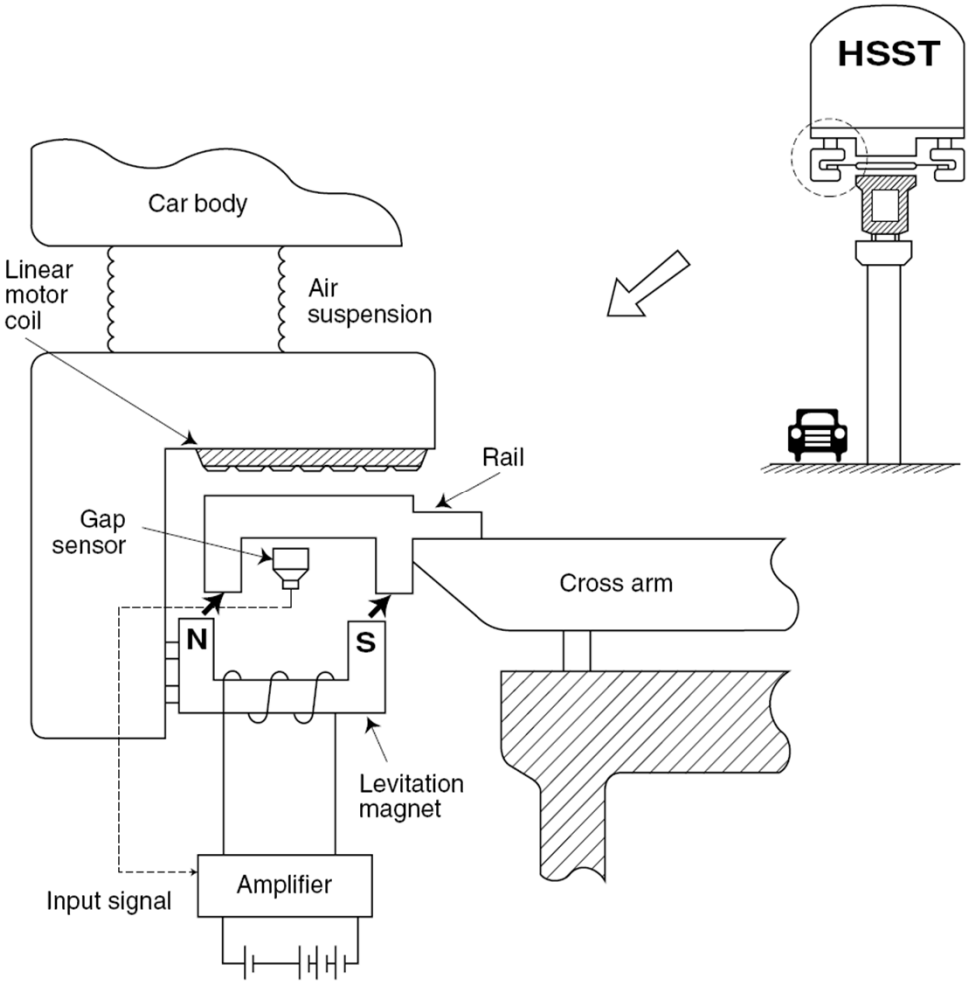
MAGLEV (Magnetic Levitation) Vehicle





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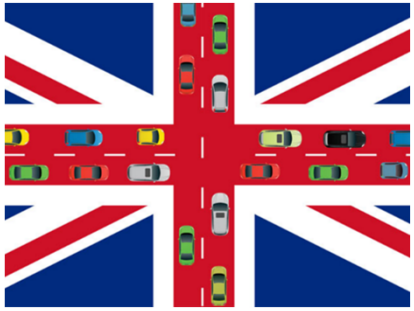
Automated Driving Worldwide

Mercedes Self-Driving Car Bertha Comes to California

BMW's Chinese Robocar Tests Will Use Baidu's Maps

The UK Oks Self-Driving Cars on Its Roads Soon



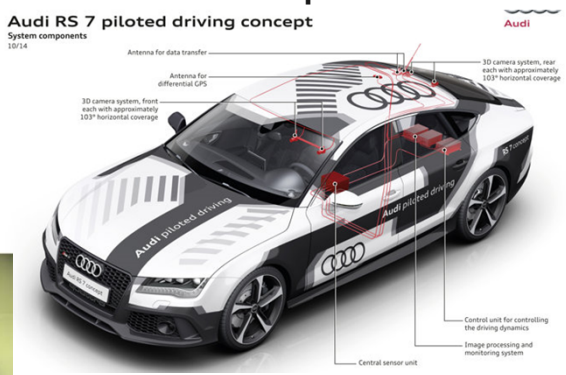
GM To Pour All Resources Into Single Car That Can Be Safely Driven Down Street And Ba...

"Future Truck 2025"

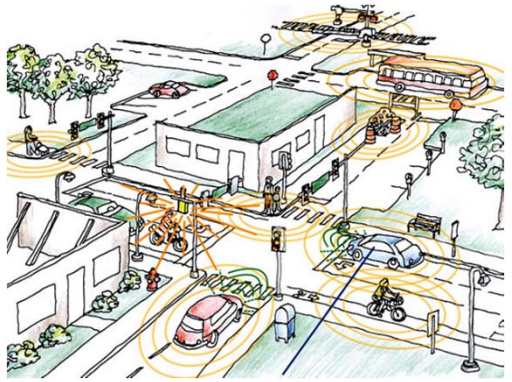
Tesla produces self-driving vehicles

Aims to **"90% Autopilot" By 2015**

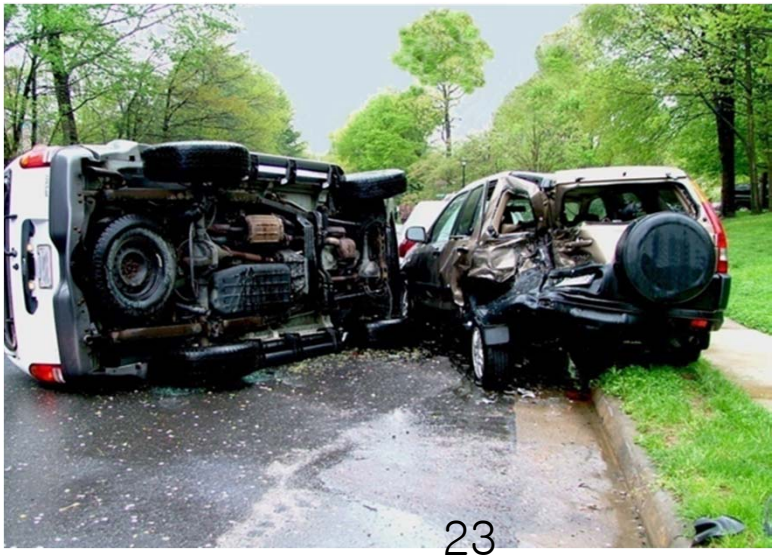
Self-driving Audi RS7 aims for 149 mph in driver-free race lap



University of Michigan Robo Car Urban Test Track



Real life cars



Status Today

Internet is available in nearly all places

Vehicles are the last white spot.

***Source: 17th ITS World Congress Busan2010, Emergence of the 'iCar', Brian Droessler, Continental**

Driver Distraction

Driver distraction is Not New, but temptation has Increased

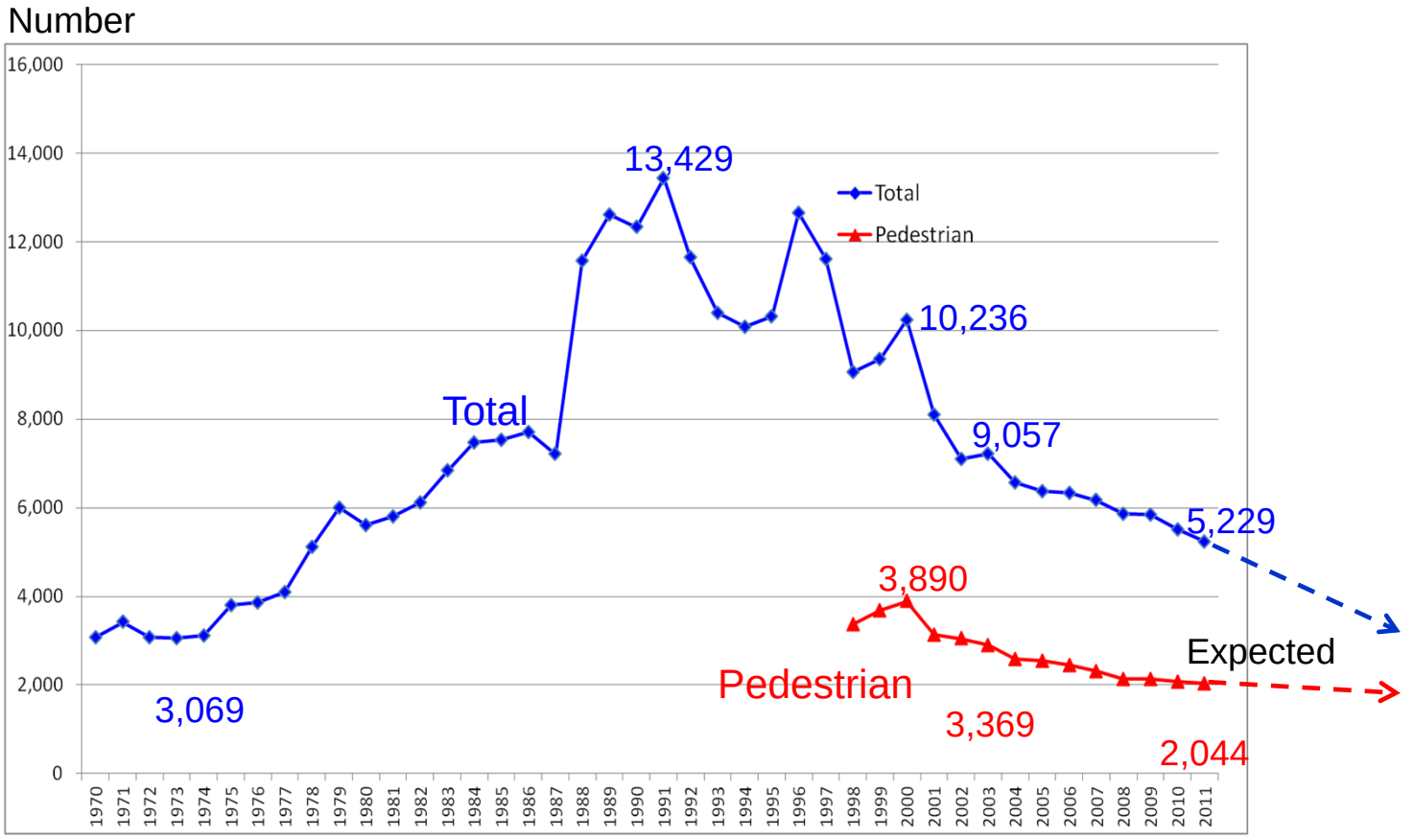
➔ Common Factor in Driver Distraction is the Driver!

*Source: ITS America, View on driver distraction, Roderick MacKenzie, Chief Technology Officer,ITS America






Trends of Road Traffic Fatalities (Korea)

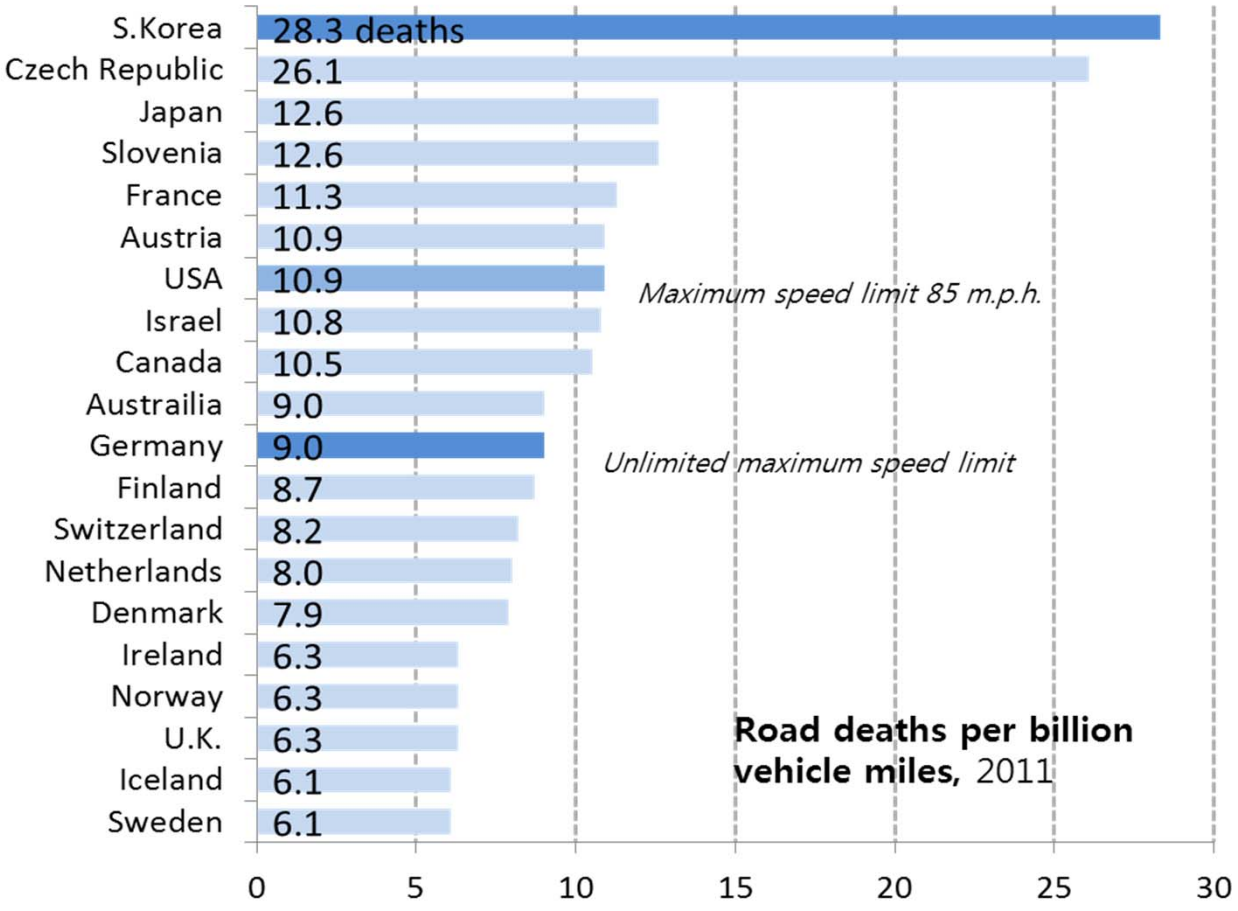


Source: KOROAD(2011)

Korea Key Road Safety Data for 2011

Road Fatalities	5,229
Injury Accidents	341,391
Killed per 100,000 inhabitants	10.7

Not a good idea to drive in Korea?



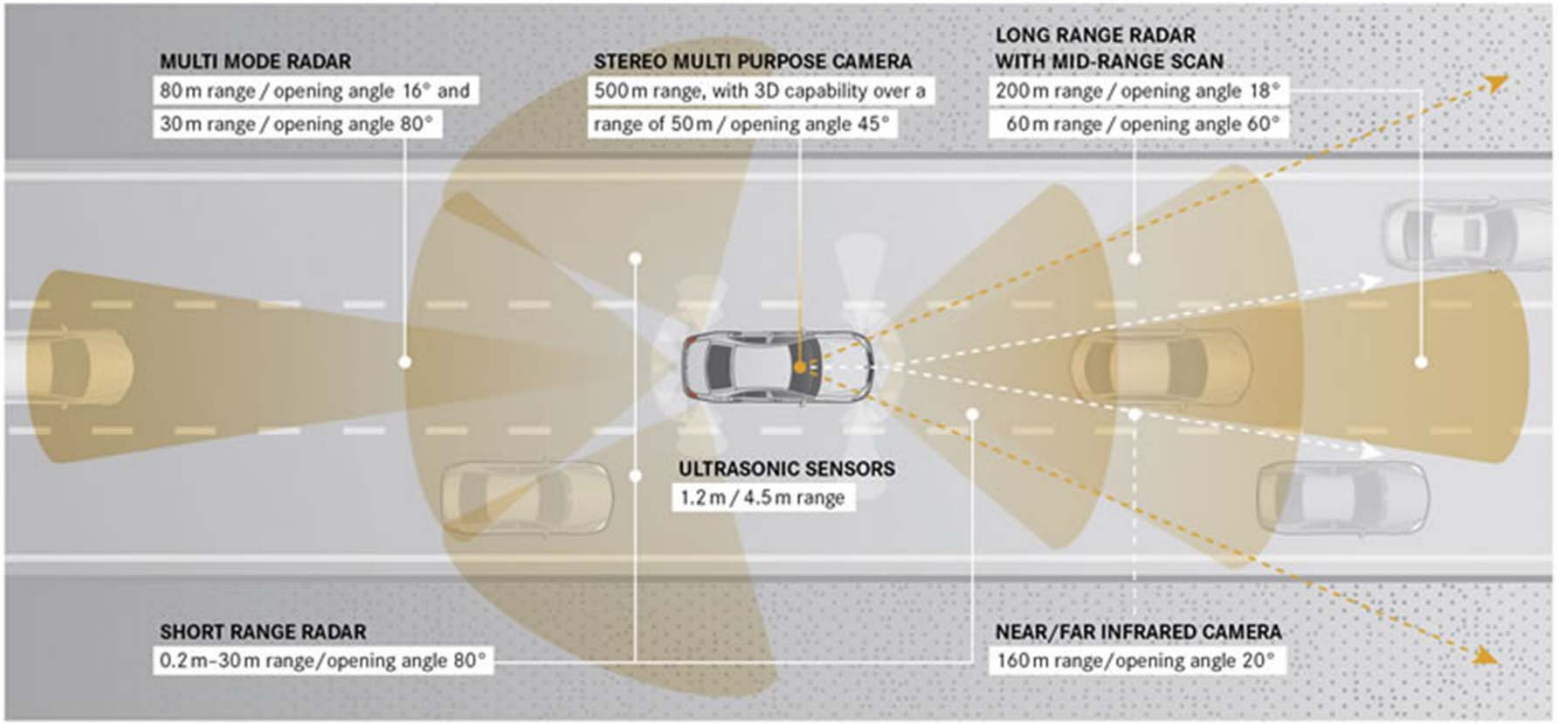
Road fatalities in Germany

Despite the unlimited speeds of parts of German roadways, deaths there rank toward the middle of comparable nations.

New Mercedes S Class

Radar, stereo camera and ultrasonic systems

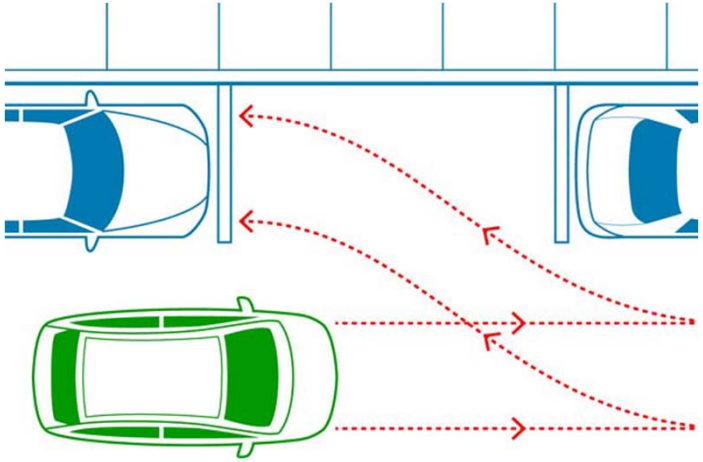
More sensors – more protection



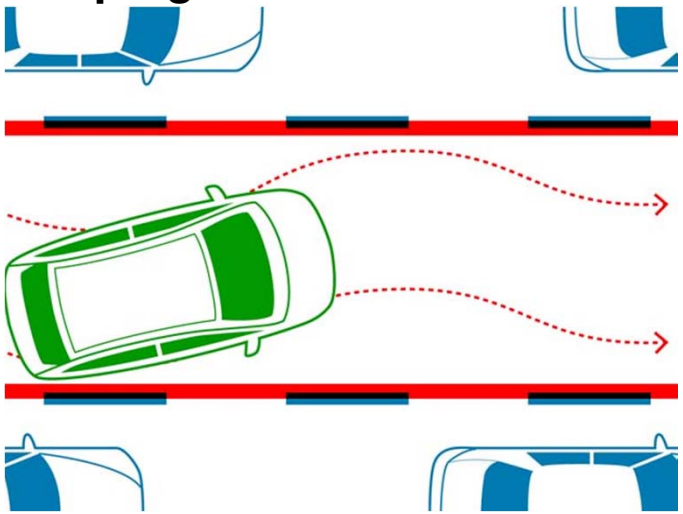
http://www.emercedesbenz.com/autos/mercedes-benz/s-class/top-20-mercedes-benz-assistance-programs/

Driver Assistance Systems

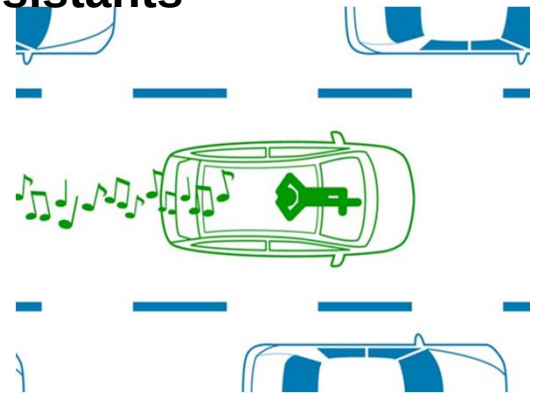
Self-Parking



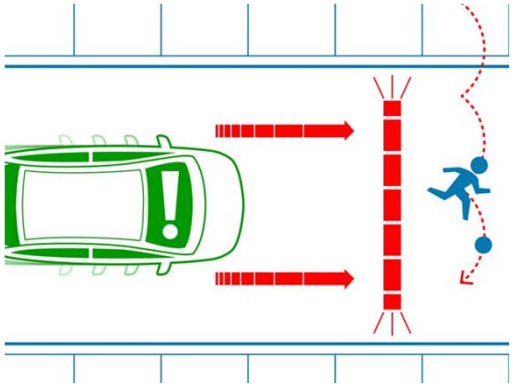
Lane Keeping



Adaptive Cruise Control and Traffic-Jam Assistants



Autonomous Emergency Braking



IEEE Spectrum newsletter July 23, 2014

Automated Driving with x-by-wire and LiDAR/Radar/Vision

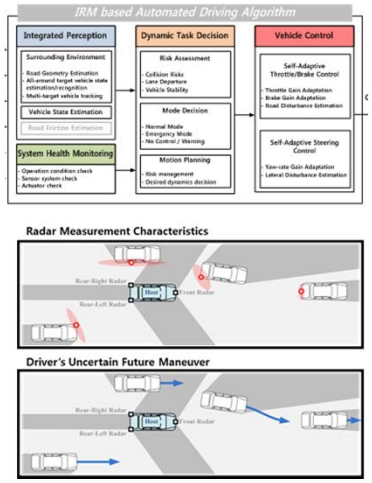
Automated Driving with x-by-wire and LiDAR/Radar/Vision

Automated Driving System

Environment

Sensor

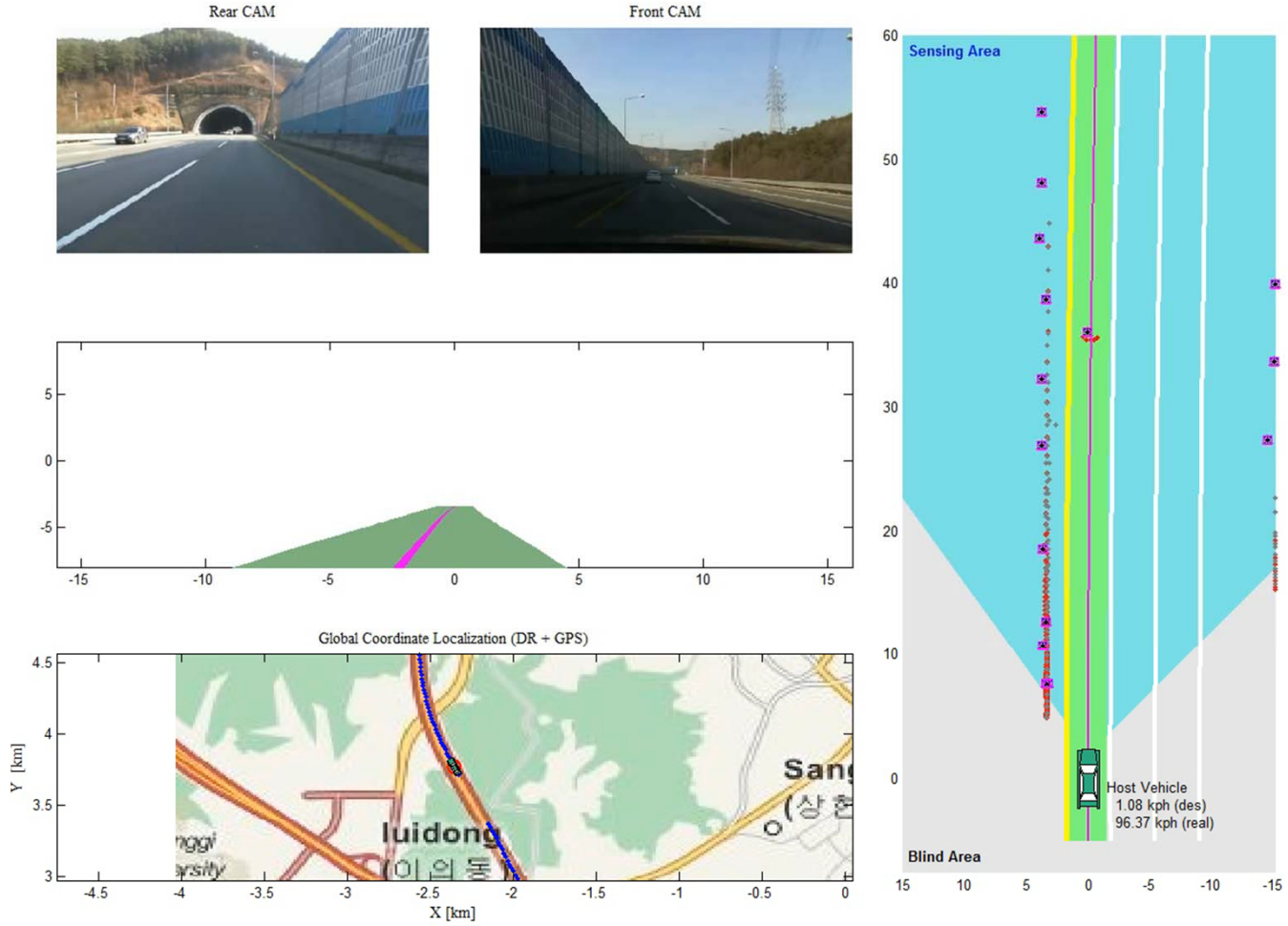
Control



Vehicle

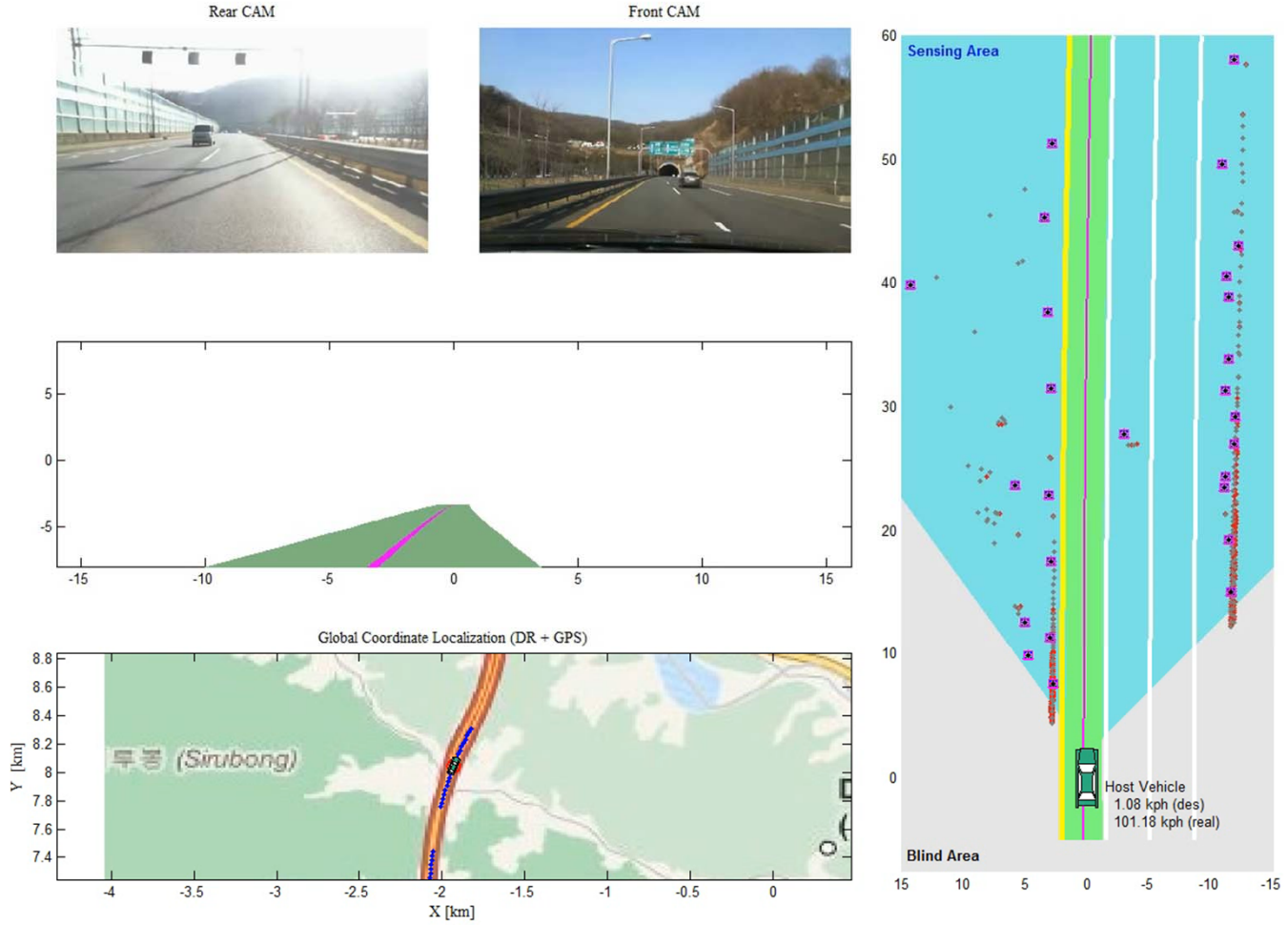
Test Data based Simulation / Normal Section

- **Drivable Area Decision & Motion Planning with IRM**
- **Preceding Vehicle State Estimation**



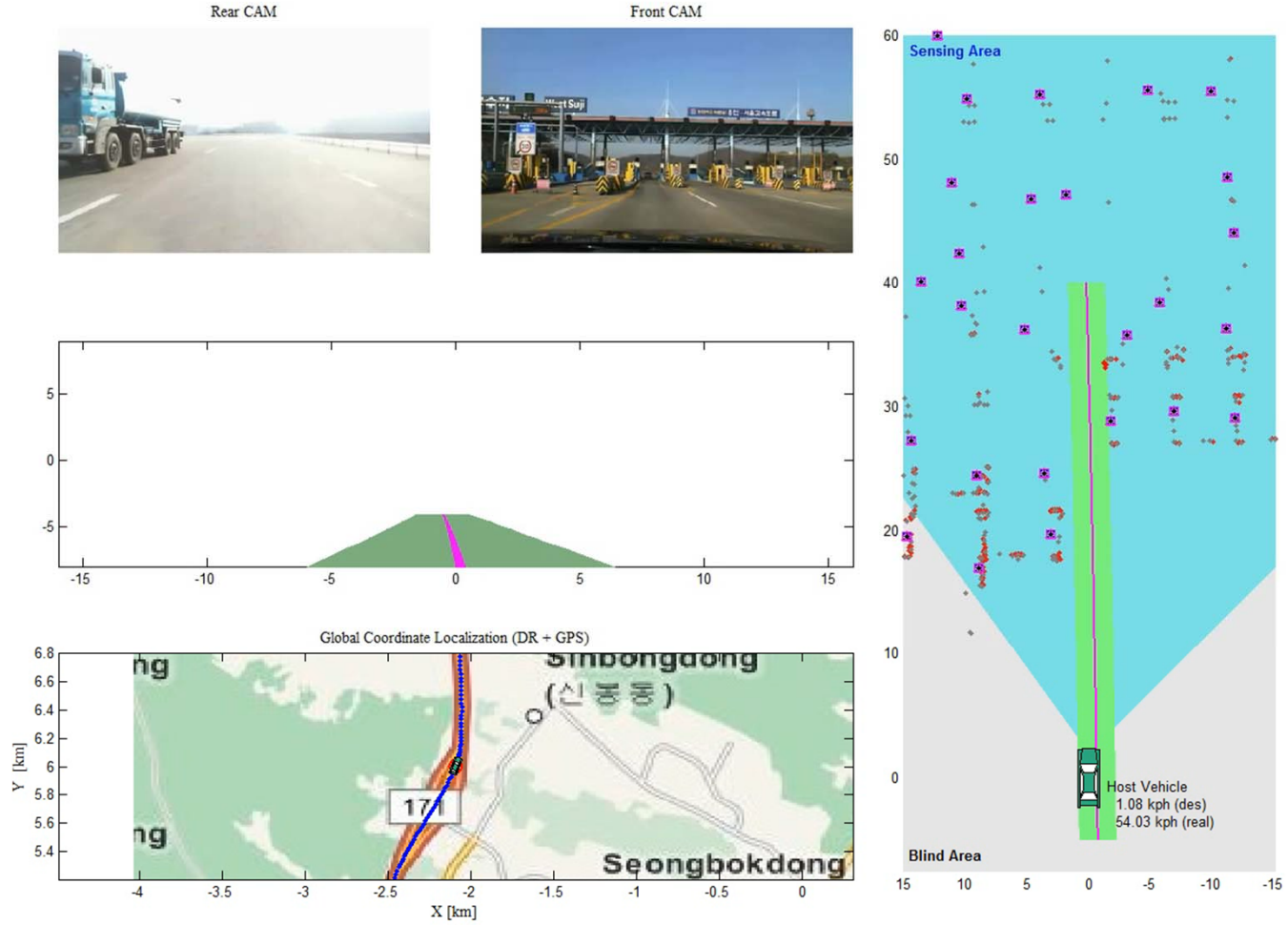
Test Data based Simulation / Tunnel Section

- **Global Pose Estimation w/o GPS (with Vehicle Chassis Sensor)**
- **Drivable Area Decision with Road Structure**



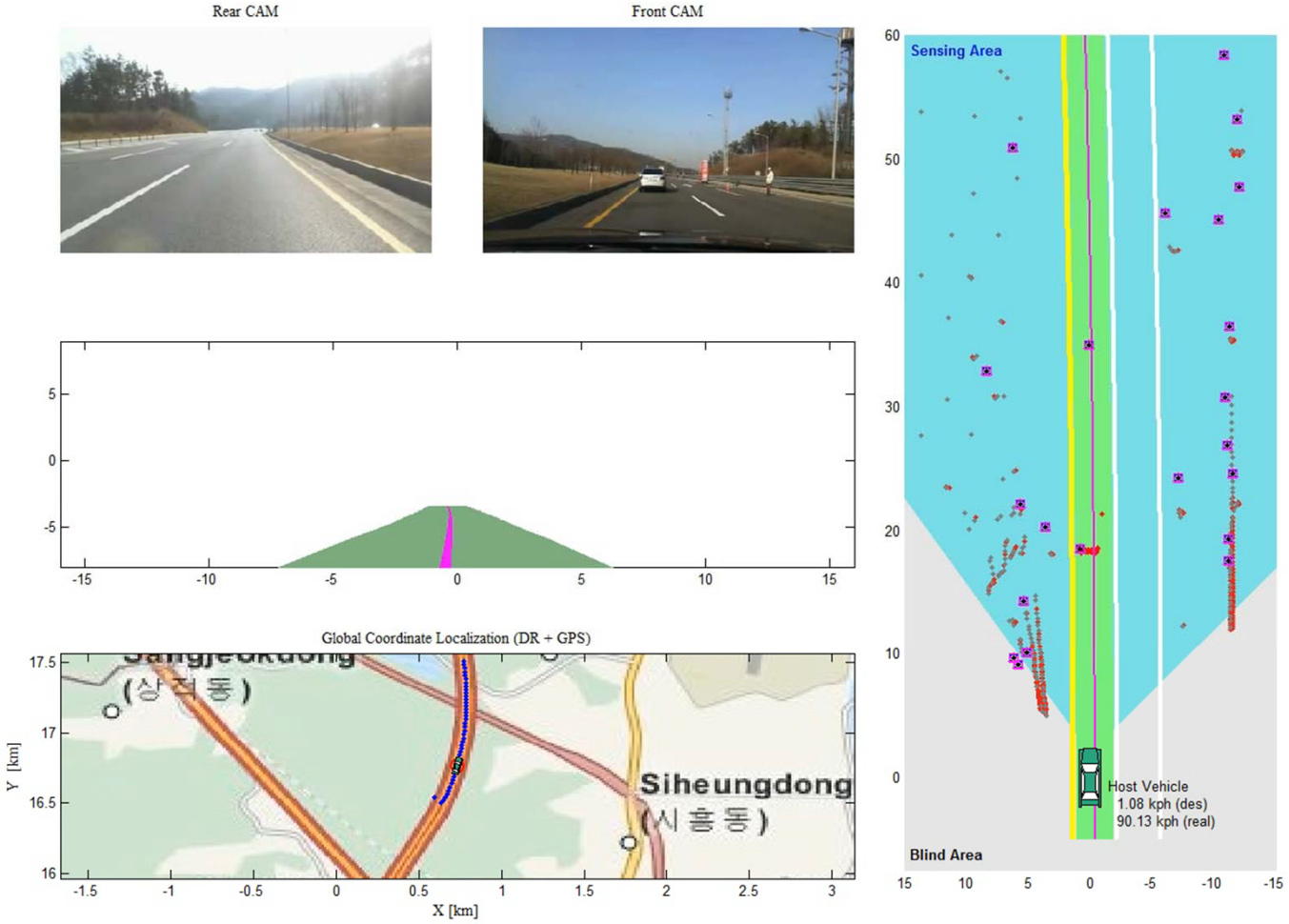
Test Data based Simulation / Toll-gate Section

- **Drivable Corridor Estimation w/o Lane Information**
- **Static Obstacle Recognition & Safe Envelope Decision**

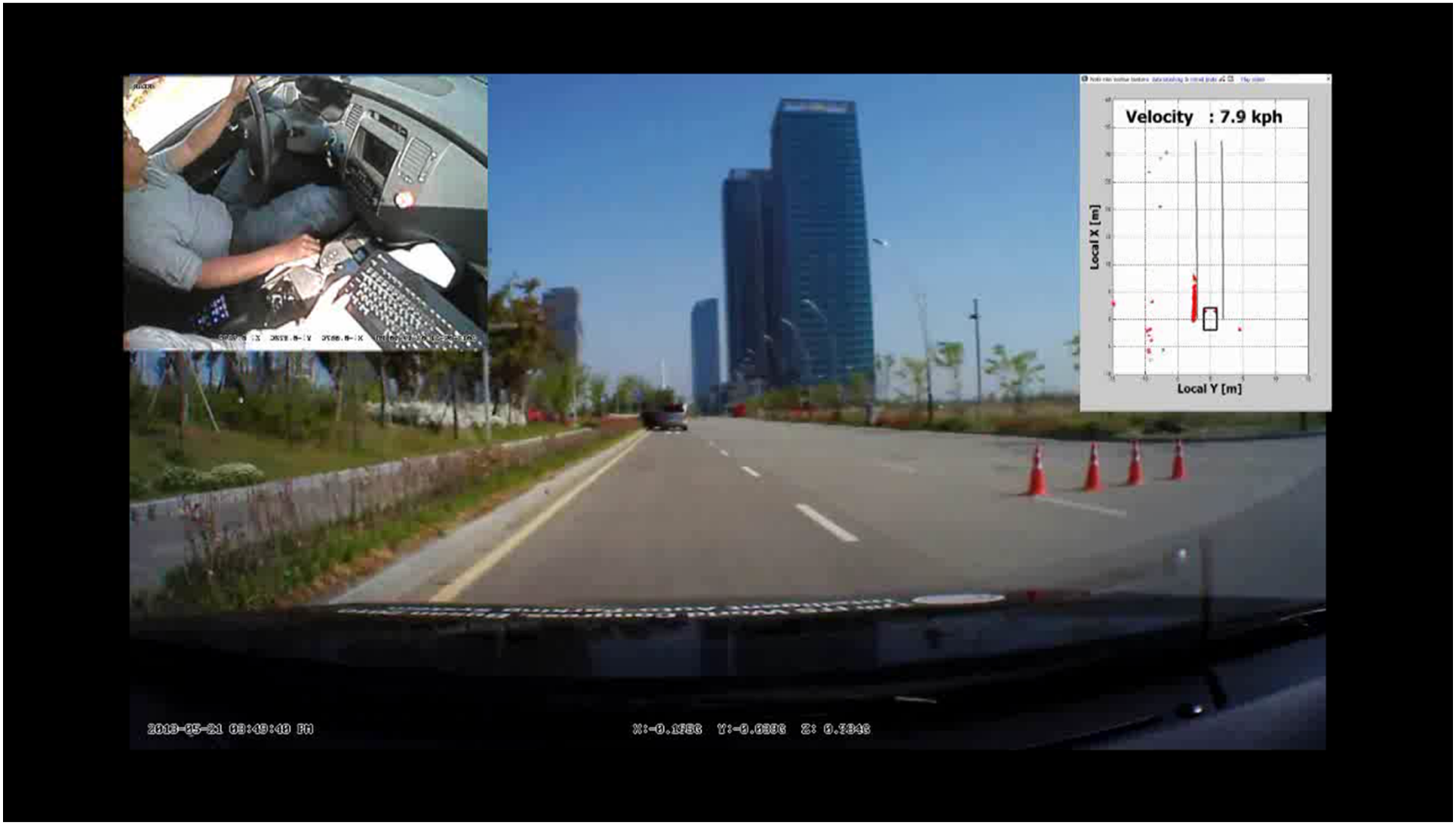


Test Data based Simulation / Repairing Section

- **Unexpected Static Obstacle Recognition**
- **Safe Envelope Decision & Motion Planning**

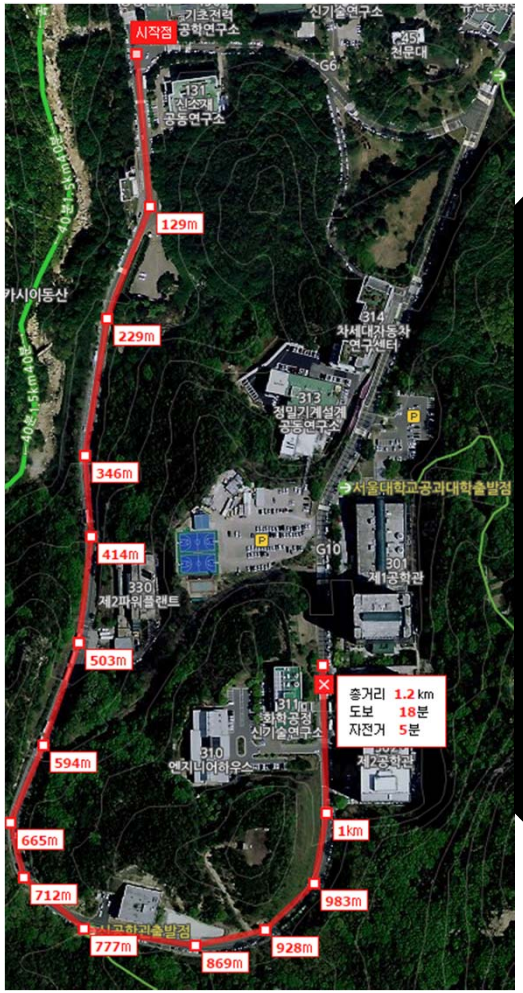


Level 4 Automated Driving



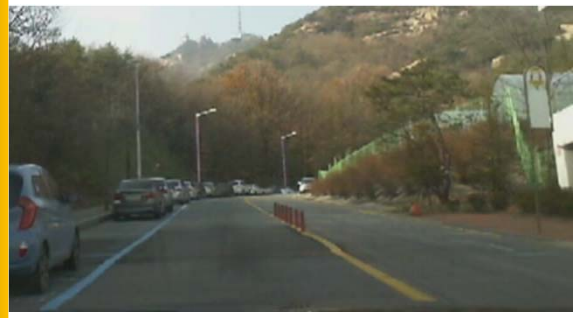
Automated Driving on Urban Roadways (SNU Campus)

- **Total Travel Length : 1.2 km**
- **Center for advanced materials research institute → Engineering Education & Research Bldg.**



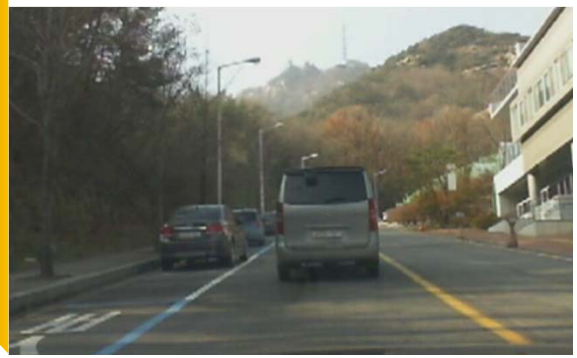
Highly Extreme Condition

- **Low Visibility of Lane**
- **Parked Vehicles**



Non-vehicle Obstacles

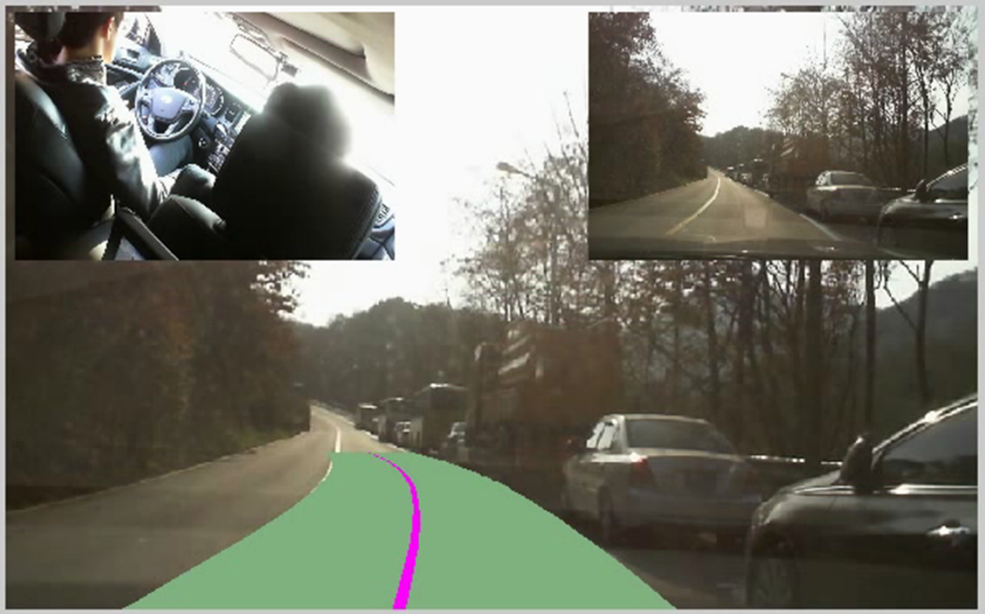
- **Pedestrian**
- **Guardrail**

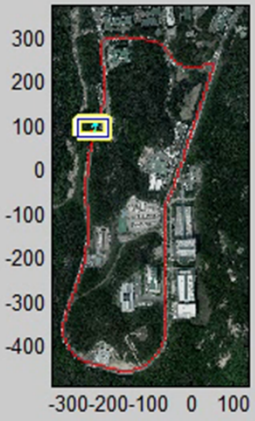


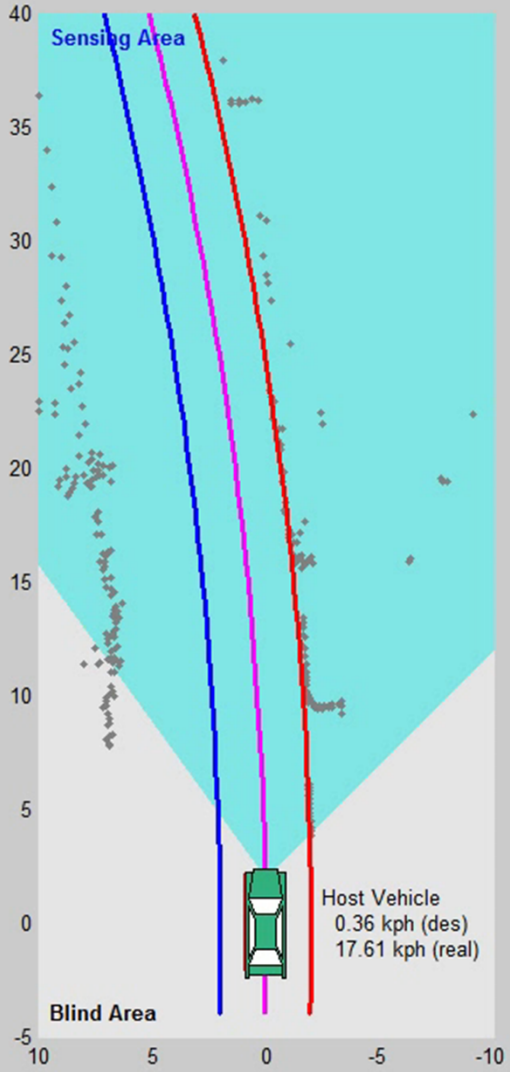
Other traffic Participants

- **Preceding Vehicle**
- **Oncoming Vehicle**

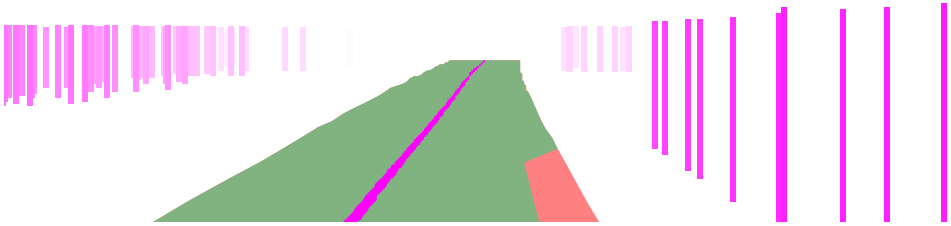
Automated Driving on Urban Roadways / Vehicle Test

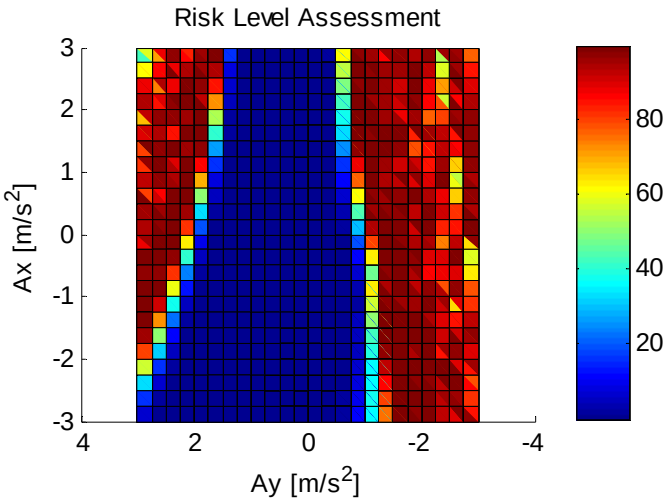


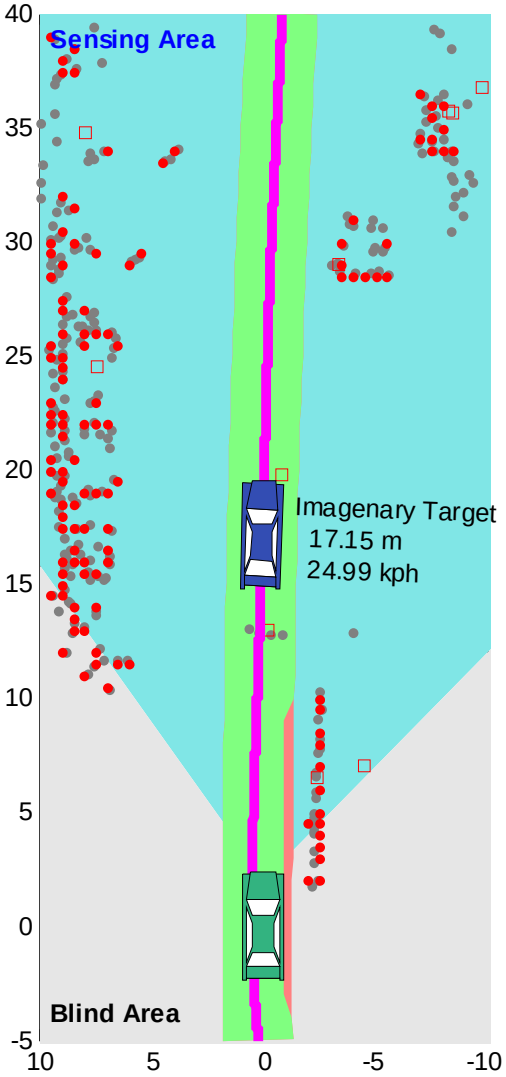




Automated Driving with Risk Management







Systems

An aircraft
A head positioner for a computer hard disk
A vehicle
An engine/transmission/brake/ steering/ suspension systems
An electric rice cooker
An excavator
A room air conditioner
A refrigerator
Electric power plant
Robots
Chemical and Manufacturing Process Control: temperature; pressure; flow rate; concentration of a chemical; moisture contents; thickness.

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End of Course overview