Outline

➤ NTUA Dpt of Transportation - NRSO

➤ NTUA Driving Simulator

➤ NRSO Road Safety activities

➤ Future work / new perspectives

NTUA History

➢ The National Technical University of Athens (**NTUA**) is a public-owned University and the largest Technological University of Greece

➢ NTUA and the **School of Civil Engineering** have contributed unceasingly to the country's scientific, technical and economic development since their foundation in **1837**

➢ In 2018, the School of Civil Engineering of NTUA was **ranked 11th in Europe** among all Civil Engineering Schools and 31st worldwide

Department of Transportation Planning and Engineering

➤ The mission of the NTUA DTPE is to **educate scientists engineers and promote science** in the field of transportation planning and engineering.

➤ The NTUA DTPE is a **Research and Innovation Center of Excellence** with global recognition [Ranked 9th in Europe, 39th worldwide (Shanghai Ranking's 2017), Scientific citations: 3rd in Europe, 19th worldwide (Pulse 2017), Road Safety: 2nd in Europe, 6th worldwide (AAP, 2018)].

➤ A **Team of 60+ Scientists**: 7 Internationally recognized Professors, 15 Senior Transportation Engineers and PostDoc, 25 PhD Candidates, 15 Transportation Engineers and other scientists.

➤ **NTUA DTPE Activities in figures** (since mid 80s):
  • More than 1.100 Diploma and 30 **PhD Theses**,
  • More than 330 road safety research **projects**, mostly through highly competitive procedures,
  • More than 1.100 scientific **publications** (> 400 in Journals), widely cited worldwide,
  • More than 150 scientific **committees**,
  • International **collaborations**: European Commission, UN/ECE, OECD/ITF, WHO, World Bank, EIB, CEDR, FEHRL, ERF, IRF, UITP, ETSC, WCTR, TRB, decades of Universities and Research Centers.

www.transport.ntua.gr

NTUA Road Safety Observatory

➢ An international reference **road safety information system** since 2004, with the most updated data and knowledge, with:
  - more than 3.000 visits per month,
  - tens of items and social media posts/tweets annually

NRSO Basic Tools

- **Databases and knowledge**:
  - Greek Road Accident Database with disaggregated data
    - **SANTRA** (1985 - 2016, 1,2 million recordings)
  - European Road Accident Database with disaggregated data
    - **CARE** (1991 - 2017, 36 million recordings)
  - International Road Accident Database with aggregated data
    - **IRTAD** (1991 - 2016)
  - Databases of **International Organisations**
    - WHO, IRF, ERF κ.λπ.
  - Databases with **Aggregated Data**
    - Vehicle fleet, vehicle-kilometers, driver behavior, etc.
  - Online Road Safety **Library** >5.000 updated reports
  - International **Bibliography** database (access to the overwhelming majority of scientific journals)
- Large number of statistical analysis **Tools** (software, standards)
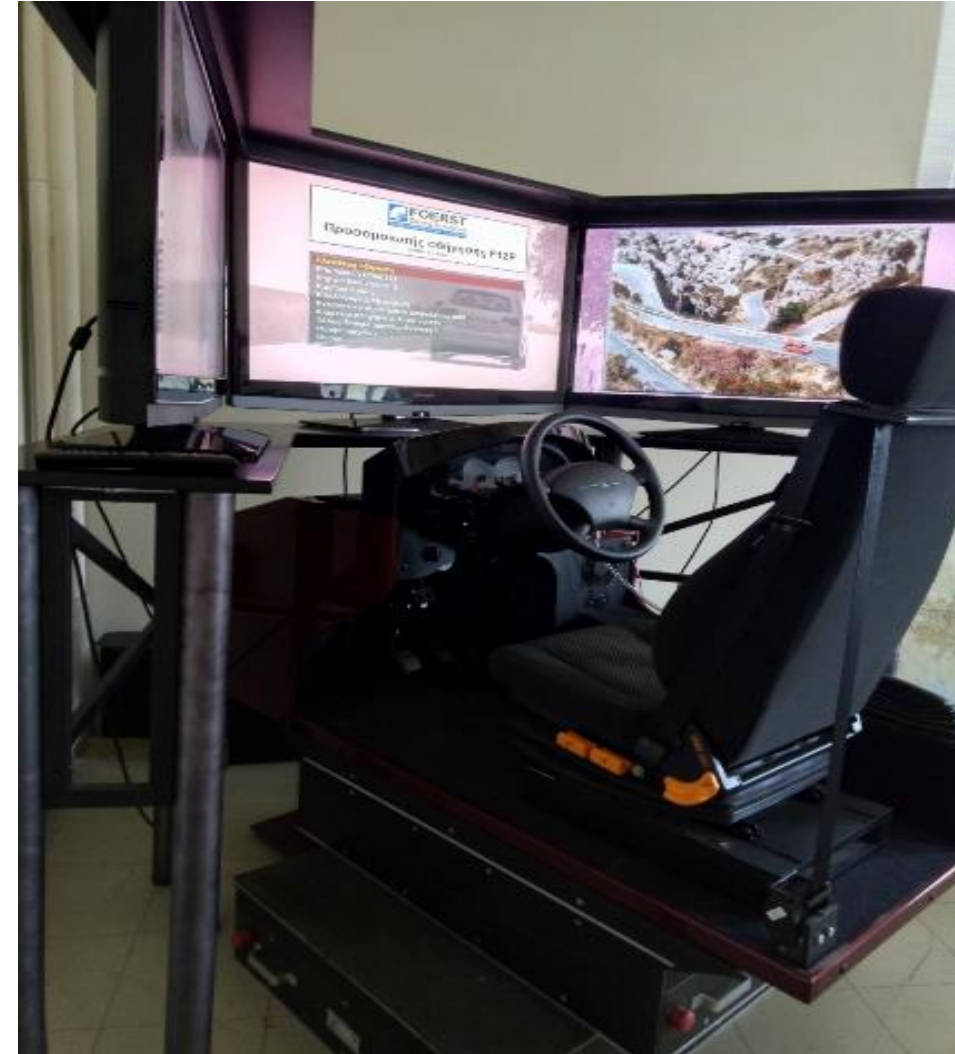- **Driving Simulator**

NTUA Driving Simulator

Driving Simulator Characteristics

➢ **Quarter-cab** driving simulator

➢ **3 LCD wide screens** 40" (full HD), total angle view 170 degrees, driving position and support base

➢ **Dimensions** at a full development: **230x180 cm** with a base width of 78 cm

➢ **Adjustable driver seat**, steering wheel 27cm diameter, pedals (throttle, brake, clutch), dashboard and two external and one central mirror

➢ **Controls available to the driver**: 5 gears plus reverse gear, flash, wipers, lights, horn, brake and starter

Driving Simulator Parameters

|	Variable	Explanation
1	Time	current real-time in milliseconds since start of the drive.
2	x-pos	x-position of the vehicle in m.
3	y-pos	y-position of the vehicle in m.
4	z-pos	z-position of the vehicle in m.
5	road	road number of the vehicle in [int].
6	richt	direction of the vehicle on the road in [BOOL] (0/1).
7	rdist	distance of the vehicle from the beginning of the drive in m.
8	rspur	track of the vehicle from the middle of the road in m.
9	ralpha	direction of the vehicle compared to the road direction in degrees.
10	Dist	driven course in meters since begin of the drive.
11	Speed	actual speed in km/h.
12	Brk	brake pedal position in percent.
13	Acc	gas pedal position in percent.
14	Clutch	clutch pedal position in percent.
15	Gear	chosen gear (0 = idle, 6 = reverse).
16	RPM	motor revolation in 1/min.
17	HWay	headway, distance to the ahead driving vehicle in m.
18	DLeft	Distance to the left road board in meter.
19	DRight	Distance to the right road board in meter.
20	Wheel	Steering wheel position in degrees.
21	THead	time to headway, i. e. to collision with the ahead driving vehicle, in seconds.
22	TTL	time to line crossing, time until the road border line is exceeded, in seconds.
23	TTC	time to collision (all obstacles), in seconds.
24	AccLat	acceleration lateral, in m/s^2
25	AccLon	acceleration longitudinal, in m/s^2
26	EvVis	event-visible-flag/event-indication, 0 = no event, 1 = event.
27	EvDist	event-distance in m.
28	Err1No	number of the most important driving failure since the last data set
29	Err1Val	state date belonging to the failure, content varies according to type of failure.
30	Err2No	number of the next driving failure (maybe empty).

Driving Simulator Features

The simulator records data at intervals of **33 to 50 milliseconds** (ms) which means that each second measured values for each variable up to 30 times.

Basic features (Ready Scenarios)
➢ **Free Driving** - Simulated Reality
➢ **Eco-Driving** - Easy on the Purse and on the Environment
➢ **Traffic Safety** - Alcohol Simulation and Hazard Situations
➢ **Fitness to Drive** - Put the Rule to the Test
➢ **Driving School** - Basic Knowledge Made Easy

Rural Road
2,1 km

Start

Finish

Urban Road
1.7 km

Finish

Start
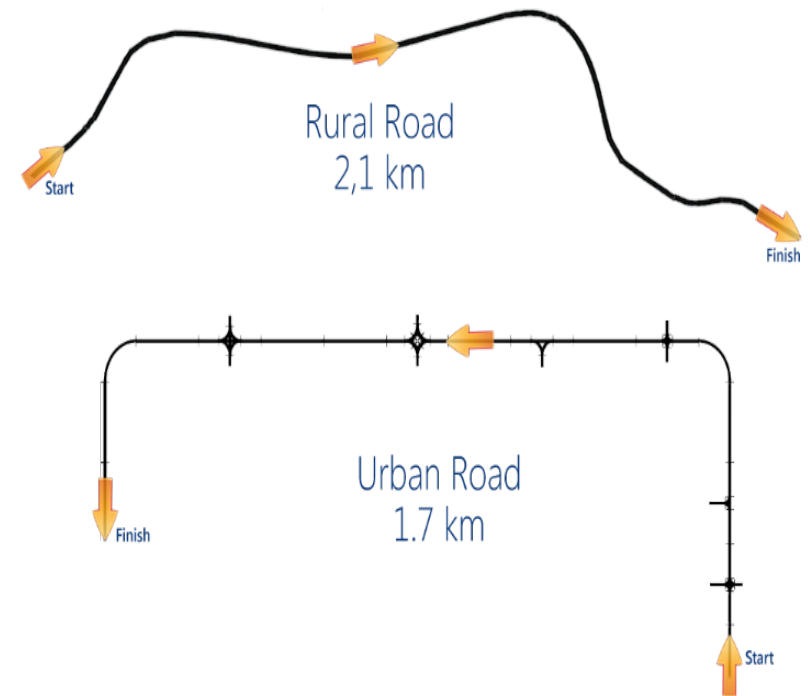
Driving Simulator Programming Tools

Using the **Programming Tool**, scenarios can be written to be run by driving simulator software

- Set **weather conditions** and position traffic signs.
- **Assign a route** to the driver (he/she will be instructed where to drive).
- Insert **other road users** and control their behaviour.
- Trigger **predefined events** (e.g. deer running from behind a tree).
- Execute various **system commands** (e.g. display custom messages).
- Monitor **driver's controls**, position and speed and conditionally perform other actions.

Driving Simulator scenarios

NRSO Driving Simulator Activities

➢ The **impact of various risk factors** to driver behavior and safety has been investigated:
  - **Distraction** (mobile phone – talking/ texting, conversation with passenger, listening to music, eating and smoking, roadside advertising)
  - **Alcohol Consumption**
  - **Environmental factors** (rain, snow, fog, night-time)
  - **Neurological diseases** affecting cognitive functions

➢ During the last decade, a set of **experiments** with the use of NRSO driving simulator have contributed to the implementation of:
  - **2 Research project**
  - **3 Post Doctoral Researches**
  - **3 PhD Theses**
  - **14 Diploma Theses**

NRSO Driving Simulator Research Projects

- ➢ "**DRIVERBRAIN** – Performance of drivers with cerebral diseases at unexpected incidents" in the framework of the research program ARISTEIA of the General Secretariat for Research and Technology (2012-2015)

- ➢ "**DISTRACT** – Causes and impacts of driver distraction: a driving simulator study" in the framework of the research program THALIS for the Ministry of Education, Lifelong Learning and Religious Affairs (2012-2015)

DriverBrain Project

- ➤ **Title:** DRIVERBRAIN – Performance of drivers with cerebral diseases at unexpected incidents

- ➤ **Objective**: the analysis of the performance of drivers with cerebral diseases (Cerebrovascular, Parkinson, Altzheimer and the Mild Cognitive Impairment at their early stages) at unexpected incidents

- ➤ **Methodology**: A driving simulator experiment was carried out, comprising a medical/neurological and neuropsychological evaluation of the participants, and a set of driving tasks for different scenarios

Distract Project

➢ **Title:** Distract – Causes and impacts of driver distraction: a driving simulator study

➢ **Objective: t**he analysis of the effect of road, traffic and driver risk factors on driver behaviour and accident probability at unexpected incidents, with particular focus on distracted driving

➢ **Methodology**: A driving simulator experiment was carried out including driving under different distraction sources, traffic (high/low) and road environment (urban/rural) scenarios different scenarios

NRSO Simulator Post Doctoral Researches

➢ Evaluation of safe driving **behaviour of older drivers with or without cerebral diseases**
Dimosthenis Pavlou

➢ Multilevel analysis of **driving behaviour with focus on distraction** based on a driving simulator experiment
Panagiotis Papantoniou

➢ Effects of **alcohol among young drivers**: a driving simulator study
Zoi Christoforou

NRSO Simulator PhD theses

➢ Traffic and safety behaviour of drivers with **neurological diseases affecting cognitive functions**
  Dimosthenis Pavlou

➢ **Risk factors, driver behaviour and accident probability.** The case of distracted driving
  Panagiotis Papantoniou

➢ Study on the effect of **insomnia in driving performance**
  Angeliki Konsta

NRSO Simulator Diploma theses

The impact of various **risk factors** to driver behavior and safety has been investigated through diploma theses:

➢ **nighttime driving (**Kontaxi, Kuriakouli)
➢ **weather conditions** (Chaireti, Sourelli)
➢ **Simulator vs real driving comparison** (Nikas, Voutsina)
➢ **Advertising signs** (Gkouskou)
➢ **Unexpected events** (Charoniti)
➢ **Texting (Gkartzonikas, Christoforou)**
➢ **Mobile phones and music** (Postantzi, Papathanasiou)
➢ **Conversing, eating, smoking** Bairamis, Sklias)
➢ **Mobile phone** (Roumpas)

Future Research (1/2)

➢ **Research Project: i-Dreams -** Safety Tolerance zone calculation and interventions for diver – vehicle – environment interactions under challenging conditions

➢ Organization and exploitation of a **driving simulator experiment of 110 drivers** in order to:
- test, calibrate and further refine the accuracy of the **safety tolerance zone** monitor
- **test** a pre-selected set of in-vehicle interventions and **decide** on which of these will be kept for implementation in the field trial
- explore **user acceptance** of the tested in-vehicle interventions
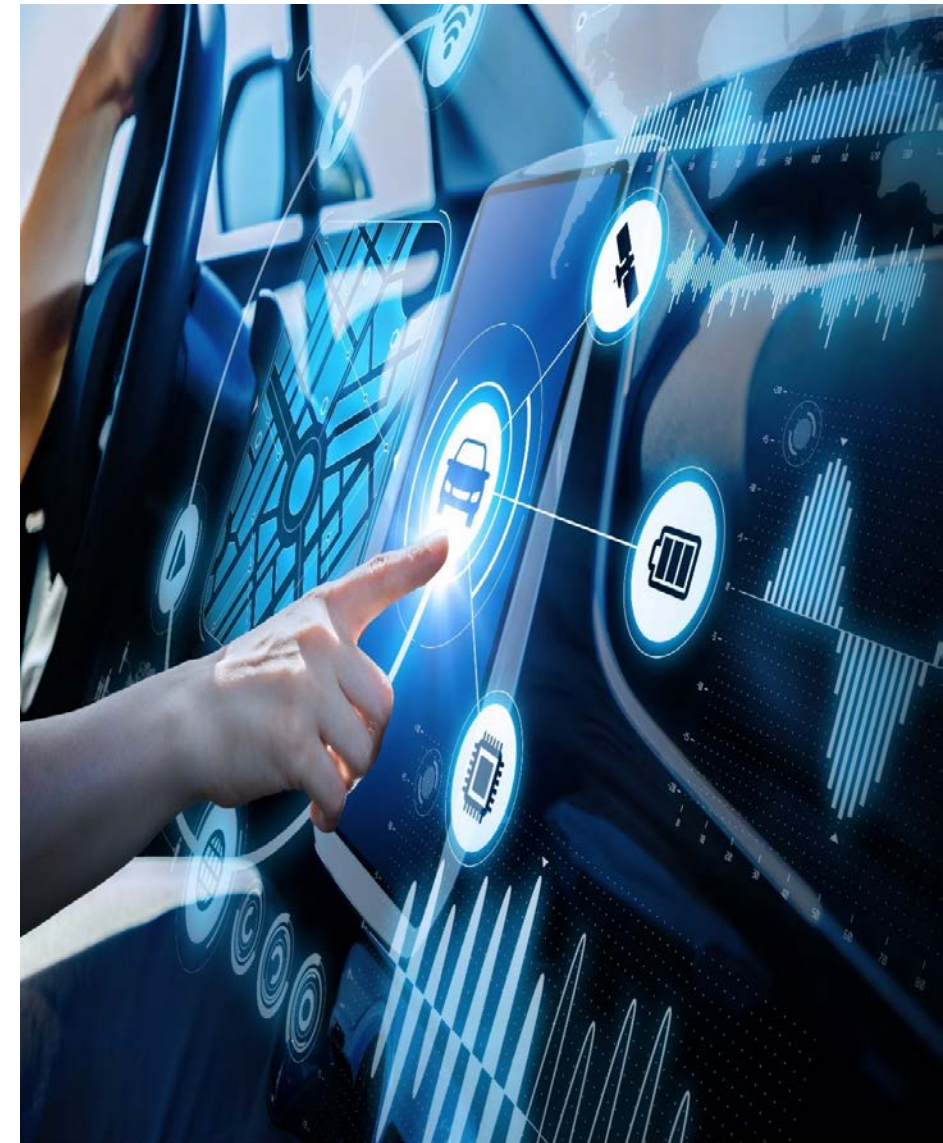
Future Research (2/2)

➢ **Research Project:** Development of Assessment Tools for Prediction of Safe Driving Behaviour of Older Drivers With or Without Cognitive Impairments

➢ Organization and exploitation of an **on-road experiment** and a **driving simulator experiment of 100 drivers** in order to:
- **Evaluate** the on-road driving behaviour
- Implement a driving simulator assessment that will focuses on the evaluation of critical **road safety measures**, such as reaction time and accident risk by programming several driving tasks into the driving simulator for different driving scenarios

New role of Simulators

- **Technological advances** in the field of driver monitoring and assessment require new roles of driving simulators to be implemented

- The development of advanced **Driver Assistance Systems** should be successfully tackled using driving simulators

- In the new era of **autonomous Vehicles** do we still need driving simulators?

- Do we have to move from **Vehicle Simulators** into **Driving Simulators?**

New role of Simulators

➢ **Driving simulators are more than ever necessary** for research and development in the field of automated driving

➢ The **future development of driving simulators** dedicated to research in automated driving will need to focus more on enabling **onboard connectivity, driver monitoring and interaction concepts and technologies**

➢ Driving simulators need to be **re-conceived as living spaces** where humans act as they would in real conditions, in connection with each other and using different technologies`