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Innovative Electric and Hybrid Vehicles Research Group

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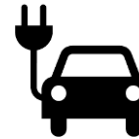
Research guideline

Research Title

“Electric Full vehicle multibody model for driving simulator including traffic and metropolitan scenario”

Areas of interest

- Vehicle Dynamics and Multibody Models
- Electric Drive and Performance Evaluation
- Driver-in-the-Loop simulator and Virtual Driver
- ADAS and Autonomous Driving Functionalities



Research approach

"Case study: real vehicle electrified and used as a technology testing platform"

Modelling



- Creating a reliable **full vehicle model** of a hybrid vehicle
- Describing relevant **driving scenarios** for ADAS / AD

Testing



- Choosing **manoeuvres** and specific conditions
- Install **sensors** and data **acquisition** systems
- Treat, analyse and **correlate** experimental data

Control



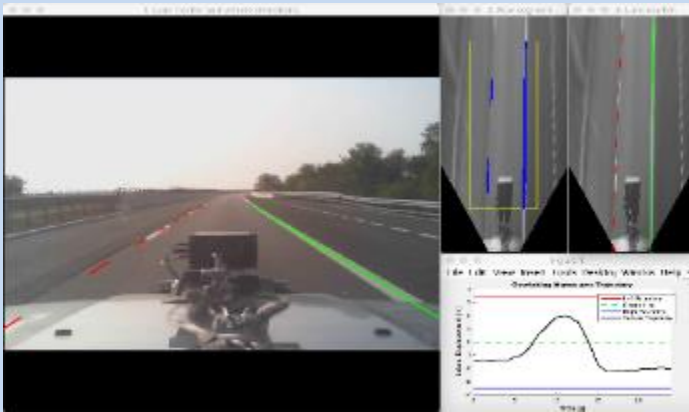
- Study **control** strategies and architectures for ADAS
- Implement and test relevant **functionalities** for Electric and Hybrid Vehicles

Preliminary analysis and results

Vehicle Dynamics Assessment for Autonomous Driving

- **Data treatment** for experimental campaign for autonomous driving application
- **Data fusion** (camera + Lidar + CAN)
- Driving **Scenario** analysis and new trends of ISO standard for Autonomous Vehicle **testing**

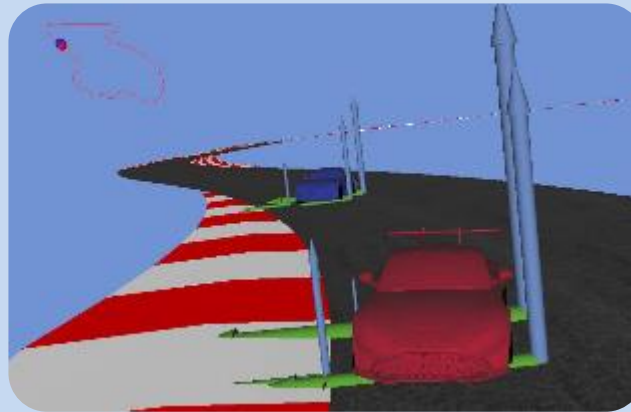
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All-wheel Drive Electric Vehicle: Active Suspension and Aero

- **Co-simulation:** Car Real Time (dynamics) and Simulink (Electric Motors and Control)
- **Trim control** and **Active Aero** logic and implementation
- **Driver In the Loop static simulator** validation

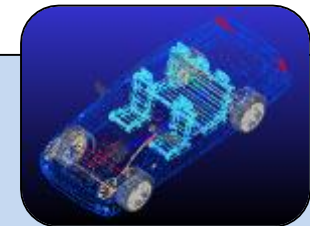
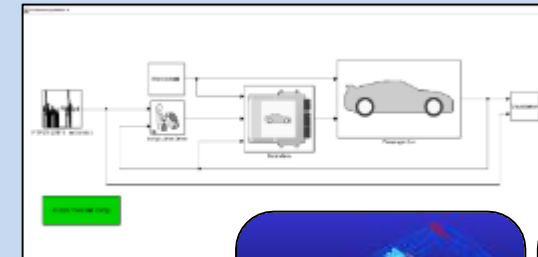
VI-GRADE



In-wheel and On-board Motor Electric Vehicle Modelling

- **Co-simulation:** Adams CAR (dynamics) and Simulink (Electric Motors and Control)
- Modelling of **batteries**, **inverters** and two types of **electric motor**
- Longitudinal **performance** and **energy efficiency** evaluation

MSC Software



Scientific publications

Published and submitted articles since Nov/19:

Title	Journal / Congress	Status
Human-Driving Highway Overtake and Its Perceived Comfort: Correlational Study Using Data Fusion	SAE World Congress 2020	Published
Experimental Characterization of Piezoelectric Transducers for Automotive Composite Structural Health Monitoring	SAE World Congress 2020	Published (Best papers award)
Dynamic Performance Comparison Between In-Wheel and On-Board Motor Battery Electric Vehicles	ASME - IDETC2020	Approved and Presented
Active Aerodynamics Through Active Body Control: Modelling and Static Simulator Validation	ASME - IDETC2020	Approved and Presented (Best papers award)
Advanced Vehicle Dynamics Through Active Aerodynamics and Active Body Control	ASME - IDETC2020	Approved and Presented
Autonomous Driving Scenario Generation in Overtake Manoeuvres Through Data Fusion	IFIT 2020	Published
Active Aerodynamics Design Methodology for Vehicle Dynamics Enhancement	IFIT 2020	Published
City Car Drag Reduction by means of Flow Control Devices	SAE Brasil Congress 2020	Approved
Integrated Design and Control of Active Aerodynamic Features for High Performance Electric Vehicles	SAE Brasil Congress 2020	Approved

Courses and didactic activity

PhD Courses:

Course	Hours	Type	Status
Automotive transmissions (manual, non-manual and hybrid)	20	Hard skills	Passed
Human-Ai Interaction	20	Hard skills	Passed
Electrochemical power sources	20	Hard skills	Passed
Entrepreneurship and start-up creation	40	Soft skills	Passed
Sustainable transport systems: energy and environmental issues	10	Hard skills	Passed
Hybrid propulsion systems	15	Hard skills	Passed
Modelling complex systems in engineering and management	40	Hard skills	Passed

Total: 125 h of hard skills + 40 h of soft skills

Didactic activity:

Assistant to the practical projects of the course Chassis Design B	21 h	M.Sc Automotive Eng.	Finished (2019/20)
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Objectives and next steps

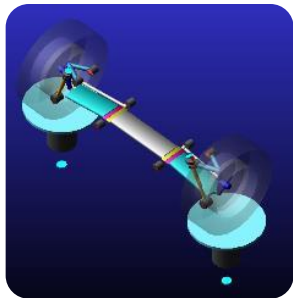
Now

2020

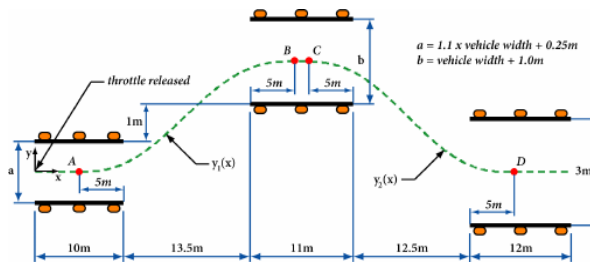
2021

2022

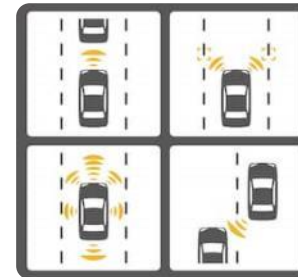
- Initial **multibody model** in Adams Car of the 500 with **modified rear suspension**
- 1D simulations and target setting for **hybrid** powertrain (rear **in-wheel** motors)



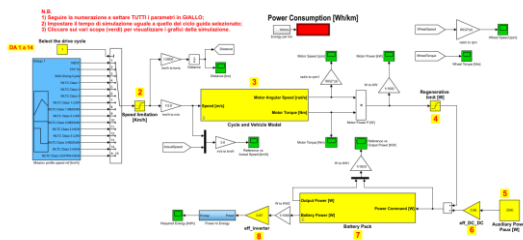
- Gather parts' **parameter** and finalize the **model**
- Plan **track tests** to validate / adjust the model
- Bibliographic research on **control strategies** and computational methods



- **Installation** of the electric motors and **validation** tests on the hybrid 500
- Implementation of a **control strategy** (torque vectoring, one pedal driving...)
- Study of driving **scenarios** and **ADAS** interfaces



- Implementation and testing of **control strategy** and/or **ADAS** functions in the 500
- **Objective** and **subjective** evaluation of the results
- Correlation with **models** and/or static DIL **simulator**



Thank you!

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