

Politecnico di Milano
Department of Mechanical Engineering
Applied Mechanics Group

Proposed MSc thesis topics

(for more information please contact the underlined professor)

ROAD VEHICLES

1. Testing of different ABS/ESP ECUs though HIL and design of a numerical tunable logic
(Ing. Sabbioni)

numerical-experimental thesis

The aims of this thesis are mainly two: first the physical connection and evaluation of the performances of different existing ABS/ESP ECUs (FIAT, BMW, LAMBORGHINI) through a hardware in the loop test bench especially considering tire model interaction (Pirelli will provide the models). The different ECUs will be connected with the experimental bench and activated through experimental tests (in particular LAMBORGHINI will give us technical assistance). Second the development of a tunable numerical ABS control logic based on the experimental data obtained.

2. Optimization of an autonomous driver model (Prof. Braghin, Ing. Arrigoni)

numerical thesis

Autonomous drive is the future of mobility due to safety, consumption and ecological benefits. An MPC controller designed for collision avoidance in highway scenario will be further investigated and optimized. The final target of this research will be the design of an optimized, as close as possible to real-time, autonomous drive system.

3. Platooning control logics for heavy trucks (Prof. Braghin, Ing. Arrigoni)

numerical thesis

Platooning seems to be quite a promising technology for reducing fuel consumption as well as a first step towards fully autonomous vehicles. However, for fully exploiting its advantages, vehicle should be as close as possible. This requires high performances to control algorithms. Higher performances are expected through the full integration with presently available logics such as ABS and ESP.

4. Autonomous drive and V2V communication in Unmanned Ground Vehicles (Prof. Braghin, Ing. Arrigoni)

experimental thesis

Vehicle to vehicle communication (V2V) is an emerging field of interest in advanced driver assistance systems (ADAS). Through the on-board implementation of control algorithm and sensing data processing, the behaviour and possible application of V2V in safety logics will be investigated. The target of the research will be the working setup of sensorized prototype vehicles communicating each other's and a proper control logic design.

Edoardo Moro automatico

5. Sensor data fusion for safety applications (Prof. Braghin, Ing. Arrigoni)

experimental thesis

Designing a reliable and robust sensing system is mandatory in obstacle detection for safety. The development of a sensor fusion algorithm will be investigated based on commercial sensors like:

IMU, IR, camera systems and ultrasound. The final target of this research will be a sensor fusion system for automotive applications robust to failures and the testing of the overall accuracy.

6. Hybrid and electric vehicle dynamics control (Ing. Sabbioni)

numerical thesis

Hybrid and electric vehicles represent the future of transportation. In addition to emission reduction, this type of vehicles allows to design new vehicle dynamics control strategies which can increase vehicle safety and performances. The aim of this thesis is to design a full electric vehicle to be used to test these control strategies. In particular a four independently driven vehicle has to be designed and assembled starting from the dimensioning of powertrain and suspensions.

7. Cross wind loads on a vehicle crossing the wake of a bridge pylon (Ing. Sabbioni)

numerical thesis

Numerical modelling of the aerodynamic forces due to cross wind effects on vehicles crossing the wake of a bridge pylon and counter measurements to improve the vehicle safety will be studied. Force modelling will rely on wind tunnel experimental results on still scaled vehicle models and will be validated through CFD simulations. A risk of overturning for the running vehicle will be investigated through multibody simulations accounting for vehicle handling, driver control and aerodynamic loads. The adoption of wind barriers to increase the safety margin will be investigated.

8. CFD analysis of the wake of a vehicle (Ing. Rocchi)

numerical thesis

The work regards the study of the wake of a vehicle for assessing the effect of the wake on objects, persons and other vehicles. The analysis will be conducted using the open-source framework OpenFOAM. There is the possibility for experimental wind tunnel tests.

9. On road vehicle laboratory (Ing. Sabbioni)

experimental thesis

With the incoming of electronics on-board, vehicles have become more complex and sophisticated, new control logic can be designed but some quantities needed by the control cannot be directly measured. To solve this issue, estimators have to be developed. This work aims to create a powerful tool to test new filters and estimators for vehicle dynamics. The commercial vehicle owned by Department of Mechanics has to be instrumented and the acquisition program in LabView has to be designed. The goal is to get information both from sensors and CAN-BUS. Once the car is instrumented, newly developed state estimators can be tested.

10. Experimental and numerical study of an engine oil lubricating circuit (Prof. Braghin)

numerical thesis (thesis will be carried out at Bosch VHIT Offenago)

The lubricating oil circuit is a fundamental part of the engine. This thesis analyses the lubricating circuit in its sub-parts in order to create a mathematical model focused to the application of a variable displacement oil pump.

By means of simulations various layouts will be analysed and compared. The thesis will be focused on the creation of a modular mathematical model for the integration of the MOP-VD control.

11. Control design of a full map VDOP for reduction of CO₂ emission (Prof. Braghin)

numerical thesis (thesis will be carried out at Bosch VHIT Offenago)

The integration of mechatronics in cars became larger during the development of high efficiency vehicles. This thesis analyses the control methods of a variable displacement oil pump in order to reduce CO₂ emissions.

By means of simulations and validation various control strategies will be analysed and discussed.

The thesis will be focused on the comparison of control strategies in terms of CO2 reduction and robustness.

12. Experimental and numerical study of proportional e-valves to manage VDOP (Prof. Braghin)

numerical thesis (thesis will be carried out at Bosch VHIT Offenago)

The integration of mechatronics in cars became larger during the development of high efficiency vehicles. This thesis analyses various valves available on market in order to define the best valve available for the purpose.

By means of simulations and validation various control and driving strategies will be analysed and discussed. The thesis will be focused on the comparison of control and driving strategies in terms of CO2 reduction and robustness.

13. Experimental and numerical study of a mechanical vacuum pump (Prof. Braghin)

numerical - experimental thesis (thesis will be carried out at Bosch VHIT Offenago)

A vacuum pump is a vane pump driven by a shaft (cam shaft or engine shaft) for producing vacuum for brake system. This thesis analyses the structure of a mechanical vacuum pump and the influence of different subcomponents.

By means of simulations various layouts will be analysed and compared. The thesis will be focused on the creation of a modular mathematical model, able to reproduce and predict the behavior of the mechanical vacuum pump (vacuum level, torque absorption, air suction ...). The model will be validated with experimental tests performed on instrumented pumps.

