PhD Program in Automotive Engineering for Intelligent Mobility

A Joint Program between the University of Bologna,
the University of Modena and Reggio Emilia and the University of Parma

https://phd.unibo.it/ami

PhD Program in Automotive Engineering for Intelligent Mobility

The Motivations

New challenges for a carbon neutral and a sustainable mobility are asking for highly skilled and educated engineers and researchers to exploit, conceive and realize innovative solutions

Sustainable and Intelligent mobility asks for integrated competences, from design and manufacturing to connectivity through clean and carbon neutral powertrain

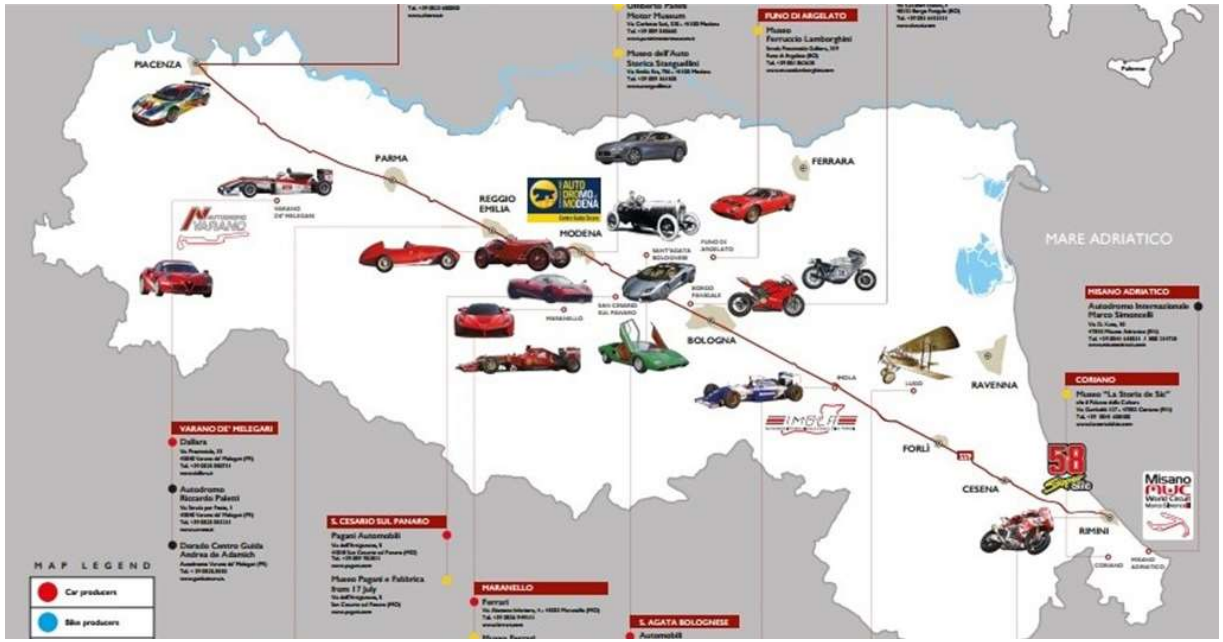
The PhD Program in Automotive for Intelligent Mobility matches all these goals in a long term-perspective of sustainable mobility

PhD Program in Automotive Engineering for Intelligent Mobility

The Stakeholders

It is fully integrated into the production context of Emilia Romagna - where the Automotive sector is represented by companies of worldwide importance in the production of high-end cars and motorcycles, agricultural machinery, cars and motorcycles for sports competitions, vehicle components.

The Automotive sector in the Region is the first industrial sector with a turnover of more than 10 billion euros, about 200 companies and 20,000 employees.



PhD Programme Structure

1. The Mission

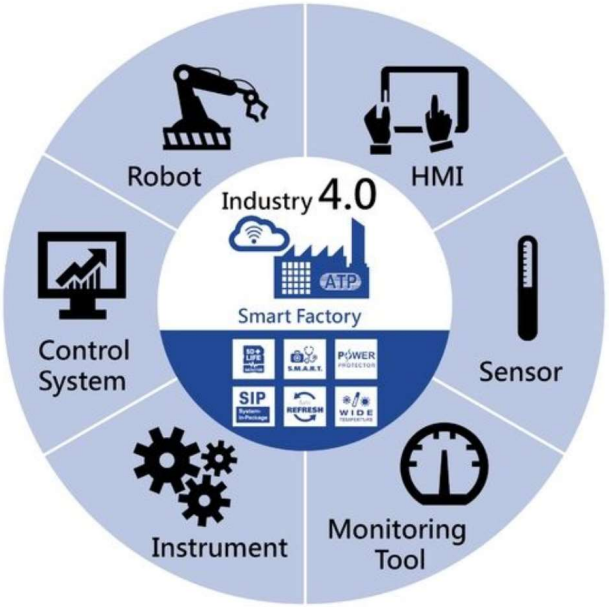
1. Provide **High-Qualified** Engineering profiles in the **Automotive and Mobility Sectors**

2. The Ph.D. engineer outcome **profile**:

   - Highly qualified personnel with multidisciplinary skills,

   - Able to direct the development and research, also in the industrial field, of innovative vehicles,

   - Able to create a meeting point between mechanical, industrial, electronics, telecommunications, controls, electrical, IT, logistics and civil engineering



What and How

2. Overview

1. The PhD Programme was established in A.Y. 2018/19
2. Since A.Y. 2021/22 the Phd Programme is **offered in English**
3. It is offered as a **full time 3 years PhD Course**
4. It is composed of **3 different educational curricula**
5. Web site: https://phd.unibo.it/ami
6. PhD Coordinator: Prof. Nicolò Cavina

   (email: nicolo.cavina@unibo.it)

PhD Programme Structure

2.4 Curricula

Curriculum 1: Vehicle Design, Manufacturing and Systems Integration

The curriculum pursues the education of researchers and high-qualified engineers, operating in the areas of design and manufacturing of the automotive sector.

Curriculum 2: Energy Systems, Powertrains, Vehicle Performance

The curriculum pursues the education of researchers and high-qualified engineers, operating in the areas of vehicle dynamics and energy management.

Curriculum 3: Vehicle Informatics and Connectivity

The curriculum pursues the education of researchers and high-qualified engineers, operating in the areas of vehicle digitalization and connectivity.

2.4.1 Curricula

Curriculum 1: Vehicle Design, Manufacturing and Systems Integration

- Industry 4.0 and Advanced Manufacturing Technologies
- Supply Chain Management
- Industrial Automation and Robotics
- Big Data and Cloud Computing for Manufacturing
- Materials, Lighting Technology and Design
- Methods for improving Efficiency and Safety of Vehicles
- Vehicle Lifecycle Assessment. Circular Economy: Vehicle refurbish, re-use of Vehicle Parts.

PhD Programme Structure

2.4.2 Curricula

Curriculum 2: Energy Systems, Powertrains, Vehicle Performance

1. Electrification and Power Electronics
2. Electric, Hybrid and ICE-based Powertrains
3. Advanced Combustion and Aftertreatment Systems
4. Batteries and Energy Storage Systems
5. Vehicle Energy Management and Energy Optimization
6. Vehicle Dynamics and Control

PhD Programme Structure

2.4.3 Curricula

Curriculum 3: Vehicle Informatics and Connectivity

1. Vehicle Human Machine Interface and Infotainment systems
2. V2V - Vehicle to Vehicle and V2G - Vehicle to smart Grid interfacing
3. Gamification for Improving Driver Behavior
4. Vehicular networks, Vehicular Sensors and Big Data for Mobility
5. Automatic and Autonomous Drive
6. Connectivity for V2I - Vehicle to Infrastructure,
7. Data Analytics and Advanced Prediction Models

PhD Programme Structure

3. Educational Activity

The PhD program in Automotive for Intelligent Mobility has the mission to pursue the highest level of education of the PhD student

Different seminars and courses are organized by inviting lecturers from both Academia and Industry

The educational activity is designed to provide students with both high-level scientific competences and soft skills

Due to the subdivision in three curricula, part of the technical education activity is vertically oriented to each curriculum

PhD Programme Structure

4. Interaction

The PhD Program takes advantage of well-established **national** academic and industrial interactions

1. Bottom-up educational thrust from:
    - Master Programs like MUNER (Master Program in Automotive)
    - Learning-by-doing Projects (Formula Student, MotoStudent)
2. Strong interaction between the University of Bologna, the University of Modena and Reggio Emilia and the University of Parma and other National Universities and Research Centres
3. Long-lasting collaborations and joint research programmes with the most important Italian companies of the Automotive sector and with the main Players of the Motor Valley of Emilia Romagna Region

PhD Programme Structure

4. Interaction

The PhD Program takes advantage of well-established **international** academic interactions

1. Students must spend at least three months at a research center located outside Italy
2. High-level academia and research centers cooperation for exchanging students
3. Dual-degree agreements:
   - Agreement for International Joint Doctorate Supervision with MINES ParisTech, Paris, France
   - Framework Agreement for Awarding Dual Doctoral Degrees with Macao Polytechnic Institute
   - Dual/Joint Doctoral Degree Program with National Chiao Tung University (NCTU), Taiwan

Information for Applicants

5. Admission

Students must hold a University Master of Science degree (or equivalent).

To be admitted to the Doctorate Program applicants must apply through **a competitive selection process** (How to apply for a PhD programme)

The application window is open once a year, typically between April and June

Knowledge of English is required (B2)

6. The approach to research

High-quality research is a priority for the Doctoral Course in Automotive for Intelligent Mobility.

High-quality research is pursued combining scientific rigor and technical relevance and it is characterized by:

1. Multi-disciplinarity
2. Multiple methodologies
3. Experimental methods, quantitative modelling, case studies and other qualitative methodologies, collaborative and action research
4. Leveraging on networks with centers of excellence (Academia and Industry)

7. Career and Placements

Ph.D. graduates will have distinctive skills and advanced knowledge to pursue a high-profile professional career especially in the automotive and mobility engineering field and to carry out high-quality research at universities or other research institutions.

Job and Career opportunities include:

- Highly qualified position in the design, project management and management in the automotive and mobility industry, i.e, personnel able to drive innovation in the sectors of Automotive and intelligent, autonomous and connected vehicles in the coming decades

- Post doc positions, research fellows and young lecturers in Italian and foreign universities;

Information for Applicants

8. Examples of recent Ph.D. Projects

- Topological optimization for additive manufacturing of motorcycle components
- Collaborative robotics for Industry 4.0
- Analysis of the fretting-fatigue behaviour of road vehicle components
- Lightweighting of automotive components by optimization of Selective Laser Melting process and heat treatment of high strength steels and light alloys
- Innovative bolted connections for automotive applications
- Physical and data driven modeling of keyhole generation in laser welding manufacturing processes
- Design of more-electric tractors for a more sustainable agriculture
- Development and testing of control and diagnosis methodologies for innovative combustion systems
- Modeling and control of internal combustion engines and hybrid powertrains
- Multicomponent modeling of reciprocating engine in-cylinder lubricant dilution
- Predictive control of pollutant and CO2 emissions of hybrid vehicles
- Development of high reliability motor drives for next generation propulsion applications
- Battery Management System of swappable battery packs
- Energy management/storage systems in electric or hybrid vehicles
- Innovative systems and methods for motorcycle dynamic performance and stability estimation and optimization
- Electrical engineering for high-efficiency and high-reliability electric vehicles
- High efficiency and rare material free electrical machines for circular economy in automotive
- Electronic systems for driver attention monitoring
- Connected Vehicles for Beyond 5G Scenarios
- Study of road-vehicle-driver interaction for connected and autonomous mobility
- Integrated systems for autonomous driving
- Big data for sustainable and resilient road network operations
- Development of AI-based smart HMIs for advanced driver security

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