



PhD in INGEGNERIA MECCANICA / MECHANICAL ENGINEERING - 39th cycle

**PNRR 117 Research Field: TRANSMISSIONS AND MECHANISMS FOR AUTOMOTIVE SAFETY
CRITICAL SYSTEMS**

Monthly net income of PhDscholarship (max 36 months)

€ 1400.0

In case of a change of the welfare rates during the three-year period, the amount could be modified.

Context of the research activity

**Motivation and objectives of the research
in this field**

The objective of the activities is to study, define and validate a methodology related to mechanism and transmission, in particular to have high efficiency, low weight and low cost actuation for automotive and safety critical systems. On one side, for currently applied solutions, typically based either on mechanical screwball drives and linear gears or on hydraulic actuators, improvements and optimization are still possible; on the other hand, new concepts of transmission systems are worthy to be considered and evaluated.

On the basis of a preliminary state of the art and of the mission cycles/profiles of the application, the research will aim at identifying a methodology to select and design transmission systems, as follows:

- Requirement analysis (loads, efficiency, space, costs, etc.)
- Failure mode and degradation analysis of actual systems
- Evaluation of new transmission systems/concepts or optimization potential on actual solutions
- Choice of further study (actual or new concept, preferred new concept)

The proposed methodology will be validated by means of simulation and tests on real parts, both on single components and on complete transmission systems. A final optimization, based on mission profile with new technology, materials, lubricants will be part of the



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| | <p>research. Further perspectives of development are represented by the definition of a methodology validation for testing and of the requirements of a test bench.</p> |
| <p>Methods and techniques that will be developed and used to carry out the research</p> | <p>The design and optimization of transmissions and mechanisms involves several competences and skills. The developed methodology will be based on the combination and integration of the following elements:</p> <ul style="list-style-type: none"> - Theory of kinematics and dynamic of different transmission systems - Analysis of failure modes - Analysis and simulation of power losses - Stress analysis and Finite Element simulation - Optimisation - Validation and testing |
| <p>Educational objectives</p> | <p>The challenges that the candidate will have to face are both theoretical and experimental:</p> <ul style="list-style-type: none"> - Perform a systematic analysis of the concepts for power transmissions, understanding their properties and application potentials - Understand the potential degradation and failure models of transmission systems and mechanisms - Define suitable models to simulate the behaviour of transmissions and to calculate their efficiency - Apply analytical and numerical stress analysis models to support the structural design of the components of a transmission system - Define and apply validation methods and tests - Apply optimisation techniques |
| <p>Job opportunities</p> | <p>Being the research carried out in the field of transmissions systems for automotive application, the primary job opportunity will be in the automotive field. In particular, automotive industries and companies providing components (brake systems, suspensions, powertrain). Also, companies involved in power transmissions for different applications represent potential job opportunities. Besides this, job opportunities will be with national and international academic and non-academic institutions and organizations, engaged in innovation, research and</p> |



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| | <p>technical development.</p> <p>Our last survey on MeccPhD Doctorates highlighted a 100% employment rate within the first year and a 35% higher salary, compared to Master of Science holders in the same field.</p> |
| Composition of the research group | <p>0 Full Professors 2 Associated Professors 0 Assistant Professors 0 PhD Students</p> |
| Name of the research directors | <p>Proff. Carlo Gorla, Roberto Palazzetti</p> |

| Contacts | |
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| <p>Phone +39 02 2399 8290 Email carlo.gorla@polimi.it, roberto.palazzetti@polimi.it</p> <p>For questions about scholarship/support please contact phd-dmec@polimi.it.</p> | |

| Additional support - Financial aid per PhD student per year (gross amount) | |
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| Housing - Foreign Students | -- |
| Housing - Out-of-town residents (more than 80Km out of Milano) | -- |

| Scholarship Increase for a period abroad | |
|-------------------------------------------------|---------|
| Amount monthly | 700.0 € |
| By number of months | 6 |

| National Operational Program for Research and Innovation | |
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| Company where the candidate will attend the stage (name and brief description) | Brembo S.p.A. |
| By number of months at the company | 6 |
| Institution or company where the candidate will spend the period abroad (name and brief description) | to be defined |
| By number of months abroad | 6 |

| Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information | |
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| <p>Financial aid is available for all PhD candidates (purchase of study books and materials, funding for participation in courses, summer schools, workshops and conferences) for a total amount of euro 5.707,13.</p> <p>Teaching assistantship: availability of funding in recognition of supporting teaching activities by the PhD candidate. There are various forms of financial aid for activities of support to the teaching practice. The PhD student is encouraged to take part in these activities, within the limits allowed</p> | |



by the regulations.