



PhD in INGEGNERIA STRUTTURALE, SISMICA, GEOTECNICA / STRUCTURAL SEISMIC AND GEOTECHNICAL ENGINEERING - 39th cycle

PNRR 117 Research Field: DEVELOPMENT OF MODELS FOR THE SIMULATION OF THE MECHANICAL BEHAVIOR OF RUBBER COMPOSITES WITH POLYMERIC CORDS

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 transition to electric vehicles, which is in line with the goals of PNRR - M2C2 on sustainable mobility, requires innovations in the area of tyre design to tackle the issue of increased vehicle weight and torque, aiming simultaneously at a reduction of rolling resistance. A good understanding of the complex mechanical behaviour of the rubber-coated fabric plies which make up the tyre structure is essential for developing high-performance innovative solutions. To this purpose, both experimental and numerical investigations on cord-elastomer composites are carried out in current research activities.

Modelling methods, which have to take into account inelastic and nonlinear behaviour of the constituent materials, are particularly valuable because they allow to predict the strains and stresses which arise in the rubber reinforced layers.

The objective of the present project is to develop mechanical models and numerical tools able to interpret the visco-elasto-plastic behavior of the polymeric cords used in tyres and of the rubber composites incorporating such cords. The models should be apt to simulate monotonic and cyclic (i.e. non-monotonic) tests on rubber reinforced composite samples, accounting also for strain rate effects.



Methods and techniques that will be developed and used to carry out the research	The project will be carried out in strict collaboration with researchers of Pirelli Tyre S.p.A., who will provide the experimental tests of the different materials. The research will require the development and implementation of different material models, of different complexity, and of analytical (possibly based on homogenization) and numerical techniques for the multiscale analysis.
Educational objectives	The Ph.D. student engaged in this project is expected to acquire the ability to tackle complex problems and to develop effective problem-tailored solution procedures.
Job opportunities	There is a growing need for post-docs with specific expertise in computational mechanics and mechanics of advanced materials applicable in different industrial contexts.
Composition of the research group	2 Full Professors 0 Associated Professors 0 Assistant Professors 2 PhD Students
Name of the research directors	Claudia Comi, Giorgio Novati

Contacts
claudia.comi@polimi.it - tel. +390223994215
giorgio.novati@polimi.it - tel. +390223994257
www.dica.polimi.it

Additional support - Financial aid per PhD student per year (gross amount)	
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	
Company where the candidate will attend the stage (name and brief description)	Pirelli Tyre S.p.A. - https://www.pirelli.com/global/en-ww/homepage/
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

List of Universities, Companies, Agencies and National or International Institutions that are cooperating in the research:

- Pirelli Tyre SpA, Milan (R&D Materials, Reinforcements Group)
- Indorama Ventures Mobility Cremona SpA, Pizzighettone (CR)
- Laboratoire de Mécanique Paris-Saclay - <https://lmps.ens-paris-saclay.fr/>

Educational activities (purchase of study books and material, funding for participation to courses, summer schools, workshops and conferences): The Ph.D. course supports the educational activities of its Ph.D. students with an additional funding equal to 10% of the scholarship, starting from the first year.

Teaching assistantship (availability of funding in recognition of support to teaching activities by the PhD student): Ph.D. students are encouraged to apply, upon prior authorization, to the calls to support teaching activities at the undergraduate and Master levels at Politecnico, being paid for that. The teaching assistantship will be limited up to about 80 hours, maximum half of them devoted to teaching and classroom activities and the rest to support classworks and exams.

Computer availability and desk availability: Each Ph.D. student has his/her own computer for individual use. Each Ph.D. student has his/her own desk, cabinet and locker.