MECHANICAL ENGINEERING

CRT/DIMEAS - Safety of future mobility vehicles: design and injury evaluation with numerical methodologies

Funded By	Dipartimento DIMEAS FONDAZIONE CRT CASSA DI RISPARMIO DI TORINO [P.iva/CF:06655250014]
Supervisor	SCATTINA ALESSANDRO - alessandro.scattina@polito.it
Contact	
Context of the research activity	Urban mobility is facing rapid evolution in the last years. Among the different topics, the introduction of the autonomous driving and of the micromobility vehicles are two of the most important ones. In this perspective, new types of vehicles are going to be used. The topic of the research will be studying the passive safety of the occupants of autonomous vehicles and of the micro-electric vehicle users.
	Urban mobility is facing a deep evolution in the recent years. Innovative types of vehicles are going to be used by road users. Autonomous vehicles and micro-electric vehicles are two of the main examples. In the autonomous vehicles, the occupants can assume whatever postures (rotated seats, standing or lying down positions). While in the most recent passenger cars and commercial vehicles the passive safety level could be considered acceptable, the protection of the occupants in new cockpit configurations is something new and it has to be deeply investigated. In any case, active systems used by the autonomous vehicles cannot ensure a zero-accident scenario at least in the near future, where a mixed environment will be made with traditional and autonomous vehicles. Considering micromobility, a wide range of innovative vehicles are used today and will be introduced in the close future in the urban environment: from cargo bike and general human powered wheeled cycles, to electric kick scooters and electric single-occupant vehicles. Safety of these new categories of vehicles in case of accident has to be quite completely studied considering that, on one side, these vehicles have been recently introduced (still without specific regulations in many cases) and they don't have active systems. On the other side, there is a general deficiency of safety for the category of vulnerable road users which, moreover, cannot have or wear active devices. In this complex framework, the research activity will focus on the study of the passive and vulnerable road users safety of the future mobility vehicles above mentioned. The studies will be carried out by means of virtual instruments. In particular, finite element simulations will be used. This powerful instrument will allow to replay accident scenarios in virtual environment.

Objectives	Moreover, advanced instruments in finite element environment like Human Body Models, will be used to study the injuries of vehicle's occupants and vulnerable road users in several accident scenarios. The analysis will allow to define innovative solutions for the design of future mobility vehicles. Therefore, among the main activities and objectives of the Ph.D. program, there are: • Definition of a solid background about the future mobility (smart cities, autonomous driving, urban mobility) • Literature review about the passive safety of autonomous vehicles: vehicles and passenger configurations, injuries evaluation and injury criteria, safety devices • Literature review about innovative vehicles: human powered vehicles and electric small vehicles: o Investigations on structural aspects and safety design criteria o Passive safety level o Accident scenarios o Injuries and injury criteria • Definition of passive safety level of vehicles for future mobility • Definition of priorities to be investigated • Definition and/or development of finite element (FE) models of innovative vehicles for future mobility • Implementation of FE vehicles models and human models for simulation of accident scenarios • Study of injuries on priority scenarios previously defined with the developed FE models • Definition of design criteria for improvement of vehicle passive safety for future mobility. For this purpose, design modifications on actual solutions and possible introduction of innovative safety devices will be evaluated mainly by means of FE simulations • Dissemination of the research activities and results: participation to international conferences and writing of high-quality papers submitted to peer review journals or conferences • Writing of Ph.D. final thesis Priorities will be established considering the starting scenario and the first obtained results in collaboration with other research groups (inside and outside Politecnico di Torino) and possible involved companies. The research will be carried out at the Politecnico di Torino. Different aspects of the research topics could be investigated during abroad period in foreign research institutes taking advantage of different points of view and under the supervision of acknowledged researchers.

Skills and competencies for the development of the activity	The ideal candidate should have: • Solid background in MSc Degree in Mechanical or Vehicle Engineering • Solid background or competences in numerical modelling and simulation tools for nonlinear finite element simulations • Basic knowledge about injuries evaluation • Background and knowledge in vehicle design (mainly structural aspects) • Multidisciplinary approach to research activities and problem-solving skills