PhD in Mechanical Engineering

Research Title: Active chassis control systems

Funded by	SILK-FAW

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Context of the research activity	The research develops in the framework of the between Politecnico di Torino and SILK FAW, a leader in high performance electric vehicles. The general topic is that of the vehicle control systems. The electrification of automotive systems is an ongoing evolving effort, whose impact is affecting not only the powertrain but also the chassis. Apart from the benefit in terms of better actuation efficiency, comparted to the more conventional hydraulic or pneumatic actuation, the electromechanical actuation simplifies the system layout as it requires just electrical cabling and the connection to the vehicle onboard network to allow a centralised control. The benefit is even more evident in case of BEV. Additionally electromechanical actuation allows to convert in electricity the mechanical energy during the passive actuation phases. If this energy is locally used in the active phases, the benefit is of lower energy needs, additionally each actuator can be autonomous, and its operation does not require power cabling to the vehicle. Politecnico di Torino has strong experience in electromechanical and electro-hydrostatic actuation systems for the following applications: regenerative shock absorbers, fast and slow acting height adjustment systems, 4-wheel steering actuators. These actuation systems can be (in part or all) integrated in a

	smart corner. From the control point of view the centralised control of the four smart corners can lead to benefits in terms of: • Better handling and safety in case of limit conditions. • The knowledge of each actuator effort and feedback variables allow a better knowledge of the tire operation. • Better occupant comfort due to the possibility to adapt the suspension damping according to the driving conditions. • Lower fuel consumption due to the possibility to adapt the ground clearance as function of the road conditions. The smart corner concept enables a revision of the suspension system. Just to make an example, rotary electromechanical shock absorbers can be integrated in the rocker of a typical push rod suspension thus allowing to remove the conventional hydraulic damper. The benefits that can be obtained by a smart corner system can be particularly attractive in BEV vehicles to reduce the negative effect in terms of handling and energy requirement of a larger vehicle mass. These benefits are even larger in case of a high-performance vehicle as they can improve the vehicle stability in limit or wrong manoeuvres.
Objectives	Considering the above-mentioned context, the objectives of the research are • Vehicle and system specifications and expected performances. • Trade-off between actuation configurations for smart corner • Smart corner hardware design • Smart corner control desing • Construction and laboratory tests. • Vehicle tests.
Skills and competencies for the development of the activity	Knowledge of vehicle dynamics and vehicle dynamics simulation, modelling of mechatronic systems, control systems design.