

DA CONSEGNARE AL COORDINATORE DEL CORSO PER LA PRESENTAZIONE DEL DOTTORANDO AL GIUDIZIO DEL COLLEGIO DEI DOCENTI IN VISTA DELL'ESAME FINALE

SCHEMA INFORMATIVA SULLE ATTIVITA' DEL TRIENNIO

- Cognome e NomeXU YIJUN.....
- Titolo di studio posseduto.....Mater in Automotive Engineering.....
conseguito in data10/2014..... presso l'Università/Politecnico diTorino.....
- Dottorato di Ricerca inMechanical Engineering.....
- Ciclo30..... Anni accademici di riferimento.....2014/2015.....2015/2016.....2016/2017....
- Dipartimento
.....Dipartimento di INGEGNERIA MECCANICA E AEROSPAZIALE (DIMEAS).....
- Coordinatore
.....Prof. LUIGI GARIBALDI.....
- Tutore
.....Prof. NICOLA AMATI.....

Titolo della Tesi di Ricerca (in Italiano e/o in Inglese).....
Design and characterization for regenerative shock absorbers.....
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A. DESCRIZIONE DELL' ARGOMENTO DELLA TESI (massimo 20 righe)

The trend of reducing the emissions in automotive sector leads the development of electrification of vehicle powertrain and chassis. Those vehicles equipped with regenerative shock absorber can transfer the vibrational energy coming through the road irregularities into electricity which can be further used for other purposes for example to charge the battery. To realize the regenerate target, the developed devices should be able to vary their damping behaviors while converting part of the dissipated power into electricity. Thus an electric machine together with a suitable transmission system need to be integrated into the vehicle. Several different solutions have been investigated during the last few decades and the present thesis describes one hydraulic regenerative suspension. The hydraulic shock absorber with controllable damping and energy harvesting features employ the electrohydrostatic actuation principle, use a hydraulic actuator directly interfaced to a motor-pump unit by means of a hydraulic circuit to convert the linear motion of the piston into rotation. As the core component of the hydraulic regenerative damper, the performance of the motor-pump unit heavily influences the energy harvesting capability. In order to maximize the energy regeneration, the hydraulic, mechanical and electric subsystems must be integrated and optimized as an entire system. The thesis establishes a novel system-level approach that investigates the role of different design aspects on the performance of the motor-pump group which is entirely designed to guarantee

damping and energy harvesting features, while complying with important design constraints such as envelop and supply voltage and this approach can be extended to any motor-pump unit for hydraulic regenerative dampers.

B. ATTIVITA' DI RICERCA SVOLTA NEL TRIENNIO
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B.1 descrizione complessiva e sintetica dell'attività di ricerca

The research activities during my PhD period are mainly focused on the topic of electrification of vehicle powertrain accessories and chassis. The goal is to eliminate the traditional belt-drive system by using electric machines, in this way we can have a better control of these accessories and to avoid them running all the time, therefore a noticeable energy can be saved and the efficiency of the internal combustion engine can be further improved. Regarding the electrification of the chassis, the regenerative shock absorbers which can vary their damping behaviors can convert the otherwise-dissipated power coming from the road irregularities into electricity to charge the battery, in this way the emission of the vehicle can be further reduced while the handling and comfort are still guaranteed.

B.2 argomenti di ricerca specifici affrontati

For the electrification of the powertrain accessories, an electric water pump is developed. Instead of using permanent magnetic motor (PM), the pump is driven by a hysteresis motor (HM). Compared with PM motors, HM uses semi-hard magnetic materials which has comparable magnetic property as permanent magnetic materials and much better mechanical features such as high mechanical strength and operating temperatures. Therefore it is considered very suitable for high speed and temperature applications. For the electrification of the chassis, a hydraulic regenerative shock absorber is developed, a novel system-level approach is established to design the motor-pump unit which is also the core component of the regenerative damper. The approach is based on the efficiency analysis of the hydraulic, mechanical and electric domain in order to maximize the total efficiency and therefore the regenerative capacity of the system.

B.3 risultati più rilevanti ottenuti nel triennio

In the past three years, I have attended some courses and seminars held by Politecnico and also participate in some projects in our lab. From which I improved my personal knowledge and skills. The prototypes we developed for these projects are successfully built and tested, the experimental results are validated and the final prototypes are reliable and have been delivered to our industrial partner.

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B.4 collaborazioni di ricerca avute con Università, Centri di ricerca ed Industrie nazionali ed internazionali (specificare il quadro entro cui sono avvenute: contratti di ricerca, periodi di formazione, ecc.)

I have participate in the project of Regenerative shock absorber between Politecnico di Torino Mechatronics Lab (LIM) and Magneti Marelli

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B.5 ulteriori attività di ricerca (progetti e contratti di ricerca nazionali ed internazionali)

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B. 6 brevetti conseguenti l'attività di ricerca

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B. 7 altre attività che si ritengono degne di menzione

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C. ATTIVITA' DI FORMAZIONE

C.1 partecipazione ad attività interne di supporto alla didattica (specificare su quali corsi, e se eventualmente il dottorando sia stato nominato cultore della materia)

I had the chance to support the professor with the course Machine design in Mechanical Engineering and Chassis design in Automotive Engineering, to show the student some experimental testing such as impact test.

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C.2 corsi e seminari più significativi seguiti (interni, esterni, ecc. - indicare solo il tipo ed il numero)

Hard skill courses Total Hours: 123
Soft skill courses Total Hours: 45
Seminar "Past, Present and Future of Turbocharging" Total Hours: 5
Summer School "Multi-domain modeling of mechatronic systems for more electric vehicles"

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C.3 periodi di formazione esterni al Politecnico (tipo di formazione, luogo e durata)

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D. PUBBLICAZIONI FATTE E IN CORSO (indicarne il numero e il tipo: riviste nazionali ed internazionali, congressi, capitoli libri ecc.)

Title: Optimized design and characterization of motor-pump unit for energy-regenerative shock absorbers

Authors: Renato Galluzzi, Yijun Xu, Nicola Amati, Andrea Tonoli

Journal: Applied Energy (Elsevier)

The paper is under review

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Data,

05/10/2017


(firma del dottorando)