ALL. B

STUDENTS' ANNUAL ACTIVITY REPORT CYCLE XXXV YEAR 2019/2020

- Name and Surname **IRFAN KHAN**
- Dottorato in **Mechanical Engineering (XXXV Cycle)**
- Department **Department of Mechanical and Aerospace Engineering (DIMEAS)**
- Coordinator **Prof. Luca GOGLIO**
- Tutor **Prof. Andrea TONOLI**
- Macroarea

  Powertrain electrification

- Short description of research activity (maximum 20 lines)

  Increasing concerns about global warming as well as oil and resource depletion have led to more stringent regulations linked to fuel economy, emissions, and energy conservation. In the automotive industry, this has created an incentive to focus efforts on alternative powertrain technologies.
  In this context, fully electric, hybrid and plug-in hybrid electric vehicles (BEVs, HEVs, PHEVs) have gained an increasing momentum in the market. Several hybrid architectures are available in the market and are object of study and research. While autonomous vehicle technologies are also gaining a lot of attention from academia and industry. Hence, opening a lot of research opportunities. The research work is mainly focused on:

  - **The development of P2 and P4 integrated hybrid architectures in cooperation with the industrial partner Physis New Energy Technology srl, in the framework of the activities of the Interdepartmental Center CARS (Center for Automotive Research and Sustainable Mobility) of Politecnico di Torino.**
  - **Study of possible failure modes or accelerated wear of crankshaft bearings in P2.5 Hybrid architecture. (FCA-CRF)**
  - **Design, construction and implementation of steering and braking actuators for automated vehicles.**
  - **Study, design and implementation of the control strategies for automated racing vehicles to improve the performance.**

- Training activities carried out during the year (courses, seminars, etc.); for each activity specify the nature, duration, and location
  1. **01UJJRO- Automotive transmissions (manual, non-manual and hybrid) (20 hours – Hard skills, Politecnico di Torino)**
  2. **03OYCIV - Hybrid propulsion systems (15 hours – Hard skills, Politecnico di Torino)**
  3. **01LCPRV - Experimental modeling: costruzione di modelli da dati sperimentali (33 hours – Hard skills, Politecnico di Torino)**
  4. **01QORRO - Writing Scientific Papers in English (15 hours – Soft skills, Politecnico di Torino)**
  5. **01SWPRO - Time management (2 hours – Soft skills, Politecnico di Torino)**
  6. **FSG Formula Driverless Waymo Academy (15 hours, Webinar)**
  7. **Regulation 1151 – WLTC Cycle, Prof. F Cavallino (15 hours, Online training)**
  8. **Simdrive training from DAYCO (20 hours, Online training)**

- Possible participation in further research activities during the year (research projects and agreements)

  - **Instrumentation and testing of the steering and braking actuators for an electric racing vehicle participating in the Formula Student championship for the Driverless category to test the developed algorithms on the racetrack.**

  - **Study and integrated design of an innovative e-axle (P4) in collaboration with Physis New Energy Technology srl.**

  - **Instrumentation and testing for the detection of possible failure modes or accelerated wear of crankshaft bearings in P2.5 Hybrid architecture with FCA-CRF.**

- Possible participation in internal activities to support teaching during the year (specify on which courses, named as “subject expert”)

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- Stays at other research institutions during the year

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- Collaborations with companies during the year

  FCA-CRF

  - **Study of possible failure modes or accelerated wear of crankshaft bearings in P2.5 Hybrid architecture.**

  Physis New Energy Technology srl.

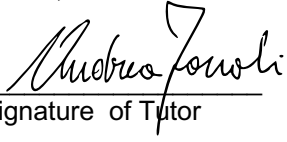
  - **The investigation of the most promising P2 solution in terms of packaging, reliability, performances in traction and in regenerative braking.**

- List of accepted papers

  1. **Irfan Khan, Stefano Feraco, Angelo Bonfitto, and Nicola Amati. " A Model Predictive Control Strategy for Lateral and Longitudinal Dynamics in Autonomous Driving." *Proceedings of the ASME 2020 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference,* 22nd International Conference on Advanced Vehicle Technologies (AVT). (Accepted for publication - DETC2020-22287*)*.**

  2. **Stefano Feraco, Angelo Bonfitto, Irfan Khan, Nicola Amati, and Andrea Tonoli. " Optimal Trajectory Generation Using an Improved Probabilistic Road Map Algorithm for Autonomous Driving." *Proceedings of the ASME 2020 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference,* 22nd International Conference on Advanced Vehicle Technologies (AVT). (Accepted for publication - DETC2020-22311).**

Torino, 17/09/2020



Signature of Tutor

Signature of the Phd student

The Coordinator

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