PhD in Computer and Control Engineering

Research Title:

Sensor system integration through AI

Funded by	SILK - FAW

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Context of the research activity	The recent developments of Automotive require a tight interaction of control software with sensors to monitor the evolution of the mechanical and electrical equipment and to be at the same time aware of the evolution of the surrounding environment. In this perspective, the adoption of sensors (both physical and virtual) and their integration through monitoring models is crucial to improve the effectiveness of both the production plan and the quality of the vehicle under design, to allow run time monitoring and reaction. Such a coupled interdependency between cyber (that gathers data from the environment to apply algorithms) and physical (that reacts to the decisions of the cyber portion) typically exploits AI and Machine Learning to create models that are aware of the past evolution of the plant/vehicle under analysis and that can automatically adjust to the evolving conditions during operation. This approach complements the presence of top-down models relying on formal and physical descriptions of equipment behavior, to improve awareness and monitoring. The joint application of such techniques, together with the other Industry 4.0 enabling technologies (big data, IoT, …) allow to improve the production, design and maintenance processes, foresee the evolution of the automotive system (plant or vehicle), apply energy optimizations and estimate its future evolution.

Objectives	The objectives of the Ph.D. plan are the following: • Developing the competences on the physical systems modeling, including machine learning approaches and simulation languages like SystemC-AMS and Simulink • Sensor integration and communication to enable data collection • Identifying modeling solutions available at state of the art suitable for the identified automotive scenario to make a critical analysis of the current solutions and of their limitations • Providing top-down and bottom-up modeling solutions for a specific automotive case study, to allow energy efficiency optimization and state of health improvement of the monitored system, identifying a scalable

	and effective trade off between simulation accuracy and real time simulation speed

Skills and competencies for the development of the activity	• Machine learning and AI techniques • Basics of Internet of Things protocols and communication • Basics of sensors and data collection