

COMPUTER AND CONTROL ENGINEERING

Machine Learning for in-VEhicle Context Awareness

| | |
|---|--|
| Funded By | CENTRO RICERCHE FIAT [Piva/CF:07084560015] Ministero dell'Università e della Ricerca - MUR [Piva/CF:96446770586] |
| Supervisor | CERQUITELLI TANIA - tania.cerquitelli@polito.it |
| Contact | Marco Marchetti |
| Context of the research activity | <p>The research challenge is to identify relevant vehicle contexts based on data collected using a multimodal sensing approach (on-board sensors, off-board information, user profile data, external and internal vehicle context) to provide actionable knowledge to drivers and passengers. Therefore, the Ph.D. student will define a methodology for a multi-sensor digital vehicle framework, able to collect data from heterogeneous sensors and support sensor fusion and various AI/ML applications.</p> |
| | <p>The digitization of the automotive sector is accelerating the technological convergence of data processing, connectivity, and data analytics for electric, connected, autonomous, and shared vehicles. This is introducing new data processing paradigms with embedded cognitive capabilities into vehicle domains and data infrastructures to enable new mobility applications. Vehicles are being developed with cognitive capabilities to support contextual decision-making, and innovative machine learning solutions are needed to develop vehicles that are better tailored to user needs. From the final user perspective and related services, the transition from L3 to L4 automation levels will create over time a new user called “drivenger” or “drissenger” (driver + passenger), and the life on board will change completely.</p> <p>The research challenge is to identify relevant vehicle contexts based on data collected using a multimodal sensing approach (on-board sensors, environmental data, off-board information, user profile data, external and internal vehicle context) to provide actionable knowledge to drivers and passengers.</p> <p>Therefore, the Ph.D. student will explore the possibility to define a methodology for a multi-sensor digital framework for vehicles, able to collect data from heterogeneous sensors and support sensor fusion and various AI/ML applications. An important project focus is also the abstraction layer</p> |

| | |
|--------------------------|--|
| <p>Objectives</p> | <p>over the raw data for easy integration into applications and services. The research activities will propose new data analytics solutions for data fusion, feature engineering and data interpretation, scenario/context characterization and modeling, and concept deviation and object shift detection over time.</p> <p>Specifically, this study aims to study innovative data analysis services for in-vehicle context awareness through machine learning methods. Several but strongly interrelated research objectives (RO) should be pursued to achieve this goal.</p> <p>RO1. Automatically process raw data collected from an in-vehicle or fleet with information describing the external environment to augment cognitive capabilities of vehicles in support of contextual decision making, i.e.:</p> <ul style="list-style-type: none"> ++ RO1a. How can novel data fusion techniques be defined to provide a global view of vehicle? ++ RO1b How to model automotive contexts using a multimodal sensing approach (on-board sensors, environmental data, off-board information, user profile data, etc.) to provide relevant content and functionality to the driver and passengers. ++ RO1c. Whether machine learning algorithms can overcome data cleaning issues and provide opportunistic and specific results to support in-vehicle context-aware applications ++ RO1d. To what extent are in-vehicle data collections suitable for learning pre-trained models that can be conveniently tuned to specific tasks (e.g., context modeling and categorization, predictive maintenance based on vehicle activities and driving situations). <p>RO2. Improve learning capabilities leveraging end-user feedback.</p> <p>RO3. Study a conversational interface to explore the capabilities of proposed machine learning tools for in-vehicle context-awareness together with user feedback.</p> <p>RO4. Benchmark and evaluate the proposed system with different vehicles/fleets.</p> <p>The above objectives open a broad multidisciplinary research landscape that touches core aspects of machine learning research for Industry 4.0 applications and the automotive sector. The study will advance the application of a machine learning methodology for processing raw input text, categorizing application context, modeling vehicle contexts, and supporting decision-making.</p> <p>A further focus is the continuously learns from user feedback and interactions to improve the system's adaptability by using new data to enhance the ability of the proposed data-driven approach to improve overall performance.</p> |
|--------------------------|--|

| | |
|---|--|
| <p>Skills and competencies for the development of the activity</p> | <p>Sensor-based applications, experiences related to data-driven applications in the automotive sector, data science methods, and machine learning algorithms.</p> |
|---|--|