RAILS - Roadmaps for A.I. integration in the raiL Sector

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Abstract:

The overall objective of the RAILS research project is to investigate the potential of Artificial Intelligence (A.I.) approaches in the rail sector and contribute to the definition of roadmaps for future research in next generation signalling systems, operational intelligence, and network management. RAILS will address the training of PhD students to support the research capacity in A.I. within the rail sector across Europe by involving research institutions in four different countries (Italy, UK, Netherlands, and Sweden), with a combined background in both computer science and transportation systems.

RAILS will produce knowledge, ground breaking research and experimental proof-of-concepts for the adoption of A.I. in rail automation, predictive maintenance and defect detection, traffic planning and capacity optimization. As such, RAILS will effectively contribute to the design and implementation of smarter railways.

To that aim, RAILS will combine A.I. paradigms like Machine Learning with the Internet of Things (IoT), in order to leverage on the big amount of data generated by smart sensors and applications. The research activities will be conducted in continuity with ongoing research in railways, in particular within the Shift2Rail innovation program, and it will be based on in-depth analysis of A.I. applications in transport and other relevant sectors in order to perform a transferability study of available results to railways.

The methodological and technological concepts developed in RAILS are expected to stimulate further innovation in railways providing new research directions to improve reliability, maintainability, safety, security, and performance. With respect to safety related aspects, emerging threats (e.g. the so called "adversarial attacks") and certification issues will be addressed when adopting A.I. in autonomous and cooperative driving (e.g. "Virtual Coupling"), based on the concepts of "explainable A.I." (XAI) and "Trustworthy A.I.". With respect to cyber-physical threat detection, innovative approaches will be developed based on A.I. models like Artificial Neural Networks (ANN) and Bayesian Networks together with multi-sensor data fusion and artificial vision. Resilience and optimization techniques based on genetic algorithms and self-healing will be addressed to face failures and service disruptions as well as to increase efficiency and line capacity. All those techniques will pave the way to the development of the new "Railway 4.0".

Contact:

Prof. Valeria Vittorini, University of Naples Federico II (CINI), valeria.vittorini@unina.it (coordinator)

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