CERIS: Civil Engineering Research and Innovation for Sustainability

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Summary

The present project aimed to develop different components, tools and systems that increase the competitiveness and quality of the rail transport service.

The predictable aggravation of environmental (essentially pollution and saturation of the road system) and energy (scarcity and increase in the price of oil) constraints has led the European Commission to strongly recommend the increase in the share of rail transport compared to road transport to be encouraged, to ensure the sustainability of transport systems in the European Union.

As one of the most efficient means of transport from an energy and environmental point of view, it is necessary to increase the competitiveness and attractiveness of the railway, eliminating constraints and reducing costs in operations and communications, monitoring the state of the assets (infrastructure and rolling stock), for a more predictive maintenance and uninterrupted operation, operating in a more energy efficient way and providing solutions capable of attracting more passengers and goods.

Main objective

Develop different components, tools and systems, to be tested in real vehicles and infrastructure, that increase the competitiveness and quality of the rail transport service and that are oriented for:

- The sustainability of the railway system – promoting energy efficiency, circular economy and reducing the environmental footprint, while contributing to attracting more passengers for this mode of transport;

- The reduction of operating and maintenance costs – promoting monitoring of the railway system, in order to avoid failures and consequent downtime and to optimize the life cycle of equipment (predictive maintenance);

- The enhancement of reliable information systems to support decision-making in asset management – integrating different data sources, both in rolling stock and in infrastructure;

- Traffic safety – promoting monitoring of the safety conditions in the use of infrastructure and rolling stock and the creation of alert systems to trigger protection/intervention actions.
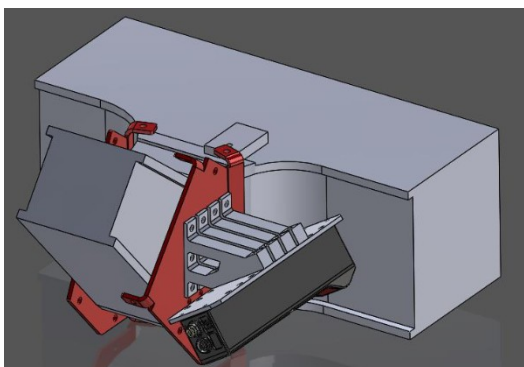

Figure 1. Rail monitoring sensor support.

Project activities and main results

PPS 1 – Sustainability of the railway system

- Development of monitoring and network energy processing solutions;

- Development of algorithms, the computational application and respective interfaces of the Ecodriving system;

- Development of reconfigurable storage systems suitable to the train and electrical substation micro-network;

- Development of light, sustainable and smart railway interior solutions;

- Demonstration and validation of the prototype in a laboratory and a real environment.

PPS 2 – Maintenance solutions

- Definition of the technical and functional requirements of the (online) management mechanism for the maintenance and monitoring of rolling stock and infrastructure;

- Development of the remote monitoring box prototype and mechanisms for generating indicators and alarms to be processed by the decision platform;

- Demonstration and validate the prototype in the laboratory and later in a real environment.

PPS 3 – Management and alert platforms for critical safety events

- Design, develop and demonstrate a new system for advanced detection of dangerous events for rail traffic;

- Design, develop and demonstrate a new automatic warning system to the driver and/or railway command centre, without operator intervention;

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- Integration of a sensing system with a real-time verification system using field visualization devices (drones);

- Validation solutions in a real operating context.

PPS 4 – Communications and cybersecurity

- Design and develop a monitoring system (sensors, geolocation devices, identifiers, embedded computing units), and respective communication and power modules;

- Design and develop a gateway that takes advantage of existing advantages in new mobile communication technologies;

- Design and develop a set of cybersecurity technologies, methodologies and procedures;

- Development of an Edge Computing platform, capable of implementing different data pre-processing services

PPS 5 – Valorisation and integrated dissemination of project results

- Promote the wide dissemination of the project results to the scientific community and the market;

- Publish technical and scientific articles in specialist journals and conferences;

- Ensure an integrated approach in disseminating and valuing project results.

Figure 2. Vibration Tests of the prototype seat skeleton.

Figure 3. Interface of the eco-driving system.