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MONITORING THE STATE OF RAILWAY INFRASTRUCTURE FROM SATELLITE USING IMAGE  
ANALYSIS TECHNIQUES AND ARTIFICIAL INTELLIGENCE FOR ANOMALY DETECTION

**Abstract**

The railway infrastructure is one of the pillars of the European mobility and transport sector. This infrastructure is the environmentally friendly backbone of a large part of the flow of goods and people along the peninsula. At the same time, railways require constant and precise maintenance over a large territory, which is often complicated to carry out and requires a substantial economic effort and expert commitment. In this regard, predictive maintenance through remote monitoring enabled by Earth Observation satellite imagery represents a powerful tool for limiting costs and automating maintenance and intervention activities. The aim of the E. Amaldi Foundation research project 'Monitoring the state of the railway infrastructure by satellite' for one of the major railway infrastructure managers in Europe involved the identification and monitoring of three main issues defined by current regulations: Hydrogeological Risk, Vegetation Monitoring and Control, and Building Monitoring. To address these issues, several analyses were performed each based on medium and high-resolution satellite images together with processing techniques and artificial intelligence. In this project, data from Sentinel-1, Sentinel-2 and Cosmo-SkyMed were analysed to monitor hydrogeological risk, flood-prone areas, flooded areas, vegetation in proximity to railway tracks and unauthorised buildings. Supervised neural network models involved in the analysis were trained on a large dataset including the above mentioned issues and the results then validated in specific areas identified by the customer. The study demonstrated how, through satellite images processed by deep learning algorithms and other image processing techniques, it is possible to automatically identify potential areas of risk for rail transit safety. The aim of this paper is to show the main results obtained and the customers expectation from the application of such models on satellite images, highlighting the business application potential and opportunities that these techniques entail.