OCTAVE

Object detection and Classification moniToring system to increAse safety in railway Vehicles

Programm / Ausschreibung	Digitale Technologien, Digitale Technologien, AI for Green 2023	**Status**	laufend
Projektstart	01.06.2024	**Projektende**	31.05.2026
Zeitraum	2024 - 2026	**Projektlaufzeit**	24 Monate
Keywords	railway infrastructure monitoring; AI methods; cloud-based and onboard system; sensor data		

Projektbeschreibung

OCTAVE (Object detection and Classification moniToring system to increAse safety in railway VEhicles) ist ein Forschungsprojekt, das darauf abzielt, den dringenden Bedarf einer modernen Gesellschaft an einem kosteneffizienten, sicheren und zuverlässigen Eisenbahnbetrieb durch ein onboard- und cloudbasiertes Infrastrukturüberwachungssystem zu decken. Das übergeordnete Ziel ist die Schaffung einer Lösung für Eisenbahninfrastrukturbetreiber zur automatischen Erkennung von Infrastrukturproblemen und zur Analyse der gesammelten Daten mit Hilfe von KI-basierten Methoden, um einen menschlichen Bediener bei der Entscheidungsfindung betreffend Instandhaltung zu unterstützen. Mit intelligenten Methoden zur Klassifizierung von Anomalien und der Zuweisung von Severity-Levels in einer Feedback-Loop, einer leicht integrierbaren Architektur in bestehende Incident & Crisis Management Systeme, einer flexiblen Cloud-Architektur und einer Low-Power Onboard-Hardware bietet die Lösung modulare und innovative Bausteine für den sicheren Einsatz in sicherheitskritischen Umgebungen. Die Forschungsergebnisse werden evaluiert und validiert unter Verwendung realer und synthetischer, im Rahmen des Projekts generierter Datensätze, rigoros getestet.

Abstract

OCTAVE (Object detection and Classification moniToring system to increAse safety in railway VEhicles) is a research project that aims to meet the pressing need of a modern society for cost-efficient, safe, and reliable railway operations using an onboard & cloud-based infrastructure monitoring system. The overarching goal is to create a solution for railway infrastructure operators to automatically detect infrastructure problems and analyse the colllected data using AI-based methods to support a human operator in the maintenance decision making process. Using intelligent anomaly classification methods and assignment of severity levels in a feedback loop, an easily integrable architecture into existing incident and crisis management systems, a flexible cloud architecture and a low-power onboard hardware, the solution provides modular and innovative building blocks for usage in safety-critical environments. The research results will be evaluated and validated, and rigorously tested using real and synthetic in the project generated datasets.

Endberichtkurzfassung

The OCTAVE project developed a holistic, AI-driven system for continuous, automated monitoring of railway infrastructure

using cameras mounted on regular trains. At its core is VADAR, a modular onboard anomaly detection framework that processes live cabin-view images to autonomously identify rail damages, trackbed foreign objects, lineside vegetation encroachment, and vandalism such as graffiti in real-time. To overcome the obstacle of scarce real-world anomaly data, the project pioneered two synthetic data generation methodologies: SYNAD, which inserts physically realistic 3D-modelled objects into real images, and SYNAGEN, which generates pixel-level anomalies for training dataset enrichment. Field tests on a live train demonstrated high detection performance at very low false positive rates, running in real time on energy-efficient embedded hardware. Detected anomalies are automatically enriched with metadata, such as geographic coordinates, timestamps, and classification and forwarded via a cloud-based backend to an Incident Management System, where a purpose-built remote analyst interface enables authorised operators to review, annotate, and manage incidents with a fully auditable record. The project's results lay a direct foundation for predictive maintenance at scale, reducing unnecessary inspection costs and supporting the broader European modal shift toward rail as the most climate-friendly mode of transport.

Projektkoordinator

- Mission Embedded GmbH

Projektpartner

- Technische Universität Wien
- CNS-Solutions & Support GmbH