AREA.AI

Adaptive Robust Low-Emission Autonomous Transport System for AI-Supported Resource Extraction

A secure and sustainable supply of raw materials is one of the major societal challenges of our time. In the context of ensuring supply security, quality, and meeting growing demands, the concept of sustainability is increasingly focusing on achieving environmentally friendly, socially accepted, responsible, and economically feasible mining practices. Key challenges for essential domestic extraction operations include reducing CO2 emissions, addressing skilled labor shortages, and gaining social acceptance for mining activities.

A significant solution approach and a future imperative to meet these growing challenges is the deployment of intelligent autonomous systems in mineral extraction, coupled with their electrification. However, implementation has been constrained by technical and technological limitations. This is where the project AREA.AI comes in.

AREA.AI aims to make a significant contribution by developing and demonstrating a transport system capable of operating safely in evolving mining environments and in mixed traffic conditions without costly infrastructure. It integrates emissions-reducing and energy-saving technologies into vehicle behavior and fleet management. This initiative directly enhances workplace safety, health, and quality, addresses skilled labor shortages, integrates resource-efficient AI, and establishes foundations for CO2-free transportation towards future mineral extraction.

Key themes addressed by AMT in the project include:

Safety in Autonomous Mixed Traffic: Immediate conversion to autonomous vehicles is unrealistic for SMEs. Focus areas of AREA.AI are therefore measures and technologies for safe mixed traffic operations involving both autonomous and manual interactions. This involves investigating necessary regulatory and operational requirements, conducting tests, and evaluating Collision Avoidance Systems (CAS). Another focus is on developing concepts for Autonomous Mixed Operation Zones (AMOZ) and designing suitable Human-Machine Interfaces (HMI) to enhance safety in mixed traffic scenarios. The project advances technical implementation and practical demonstration of these technologies, alongside engaging relevant stakeholders.

Evaluation of Communication Technologies: Dimensioning wireless networks poses a significant challenge in introducing digital technologies in mining. Within AREA.AI, the project investigates the physical behavior of radio technologies in mining environments to develop simulation approaches for optimizing radio communication. This includes researching the functionality of various radio technologies, evaluating and improving existing simulation models. The goal is developing a software model for simulating wave propagation in mining environments enabling the prediction and optimization of radio connections, enhancing the efficiency and safety of digital technologies in mining.

Ecological Analysis of CO2 Savings Potential in Electrified Vehicle Fleets: The project conducts an ecological analysis of electric propulsion concepts for mining machinery, comparing CO2 savings potential against conventional diesel-powered vehicles. The analysis considers defined use cases, renewable energy availability, electricity mix, operational capacity, and fleet composition. Its objective is to assess the ecological impacts of electrification in mining and develop scenarios for potential CO2 savings.

These efforts under AREA.AI underscore a proactive approach towards sustainable and technologically advanced mineral extraction, aiming to address current and future challenges while promoting environmental responsibility and operational efficiency in the mining sector.