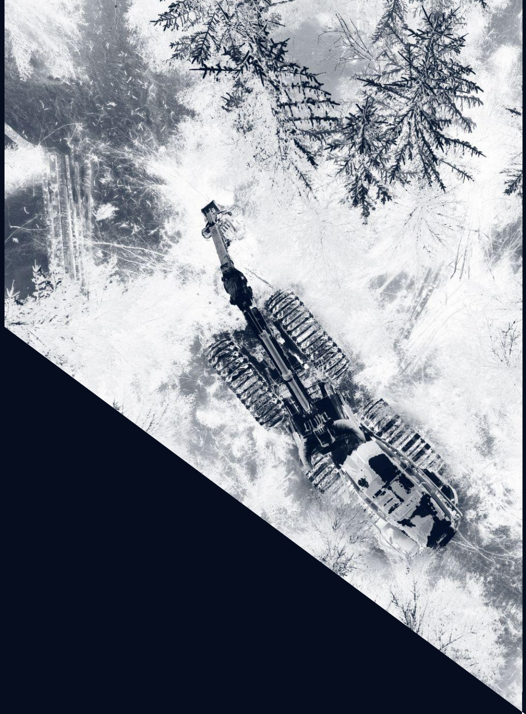
DEMONSTRATION OVERVIEW

Artificial Intelligence Systems



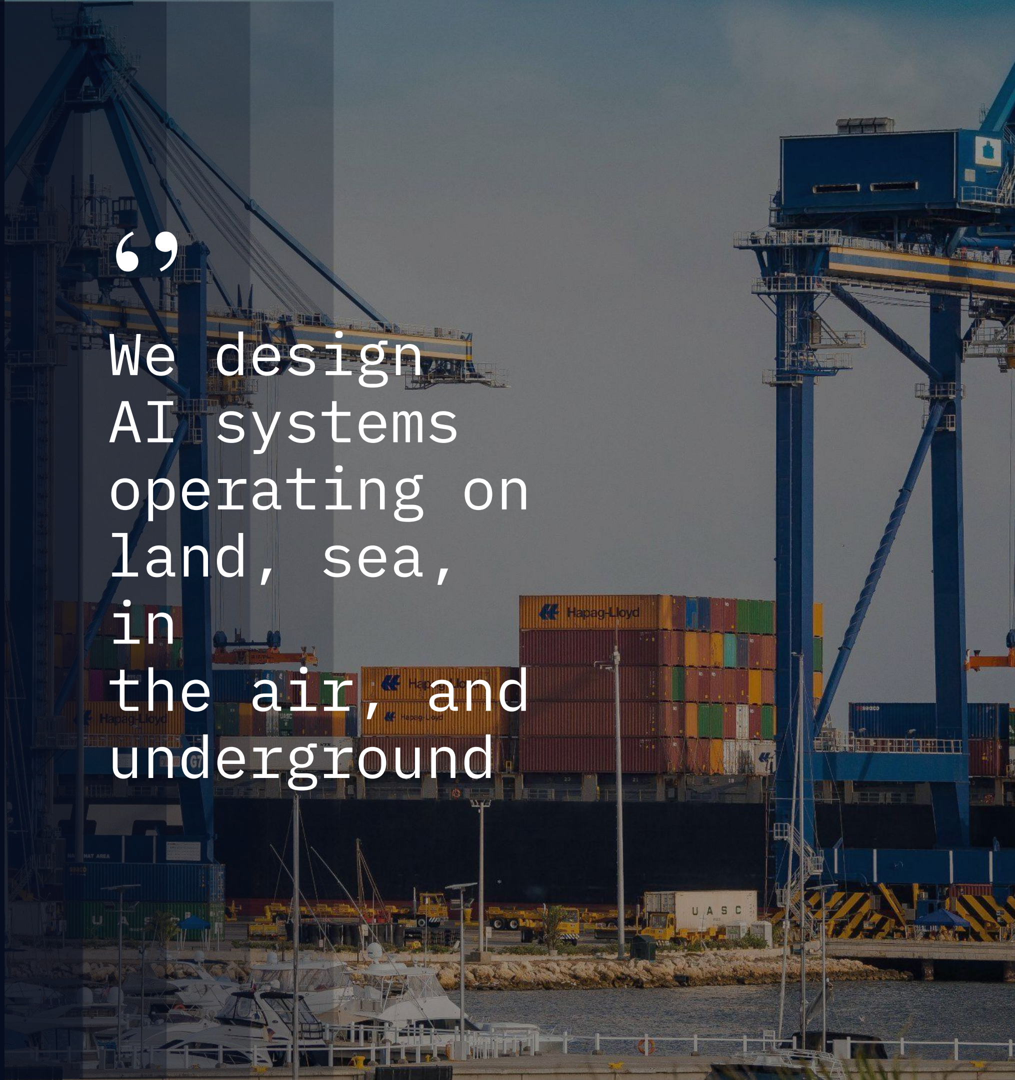
emblica

Our Mission

To pioneer the next generation of artificial intelligence for the world's most demanding environments.

To create intelligent systems that give our partners a critical advantage, by tailoring world-class AI to their unique challenges, wherever they operate. We are committed to building the future with integrity, partnership, and a relentless focus on quality.

We design and develop AI systems for our customers operating on land, sea, in the air, and underground. We don't deliver one-size-fits-all products. Instead, we work closely with our customers to understand their needs and develop systems that solve real problems and help them stay ahead in their field.



> "We design AI systems operating on land, sea, in the air, and underground

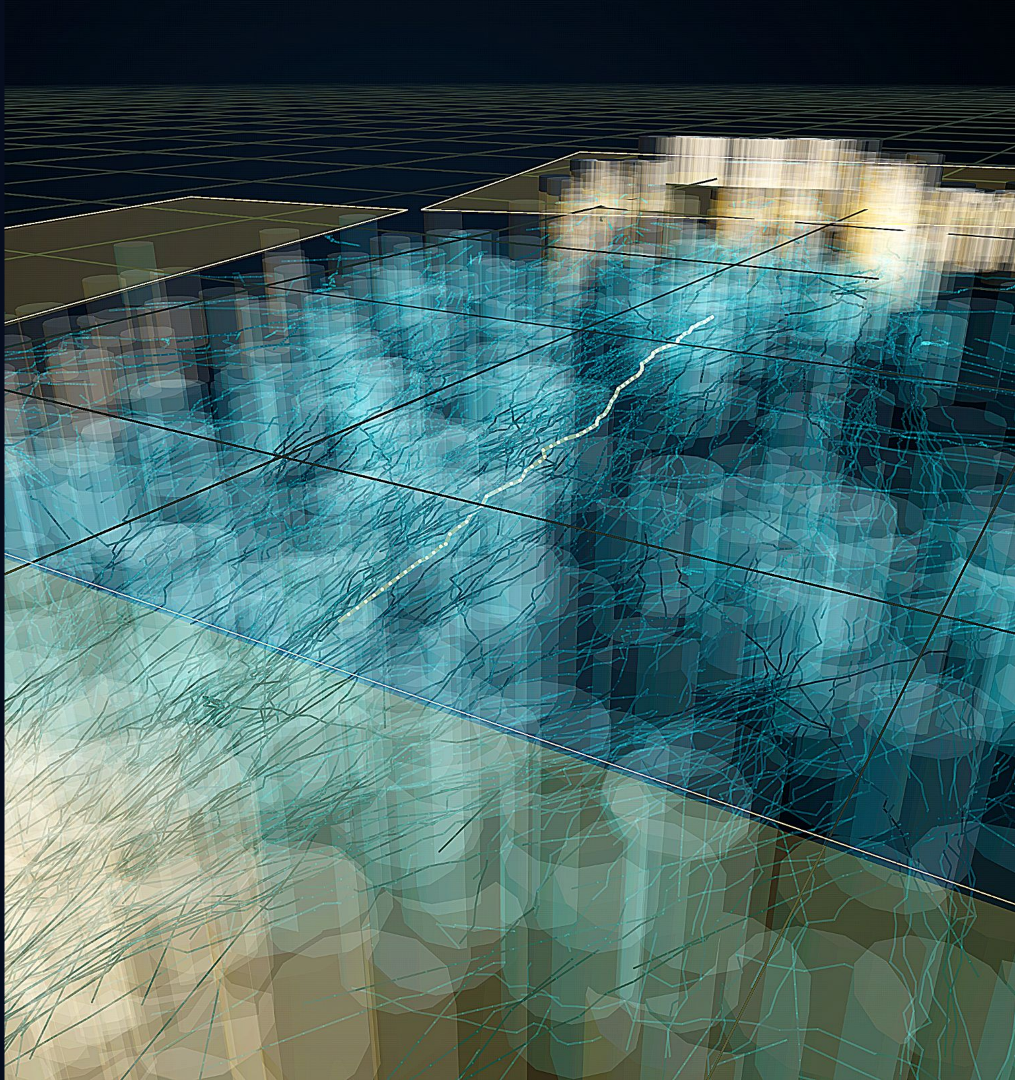
Spatial Intelligence

In this demo, we track one of nature's most complex objects, proves a simple point: if we can track this, we can track anything—stockpiles, tools, terrain, or other machines. The demo is showcasing the importance of integration and knowledge of the technology. Primitive components form flexible system.

Why is this demo relevant?

Industrial systems are complex layers of technology—sensors, PLCs, ECUs, networks. Treating them as a simple backdrop for an AI model is a critical mistake.

This demo reflects our core philosophy: a deep understanding of the full technology stack is essential for success. This intelligent integration is how we build trustworthy AI systems faster.



Simulation and Adaptation

The performance of any perception model is contingent on the quality and volume of its training data. Acquiring and manually labeling sufficient real-world Lidar data to cover every operational scenario—including different weather, lighting, and rare events—is operationally impractical and prohibitively expensive.

To overcome this challenge, our training process begins with synthetic data generation. We utilize 3D simulations to programmatically create diverse datasets. This approach allows us to efficiently generate data covering a range of objects, environmental conditions, and critical edge cases that are seldom encountered in reality. A primary advantage of this method is the generation of perfect, automatic ground-truth labels, which eliminates manual annotation.

However, a model trained exclusively on simulated data will not perform optimally in the real world due to the inherent "reality gap" between the simulation and physical sensor readings. To resolve this, we employ domain adaptation techniques. These methods are designed to make the model invariant to domain-specific characteristics (like sensor noise or texture differences), forcing it to learn the fundamental features of objects that are consistent across both the simulated and real domains.

This two-stage training methodology ensures the final perception model generalizes effectively from simulation to deployment, resulting in reliable and consistent performance.

Sensory data to insight

Tracked data, including object IDs, positions, velocities, is continuously streamed to backend for storage. This is where the system becomes truly interactive.

A finetuned LLM-Agent acts as the system's conversational brain. It's connected to the live data through a Retrieval-Augmented Generation (RAG) framework. This means you can ask questions in plain English, like:

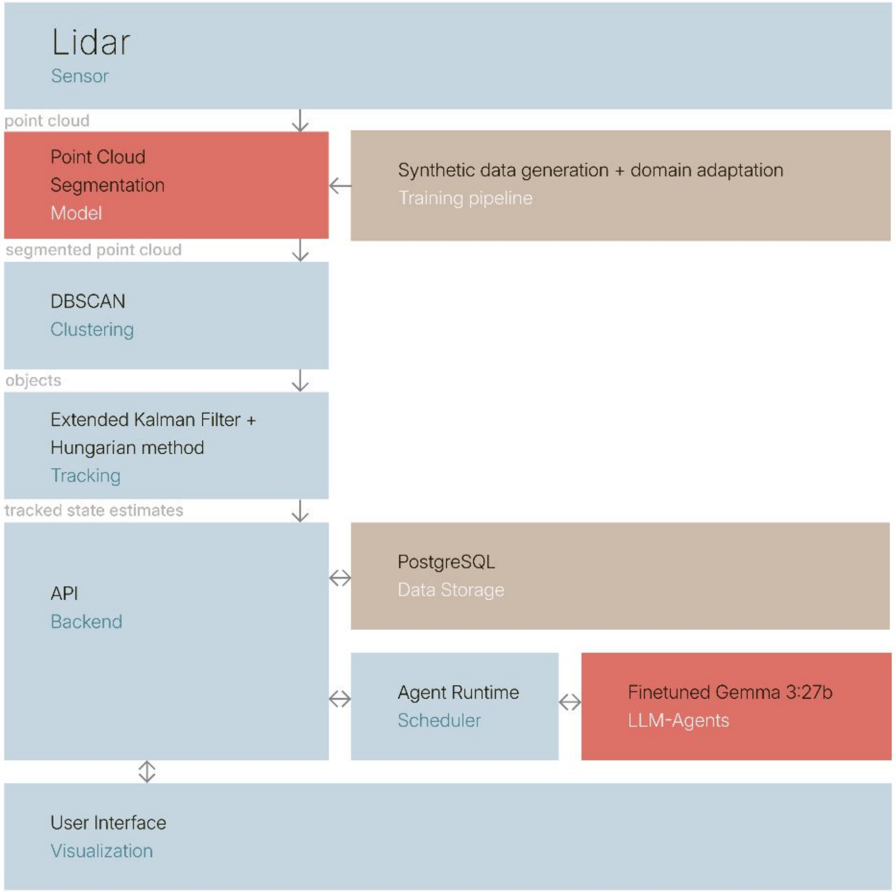
"How many people are in the restricted zone?"

"Show me the path vehicle ID 42 took."

The agent retrieves the relevant, up-to-the-second data from the database (the "Retrieval" and "Augmentation") to generate a precise, context-aware answer (the "Generation")

When to apply similar architecture in mobile working machines?

Beyond analytics and object tracking, this combination of analytical and generative AI creates new possibilities for mobile machinery in mission planning and data acquisition, especially in complex scenarios. Furthermore, employing natural language as an interface fundamentally improves
human-computer interaction, unlocking greater insight and utility from the vast data generated by these sophisticated systems.


Lidar
Sensor
point cloud
Point Cloud
Segmentation
Model
Synthetic data generation + domain adaptation
Training pipeline
segmented point cloud
DBSCAN
Clustering
objects
Extended Kalman Filter +
Hungarian method
Tracking
tracked state estimates
API
Backend
PostgreSQL
Data Storage
Agent Runtime
Scheduler
Finetuned Gemma 3:27b
LLM-Agents
User Interface
Visualization

emblica

Production-Ready 3D Perception

Native 3D point cloud segmentation models have matured beyond academic research and are now robust enough for deployment in production environments on mobile machinery. While implementing these systems requires specialized expertise, they unlock transformative capabilities. A single 3D LiDAR sensor, often installed for primary functions like collision avoidance or localization, becomes a source of immense operational value. The data streams it produces can be leveraged for multiple "sidestream" applications—such as object recognition, stockpile measurement, or terrain mapping—simultaneously. This multi-purpose use of sensor data is key to amortizing the hardware investment and maximizing the intelligence of the machine.

AI Onboard

Modern perception models are highly efficient and can be run in real-time directly on embedded hardware onboard the machine, enabling immediate decision-making without reliance on external networks. The true potential of these systems, however, is realized through sensor fusion.

By combining LiDAR data with inputs from other sensors like cameras or radar, the system's perception becomes significantly more robust and adaptable. This multi-modal approach ensures reliable performance across diverse and challenging operational conditions, from bright sunlight to heavy rain or dust, future-proofing the investment and delivering a superior level of environmental awareness.

▶ The training for the models presented did not contain any labeled real-world data

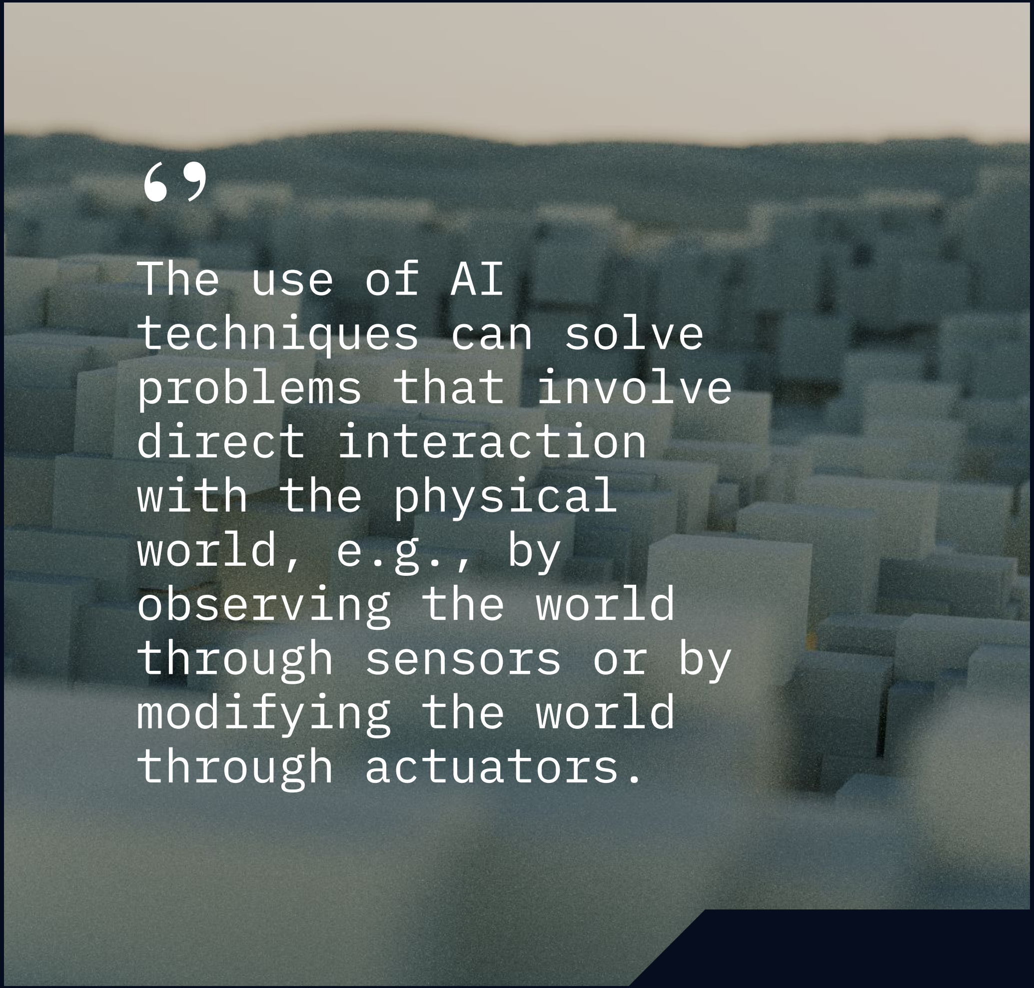
What is an AI system?

An “AI system” is much more than just a single AI model. It’s a team of technologies working together to solve a problem.

Models The pattern finders, like our segmentation model or large language models. They learn from data.

Classic Algorithms & Math The precise specialists, like DBSCAN for clustering or the Kalman Filter for tracking. They are based on established mathematical principles.

Infrastructure & Code The essential support crew, including the database that stores information, the API that handles requests, and the code that “glues” everything together.



> The use of AI techniques can solve problems that involve direct interaction with the physical world, e.g., by observing the world through sensors or by modifying the world through actuators.

Your partner in
Data and AI