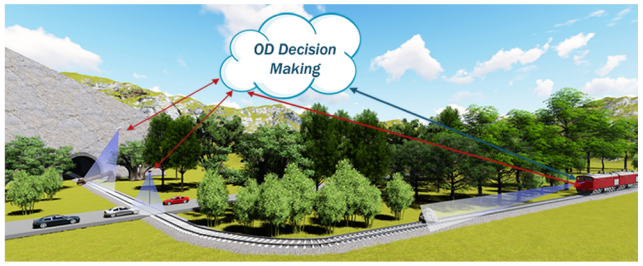
Executive Summary

SMART2 goal was development of a holistic Obstacle Detection (OD) system for railways consisting of three sub-systems: on-board, UAV-based and trackside OD systems.
A holistic approach to autonomous OD enables detection even in the areas that are not in the field of view (FoV) of an on-board system such as areas beyond the curves. The data recorded by the sensors of each of three OD systems are processed to inform cloud-implemented OD Decision Making (ODDM) system about possible obstacles in their FoVs. ODDM integrates coming information and makes the final decision on OD and suggests possible actions for the train control.

SMART2 project developed a working prototype of the holistic OD that was evaluated in different real-world railway use-case scenarios. By development of this advanced innovative solution for OD system, SMART2 will contribute to competitiveness, efficiency and operational reliability of railway traffic through the OD automation necessary for GoA 3/4 operation.



In SMART2, the on-board OD system is complemented by UAV-based and trackside OD systems to increase the detection area.

Consortium Members

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OHB Digital Services, Germany
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University of Newcastle, United Kingdom
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SMart Automation of Rail Transport 2

Advanced integrated obstacle and track intrusion detection system for smart automation of rail transport

www.smart2rail-project.net

Shift2Rail

Horizon 2020
European Union Funding
for Research & Innovation

Obstacle detection in 3D LiDAR point cloud

3D LiDAR-based trackside OD system detects objects, possible obstacles, at level crossings (red bounding boxes).

Real-world evaluation tests

Numerous static and two dynamic real-world field tests were conducted. During the dynamic field tests in June and August 2022, the SMART2 OD on-board system was mounted onto the Serbian Cargo locomotive of the train running on the Serbian part of the Pan European corridor X. During the train runs, on-board sensors recorded the data of the real-life rail tracks scenes in front of the locomotive. Trackside OD system was located on a selected level crossing and UAV-based system was overlooking the selected curve on the route.

Rail track detection

A novel, fast and efficient rail track detection method was developed using a state-of-the-art Bounding Box Deep Learning (DL)-based object detection that detects parts of the rail tracks. For this purpose, the rail tracks in training images were annotated with multiple object Bounding Boxes specifying rail tracks as objects consisting of multiple parts.

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Holistic approach to obstacle detection

On the approach to the curve, the on-board OD cannot detect obstacles beyond the curve, but the UAV-based system can. At some distances, obstacle is detectable by both systems, the zoomed on-board OD thermal camera and UAV camera.

	UAV camera	On-board thermal camera
Distance of detected person to the train	225.4 m	224.5 m

Obstacle detection and track intrusion detection in on-board camera images

	Person	Bicycle
Frame 1 (red detected rail track)	198.4 m	204.9 m
Frame 2 (green detected rail track)	182.3 m	175.7 m

Detected rail track was used for definition of Region of Interest (RoI). Position of a detected object with respect to RoI determines the risk level for track intrusion: red (high risk) and green (no risk). In addition to risk level, distance of the object to the train was estimated.