

Document Control Sheet

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<p>3. title</p> <p>Original german title:</p> <p>Verbundprojekt: SAFEAI – Autonomes Fahren bei mobilen Arbeitsmaschinen – Aspekte funktionaler Sicherheit unter Einbezug leistungsfähiger KI-Methoden; Teilvorhaben: Software und Steuerungssysteme und deren sicherheitstechnische Verifizierung und Validierung. Individueller Schlussbericht – InMach Intelligente Maschinen GmbH</p> <p>English title:</p> <p>Project SAFEAI – Autonomous Driving of mobil working machines – functional safety aspects under consideration of high performance AI methods; Part: Software and control systems and their safety related verification and validation. Individual final report – InMach Intelligente Maschinen GmbH</p>	
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18. abstract

The project had a distinct focus on safety-relevant core topics such as the safe perception of the environment and threat detection. The goal was to use the insights obtained in this project to ensure the functional safety of functional models acting as assistance systems, and bring them closer to serial production. First steps and an evaluation were carried out on agricultural and more so on municipal technology.

The subproject within the consortial project SafeAI had the goal to develop and validate safety-oriented control systems for the autonomous operation of mobile driven machines, in particular agricultural and municipal machines. A particular focus was placed on the question how AI systems can be included here under the viewpoint of functional safety. The two application areas of agricultural machines and municipal technology pose different requirements on AI systems: While agricultural machines mainly operate in rural environments with unstructured, often changing conditions, municipal machines operate in urban or infrastructurally more complex areas, where they have to interact with other vehicles, pedestrians and dynamical obstacles. In particular, in urban scenes it can often be the case that human beings are completely or partially occluded.

Important technical and scientific results of the project include the development of a safety-oriented E/E architecture and corresponding selected control nodes, as well as the implementation and optimization of artificial neural networks for object detection and distance estimation (e.g. YOLOv7, DepthAnythingv2) on powerful mobile platforms (NVIDIA Xavier AGX, NVIDIA Orin AGX), their integration into the system architecture as well as the validation of the developed controllers and models under real operating conditions. Furthermore, relevant data sets were recorded and annotated in order to train the neural networks and to evaluate the suitability of various sensors such as cameras, lidar and radar under real outdoor operating conditions.

19. keywords

Autonomous working machines, AI, Safety, High Performance Electronics, risk analysis, multimodal sensors, environment perception

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