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Autonomous Inland
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Addressing safety and reliability in autonomous inland shipping

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Abstract

This paper provides an overview of the research and development of automated and autonomous vehicles, with a focus on safety and reliability issues for inland vessels. Several projects and methods for achieving reliable and safe behavior are presented in an introductory manner.
The Autobin project addresses the development of an autonomous vessel for inland navigation. The focus is on the analysis of sub-functions and their responsiveness in different situations. Notable results include dynamic quantification of the reliability of functions such as object detection and tracking.
As part of the Fernbin project, remote control of inland vessels is discussed, which includes action planning, encountering vehicle behavior prediction, and the task of automatically predicting the behavior of surrounding vessels. For this, Deep Learning (DL)-based models, among others, are used for accurate predictions. The analysis of uncertainties associated with these models is crucial for reliable decision making. Human-machine interaction monitoring and risk assessment are integrated components of remote control, making the evaluation of decision options critical to safety and reliability. Overall, Fernbin aims to improve inland vessel control through advanced prediction, uncertainty analysis, and reliable decision making.
The SafeBin project will focus on developing a formal frame for risk assessment of Systems for automated guidance and control of inland vessels. The project performs functional safety-related analyses and risk assessments using classical methods such as Failure Mode, Effect Analysis, and Fault Tree Analysis. It addresses as a new contribution scenario-related risks and thus formulates dynamic and situational reliability requirements to make the realization of functions more flexible.

Together, these contributions address the area of safety of automated and autonomous vehicles, especially inland vessels. They cover important aspects such as redundancy, reliability, vehicle behavior prediction, behavioral prediction of human actors, human-machine interaction monitoring, risk assessment, and dynamic command and control systems. The research results reported contribute to safer and and more efficient autonomous operation in inland navigation.