

ADVANCING SAFETY IN MOBILITY WITH HYDROGEN-BASED FUELS: AUTONOMOUS MARITIME OPERATIONS AND HAZARDOUS INTERMODAL INTERACTIONS

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ABSTRACT

In response to the European Union and International Maritime Organization's ambitious strategies to reduce greenhouse gas emissions, the transition to hydrogen-based fuels in transportation is rapidly accelerating. This shift not only promises significant environmental benefits but also presents new challenges in safety management across diverse transportation systems. This study outlines two pioneering research initiatives aimed at enhancing safety in zero-emission transportation, specifically focusing on hydrogen and ammonia fuels. The first project introduces a novel safety analysis framework tailored for autonomously operated zero-emission ships. This framework seeks to address the unique challenges posed by autonomous navigation and zero-emission propulsion technologies. By systematically assessing the operational risks and failure modes associated with autonomous ship operations and hydrogen-based fuels, this research seeks to establish a set of safety standards and best practices that can be adopted globally to safeguard these advanced vessels against potential major accidents. The second project examines the safety of critical interactions between diverse zero-emission transportation modes, such as ships, cars, and airplanes. This initiative is crucial in identifying and managing potential hazards that arise from the interaction of different transportation systems, particularly when these systems operate in close proximity or share common infrastructures. By identifying key risk factors and interaction points, the project aims to develop a predictive model of potential conflicts and propose mitigation strategies that enhance overall system safety and reliability. Together, these projects are expected to contribute to the broader discourse on sustainable mobility by not only addressing operational safety but also by enhancing the understanding of how hydrogen-based fuels can be integrated safely across multiple transport sectors.

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