# Chapter 2
# Integration of AI for Autonomous Navigation in Hovercrafts

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## ABSTRACT

*This chapter delves into the integration of artificial intelligence (AI) for enhancing autonomous navigation in hovercrafts, highlighting key design frameworks, technologies, and algorithms. It explores how AI optimizes the complex interplay between propulsion, lift, and steering systems, enabling adaptive real-time decision-making for efficient manoeuvring over various terrains. Emphasis is placed on sensor fusion techniques, machine learning for environmental recognition, and control systems to handle dynamic conditions. Applications in search and rescue operations, military missions, and coastal monitoring showcase AI's practical benefits. Challenges, including maintaining stability, overcoming unpredictable environmental factors, and ensuring safety protocols, are also discussed. The chapter concludes by outlining pathways for future advancements that could revolutionize hovercraft efficiency and expand their operational landscape.*

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## 1. INTRODUCTION

The integration of Artificial Intelligence (AI) in autonomous navigation systems represents a paradigm shift in the capabilities of hovercrafts. Hovercrafts, as amphibious vehicles capable of operating across diverse terrains such as water, ice, and land, are uniquely positioned to benefit from advanced navigation technologies. However, their operational complexity, stemming from dynamic and variable environments, presents significant challenges for traditional navigation systems.

AI-driven autonomous navigation addresses these challenges by leveraging machine learning algorithms, computer vision, sensor fusion, and real-time decision-making frameworks. These technologies enable hovercrafts to adapt to unpredictable conditions, optimize routes, and ensure operational safety and efficiency without human intervention. For instance, neural networks can analyze data from LiDAR, cameras, and inertial sensors to identify obstacles and generate safe paths in real time.

This chapter explores the transformative role of AI in enhancing hovercraft navigation, focusing on the key technologies, methodologies, and applications. It delves into the integration of deep learning for perception, reinforcement learning for control, and edge computing for real-time processing, highlighting their collective impact on achieving full autonomy. Additionally, the discussion extends to the potential use cases in areas such as search and rescue, environmental monitoring, and military operations, where hovercrafts' unique capabilities are amplified by AI.

The synergy between AI and hovercrafts not only advances autonomous navigation but also contributes to broader developments in autonomous systems. By addressing technical challenges such as robust localization, obstacle avoidance, and energy efficiency, this integration sets the stage for a new era of intelligent and versatile hovercraft operations (Okafor, B. E.2013).

## 2. HISTORICAL BACKGROUND OF HOVERCRAFT

The history of the hovercraft reflects a remarkable evolution of technological innovation and engineering ingenuity. Early conceptual ideas can be traced back to 1716, when Emanuel Swedenborg, a Swedish philosopher, proposed a flying machine that incorporated air-cushion principles, though it was never built. In the 1870s, Sir John Isaac Thornycroft, a British engineer, made significant strides by experimenting with air-lubricated hulls, laying the foundation for hovercraft technology. Further theoretical developments occurred in the early 20th century when Russian scientist Konstantin Tsiolkovsky described an air-cushion vehicle in 1915, and Austrian engineer Dagobert Müller von Thomamühl advanced the concept by experimenting with ground-effect vehicles during the 1920s. Sir John Thornycroft