Augmented Reality-Based Ship Handling Training Method

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Chapter 1

Introduction

Chapter 2

Foundation

In vessel handling terminology, maneuvering refers to the task of controlling a vessels movement using its propulsion and navigation systems; taking into account environmental forces such as wind, waves and, current acting on the vessel. Vessels move in a variety of marine environments. Starting from ports in harbors where the water is shallow and vessel traffic is high, a vessel might navigate the vast open seas to a different port in a harbour across the ocean. Vessels also navigate inland waterways such as rivers, canals, backwaters and creeks. More recently, developments in offshore wind farming and the oil and gas industry have necessitated regular and frequent visits to offshore structures located on continental shelves. Figure 2.1 shows some prominent offshore oil fields in the North sea.

Handling large vessels at low speeds has been difficult on marine vessels historically. The working mechanism of rudder systems of the past made it difficult to turn large vessels in place. From a human operator perspective, the challenge of maneuvering at low speed is further amplified when the operation occurs in close proximity to large physical objects in the vicinity. The stress from risk of collision adds to the difficulty of the task. Refer to [1] for a objective evaluation of ship handling difficulties arising from restricted maneuvering area or traffic congestion. Examples of difficult maneuvering operations are approaching a harbour, berthing, sailing side-by-side another vessel, approaching and stationing close to an oil platform, etc. An often recurring sequence is that of port-bound vessel heading to its berthing location in the harbour. Having entered pilot waters from seaward, its course needs to be controlled to ensure safe passage through channels, bridges, and locks; while avoiding collisions with other vessels at the same time. Safety risks involved in such tasks make it a stressful operation. Mistakes have

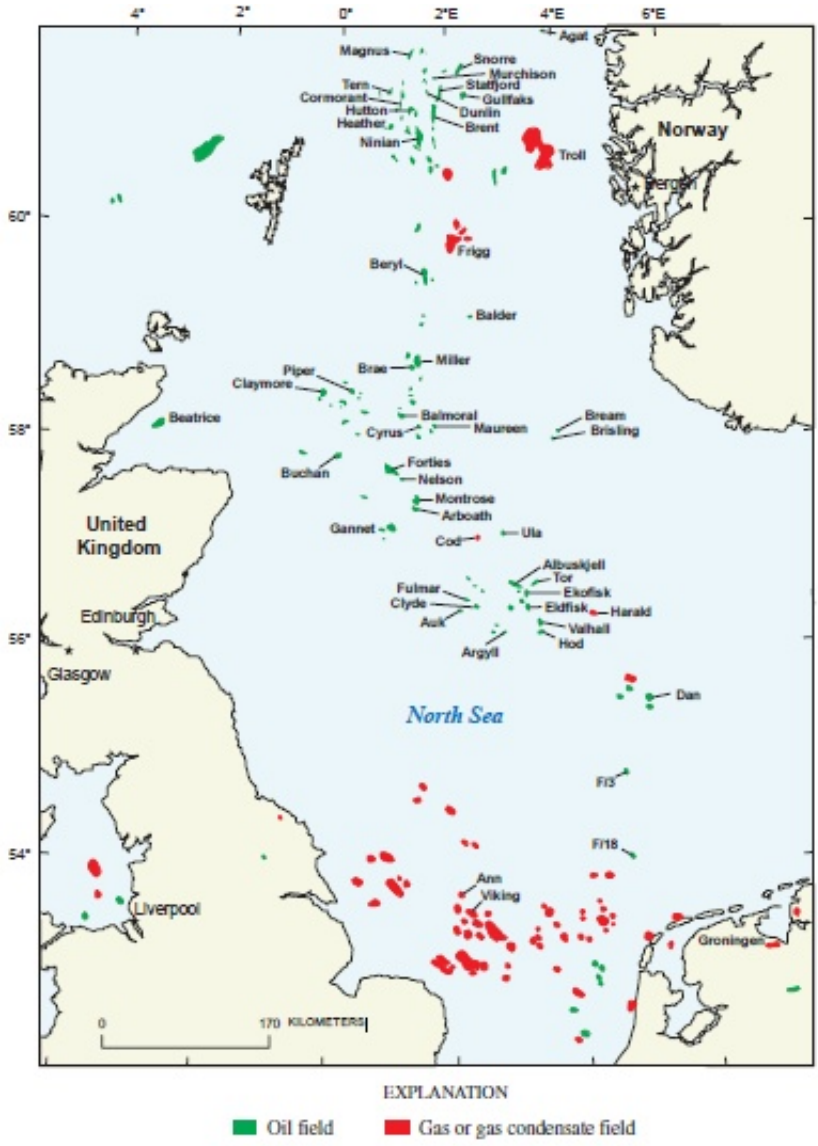

Figure 2.1: Map of oil and gas fields in the North sea

Get higher resolution picture

Figure 2.2: Offshore supply vessels in operation

high associated costs, possibly leading to lost lives and damage to expensive constructions.

A particularly relevant case is that of offshore supply vessels. Offshore supply vessels need to regularly approach and be stationed close to offshore oil platforms to perform supply operations.

talk more about supply operations

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This requirement led to the development and subsequent popularity of dynamic position systems. Dynamic positioning (DP) is a computer-controlled system that maintains position and heading of a vessel automatically by using its propellers and thrusters. Information from position reference sensors that provide the vessels position and heading, along with information from wind sensors, motion sensors and gyrocompasses on the vessel are used by the system. The information is supplied as input to a program that calculates the changes in position/heading required to bring the vessel a preset location and, activates the vessels thrusters as necessary.

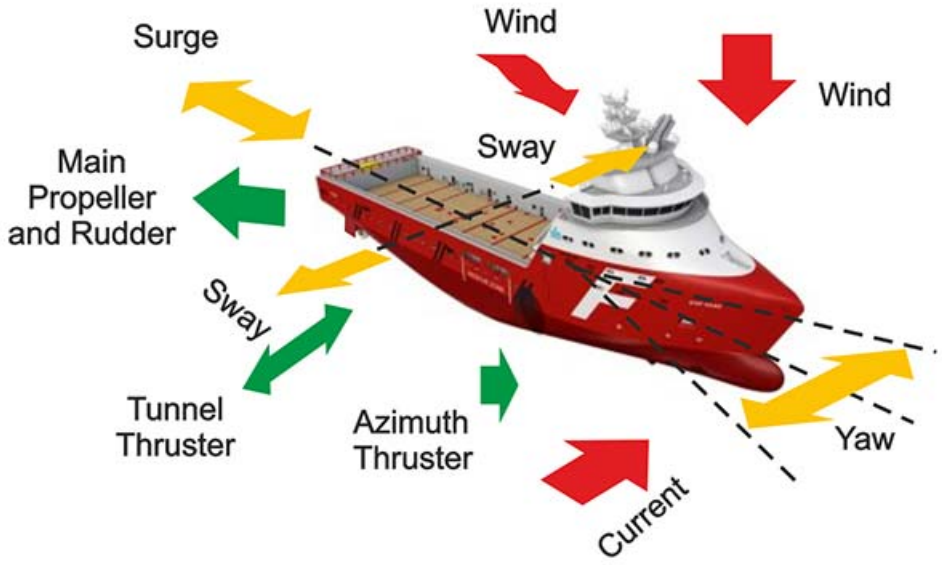

Figure 2.3: Forces acting on a ship and its possible movements

Make a sketch of the forces on a ship and its movements

make own picture with legend of forces

The use of dp systems has been increasing over the years since its first inception in 1960s. There are well over 2000 DP vessels in operation today [2]. From the early days of the technology where main focus areas of research were accurate position measurement and control system technologies used, research has now moved on to more specialized problems such as optimizing dp systems for energy efficiency. With increasing popularity of dp systems and increased use of sophisticated technology onboard ships, the marine industry can expect more advanced automation in vessel control over the years. Future systems could be enabled with features such as au-

tomatic maneuvering in shallow water and harbor areas, formation sailing, and automatic collision avoidance.

Bibliography

[1] Kinzo Inoue. Evaluation method of ship-handling difficulty for navigation in restricted and congested waterways. *Journal of Navigation*, 53(01):167–180, 2000.

[2] Asgeir J Sørensen. A survey of dynamic positioning control systems. *Annual reviews in control*, 35(1):123–136, 2011.