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Ship Simulation Study to Determine the Safety of Navigation Channel at Terengganu River, Malaysia

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ABSTRACT

Major development such as construction of Malaysia iconic draw bridge at Terengganu River shown the reduction of width for the navigation channel surely will affect the safety of the river user. This study aims to simulate the ship navigation process along the river channel to assess the safety of the channel. using the full mission ship simulator with real-time simulation approach and based model of the navigational channel and with worst weather environment. The results show the ship simulations track of the ship navigate through the navigation channel is safe, although encountered a few obstructions along the navigating process. This paper will provide proof that the navigation channel is safe for its user and few obstructions are highlighted.

1. Introduction.

Safety of navigation channels is the main motivation of this article. To determine the safety of navigation channels, several studies need to be done to address the safety manouverbility along the navigation channel. One of the related studies is the simulation test which can be one of the factors in ensuring the safety of the navigation channel.

According to Bhaskaran (2008), a simulator can assist in many things such as training, case study and also validation of safety assessment based on scenarios. This shows simulator study results can lead to determine the safety of navigation channel.

In order to gain a batter results, a real-time simulation test is used in this study. According to Belanger (2010), real-time simulation is the best method in validation process. A real-time simulation will have a high accuracy value since it recreates almost the same surrounding factors.

A navigation channel is the channel created for the marine user to navigate safely along a waterway from one point to another. Terengganu river has their own navigation channel that located along the Duyong Island up to its river mouth which passes through Malaysia iconic Drawbridge.

According to Wahaba (2019), Terengganu river had been very important to the locals since lots of maritime activities had actively been conducted, for instance fishing activities, offshore activities, shipyard services and recreational activities. This river flows through the state capital of Terengganu, Kuala Terengganu and flows into the South China Sea.

Kori (2022) stated, Terengganu is constantly developed from year to year, with great economic growth. For the maritime sector Kuala Terengganu has a popular inland waterway near Duyong Island. This river lane is known as the place for boat builder and nowadays has been a busy navigation waterway since many activities are using the area including the ship building and repair operations, offshore crew transport operations, monsoon yacht races, fishing vessels activity and enforcement agencies' activity.

The rapid development such as the building of drawbridge has given an impact to the safety of navigation since the marine traffic flow will be impeded. According to Madehow (2018), a

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draw bridge is a movable bridge that can be lowered or raised accordingly. Usually, a drawn bridge been built over a navigational waterway. This kind of bridge is to allow boats and ships to cross its path. Most of the bridges are more expensive to operate and maintain than stationary bridges. They also can impede traffic on water when they are lowered and on roadway or rail line when they are raised.

For this specific article, Section 2 is devoted to literature review on certain aspects related to study, Section 3 states the methodology used for this study. Section 4 explains the results from the simulation study and finally, the conclusions are presented.

2. Literature.

Terengganu Draw Bridge is the iconic bridge that link Kuala Terengganu city center to Kuala Nerus via Seberang Takir crossing Terengganu River. The overall length of the bridge is 632m, with a width of 23m (Zelan,2018).

According to Hashim (2017), the exiting navigational channel after dredging work in 2006 has the width of 100m and draught of 7m. but when the draw bridge been built, the channel width reduces to 25m because of the bridge pillar. The draught also decreases due to sand traps underneath the bridge. Vessels will be constrained by another factor that is limited air draft which is only limited to 10m height. The draw bridge existence will not only increase the density of marine traffic, but it also increases the surrounding hazard that eventually create a high-risk condition.

According to Salman (2013), a simulator is a device, designed to satisfy objective which mimics part of real situation in order to allow an operator to practice or demonstrate competence in an operation for controlled environment. When this simulator device been introduced to the maritime world, the device had been upgraded for bridge simulator and engine room simulator. This simulator is used for simulation technology for maritime training and nautical studies. The real ideas of simulator are to conduct and simulate a scenario for gaining the probability outcomes. Some of the seafarer state that a simulator is design for making mistake so that many things can be learn after and lots of things could be improve.

A bridge ship handling simulator is a replication of a ship bridge including all relevant instruments such as the radar system or the electronic chart display and information system (ECDIS). The bridge view is generated using several projectors or screens. The simulation process itself is described by a system model which represents a simplified version of the vessel and environmental dynamics (Philipp, 2017).

Now a day many industries consider the use of simulator techniques as a major contributing factor to the fundamental increase of the competency. The aviation industry is one remarkable example that motivated the first attempts to manufacture ship bridge simulator (Salman, 2013).

According to Ambroziak (2022), weather condition is a very crucial part in navigating a vessel. When it comes to risk, weather conditions play a vital role in order to provide safety passage for the marine users.

The elements that need to be taken care of are the wind, current, and waves. These three things are important when navigating a vessel. Since weather conditions are very crucial to mariners, as per said strong winds and their constant companions, rough seas probably present the most serious hazard faced by yachtsmen (Sanderson, 1994).

According to Malaysia Meteorology Department (2019), the wind speed at Duyong Island, Kuala Terengganu is 5knots up to 20knots. The maximum bad weather could reach up to 30knots. The direction of the wind is from Southeast and South. The normal wave height at Duyong Island ranged from 0.5m up to 1.5m. The worst case would be 2.0m height, that is when the monsoon hits around July up to December.

3. Methodology.

This study is focusing on the vessel navigation at the study area within the navigation channel. Six runs that include the existing environment condition and vessel will be tested. This run will be performed under the worst-case scenario since it will conclude that if the vessel is managed to passes through the worst so on the normal condition it will consider as safe. The vessel characteristic will be taken from the simulation library which refers to the nearest with existing vessel.

The manoeuvring simulation studies is carried out by using a ship-handling simulator, the simulator system must allow real- and fast-time simulations to be conducted using either 'hands-on' control (real-time conning) and automated control using an auto-pilot function and provides mathematical modelling of ships and other floating craft in 6 degrees of Freedom, namely surge, sway, yaw, roll, heave and pitch.

The ship-handling simulator system uses the industry standard S-57 electronic charts that provide the interactive backdrop to the simulations. To produce a more accurate set of simulations based on the proposed operations including in-bound and out-bound navigation, the studies need to incorporate the hydrodynamic current information.

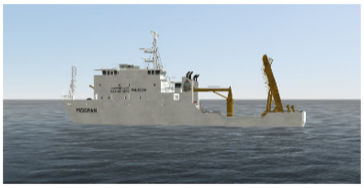
A real-time simulation exercise is performed where a human pilot will operate the ship and support tugs, to a specified port or location within the study area. This process requires the geographic database and bathymetric values to be modelled within the simulator to the exact study area specification. The use of real time simulation ensures that technical ship handling and human factors with reference to response times and communication are effectively incorporated.

Table I shows the vessel model used for all the simulation runs. This vessel model is chosen based on the characteristic of commonly vessel navigate through the navigation channel. This vessel model consists of 54.5 meters in length overall, 10.8 meter of breadth and 3.0 meter draught. This model is also equipped with twin propeller and can reach a top speed of 30 knots.

4. Results.

A total of 6 simulation runs which consist of 3 runs inbound and 3 runs outbound of the navigation channel. All simulation

Table 1: Vessel simulation model.

Vessel model	Characteristic
	LOA: 54.5m BREADTH: 10.8m DRAUGHT: 3.0m

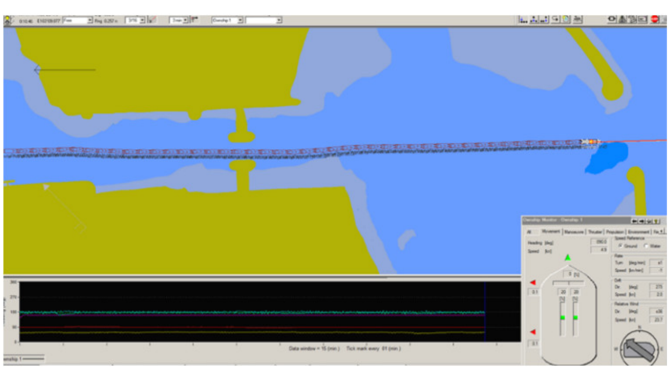
Source: Authors.

runs are the passed runs, with 2 near miss situation encounters.

4.1. Run 1 Outbound.

Based on this simulation model, the vessel manoeuvrability was hard since the weather is at worst condition. Even though the simulation is pass, but navigator should be very careful during navigating their vessel around this area. With a very limited width channel especially under the draw bridge, this is the hardest part for the vessel to pass through.

Figure 1: Run 1 Outbound .



Source: Authors.

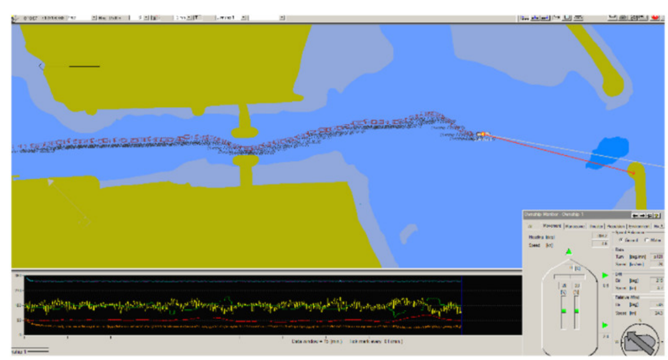
4.2. Run 2 Outbound.

Figure 2 shows second simulation runs which encounter few obstacles and result of near miss situations to come in contact with draw bridge pillar. In this simulation, the speed of the vessel is increased to 7 knots and when the vessel enters the area under the draw bridge, the vessel experiences a bank effect situation which pull the vessel near to the bridge pillar.

4.3. Run 3 Outbound.

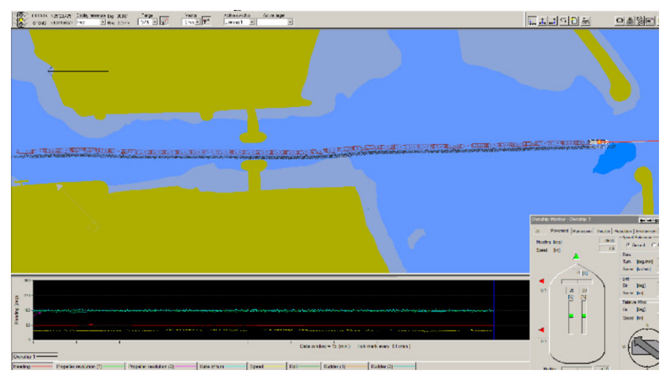
Figure 3 shows the outbound simulation run. In this run, the manoeuvrability of the vessel is more stable since the vessel only navigated with 5 knots speed. Even though the environmental condition is set to the worst-case scenario, the simulation still pass with minimum obstruction.

Figure 2: Run 2 Outbound.



Source: Authors.

Figure 3: Run 3 Outbound.

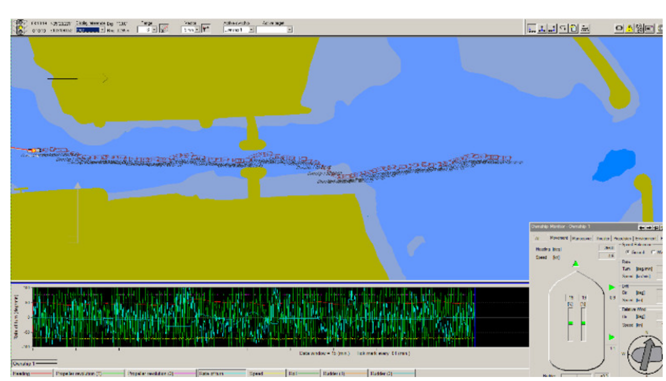


Source: Authors.

4.4. Run 4 Inbound.

Figure 4 shows the inbound simulation run of the model vessel. This simulation involves worst-case scenario weather. During the simulation the vessel experiences some obstruction and almost loss its manoeuvrability and results in near miss situation. The vessel almost come in contact with the right pillar. The vessel navigates at a speed of 7 knots.

Figure 4: Run 4 Inbound.

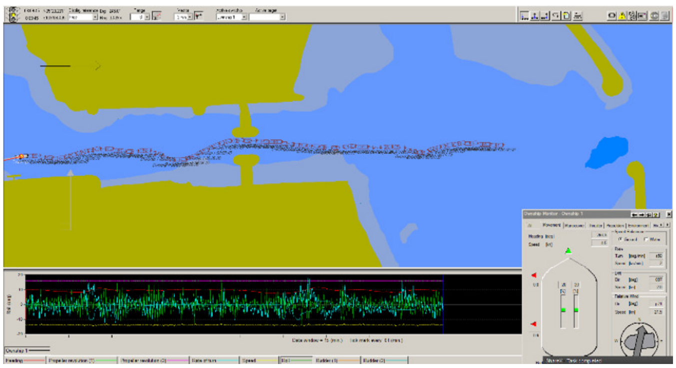


Source: Authors.

4.5. Run 5 Inbound.

Figure 5 shown the inbound simulation runs with a worst-case weather. During the simulation the vessel navigate with speed of 6 knots and experience a bank effect situation. Near the bridge pillar the vessel almost loss its control and result a after effect unstable manoeuvrability.

Figure 5: Run 5 Inbound.

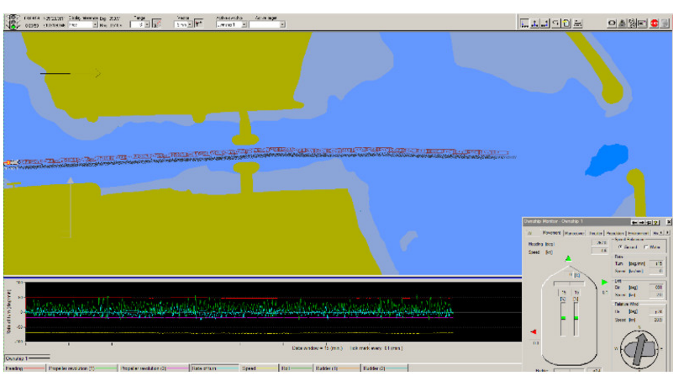


Source: Authors.

4.6. Run 6 Inbound.

Figure 6 is the most stable manoeuvrability since the vessel track shown smooth vessel simulation runs. In this inbound run, the vessel is test with a worst-case weather scenario and navigate with speed of 5 knots. This speed seems to be an ideal speed for navigate in this navigational channel since the vessel only experience minimum obstruction during the runs.

Figure 6: Run 6 Inbound.



Source: Authors.

4.7. Simulation Results Summary.

Table 2: Summary of simulation runs .

RUNS	SCENARIO	RESULT
1	OUTBOUND	PASS
2	OUTBOUND	PASS (NEAR MISS)
3	OUTBOUND	PASS
4	INBOUND	PASS (NEAR MISS)
5	INBOUND	PASS
6	INBOUND	PASS

Source: Authors.

Conclusions.

This simulation study has shown that the vessel navigates safely with a few obstructions. An ideal and suitable vessel speed can lead to a smooth navigation process along the navigation channel. Since all the simulation runs are pass with a worst-case weather scenario, this study can conclude that the navigation channel at Terengganu River focusing under the Malaysia Iconic draw bridge is safe for its user. Even though this is proof by simulation study, but all of the river users are being advise to navigate with caution and always alert with the surrounding situation.

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