JOURNAL OF MARITIME RESEARCH

Vol XXIII. No. II (2026) pp 84–87

ISSN: 1697-4840, www.jmr.unican.es

Multifarious Ship Contacts in Navigation: A Case Analysis to Avoid Collision

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ARTICLE INFO

Article history:
Received 21 Mar 2025;
in revised form 05 Apr 2025;
accepted 12 May 2025.

Keywords:
Avoid collision, case analysis, multifarious ship contact, navigation.

ABSTRACT

The study predicted multifarious ship contacts in navigation to avoid ships collision. The objective composed of threefold: first, determine the ships relative motion lines (RML) of multifarious ship contacts A, B, and C; second, predict whether own ship change course, speed, and time as well, and test if there is any significant difference between RML of multifarious ship contacts and whether predicted own ship change course, speed, and time. The study used quantitative research design, since it involved systematic predictive investigation about multifarious ships contacts in navigation to avoid collision via statistical, mathematical integration and providing an in-depth predictive analysis. Results revealed, the new relative motion lines (RML) ship contacts A (280^0), ship contact B (051^0), and ship contact C (028^0). Ship contacts A, B, and C maintained true course and speed, *e-m* vector remains static, while own ship's *e-r* vector rotated about *e* to the new course 065^0 and changed in magnitude conformed to reduce the speed from 20 knots to 15 knots at 1006 hours. Further, no significant difference between RML and predicted whether own ship change course, speed, and time. Thus, majority of the respondents determined the RML and predicted whether own ship change course, speed, and time, as well, due to the new RML of multifarious ship contacts A, B, & C.

1. Introduction.

Navigation is the art of conducting a ship from one port to another in a safest and convenient route (Ramirez, 2011). However, this safe and convenient navigation can be done only if the seafarers have sufficient understanding about the international regulations for preventing collision at sea (COLREGs) that would be applied in the real-world situations. One of which was predicting multifarious ship during navigation period. The seafarers should have enough skills to understand the behavior of multifarious ships in the vicinity to prevent collision.

To make the ships safe during navigation, it is significant to predict the multifarious ships contacts by determining ships relative motion lines in the vicinity to avoid collision.

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The present study gave constant details about own ship position, a situation for own ship R on course 000^0, speed 20 knots. With the stabilized relative motion display on radar set at the 12-range setting, radar contacts A, B, and C are observed and plotted directly to the reflection plotter. The plots at 1000 hours are considered as the initial plots in the solution (Torrechila et al., 2004).

By predicting multifarious ship contacts amidst these gaps necessitates the integration of advance techniques. This technique is unexplored when it comes to identifying patterns of ships behavior that includes determining the relative motion lines of the multifarious ships in the vicinity. The present study utilized predictive analytics to fill in the gaps and generate reliable predicted results regarding ships movement. These predictive capabilities not only enhance navigational decision-making but also to facilitate proactive measures to avoid collision. This would be the reason why present study is conducted to understand how multifarious ships contacts influence in own ship movement regarding its course and speed.

Thus, to improve the precision of multifarious ship-position predictions, the researcher explored predictive analytics of ship positions in the vicinity. Specifically, the study determined the relative-motion lines for contacts A, B, and C and predicted whether own ship should change course to 065^0 and speed to 15 knots at 1006 hours. This advanced technique enables future seafarers to determine and predict multifarious ship contacts at sea in accordance with the International Regulations for Preventing Collisions at Sea (COLREGs).

1.1. Objectives of the Study.

This study addressed the following objectives:

1. Determine the ships relative motion lines (RML) of multifarious ship contacts A, B, and C.
2. Predict whether own ship change course, speed, and time as well.
3. Test the significant difference between ships relative motion lines (RML) of multifarious ship contacts A, B, C and predict whether own ship change course, speed, and time as well.

2. Methodology.

This section presents the research design, respondents of the study, locale of the study, research sampling techniques, research instrument, data gathering procedures, and data analysis.

2.1. Research Design.

The study used quantitative research design. This design was chosen, since it involved systematic predictive investigation about multifarious ships contacts in navigation to avoid collision via statistical, mathematical integration and providing an in-depth predictive analysis whether own ship would alter the course and whether the speed increase or decrease, and likewise the time of occurrence. Moreover, Schweigert (2021) stated that this design has strength to produce reliable results that can be generalized to a larger population.

2.2. Respondents of the Study.

There were one hundred (100) BSMT 3^{rd} year students involved as respondents. The respondents currently enrolled in the 1^{st} semester, school year 2024 – 2025 at PIT.

Table 1: Distribution of respondents by year and section.

Program/Year & Section	*Frequency*	*Percentage (%)*
BSMT 3A	35	35%
BSMT 3B	35	35%
BSMT 3C	30	30%
Total	100	100%

Source: Authors.

2.3. Locale of the Study.

The study was conducted at Palompon Institute of Technology (PIT)-Main campus, Palompon, Leyte, Region VIII, Eastern Visayas, Philippines. PIT was chosen by the researcher due to its state-of-the-art facilities in maritime education. The school has its own full mission ship bridge simulator to measures the research objectives of the present study.

2.4. Research Sampling.

Purposive sampling techniques was used since the study focused on 3^{rd} year marine transportation students and currently enrolled at Palompon Institute of Technology (PIT), Palompon, Leyte. The study chooses only one hundred (100) respondents from a larger population to meet the minimum standards based on the Slovin sample size formula within +/- 5% margin of error.

2.5. Research Instrument.

A researcher-made questionnaire was used about multifarious ship contacts: A, B, C during navigation simulation period applying full mission ship bridge simulator of the college of maritime education at Palompon Institute of Technology, Palompon (PIT), Leyte. The instrument was validated first both internal and external research experts on this field of specialization before using it to gather the data of the study.

2.6. Data-Gathering Procedures.

The researcher prepared and sent a letter request to the President of Palompon Institute of Technology (PIT) for approval to conduct this study. After the approval, immediately the researcher went to the institution to perform the simulation activity assisted by the maritime faculty in-charge of the laboratory. Afterwards, data retrieved and subjected for analysis using suitable statistical tool to measure on what was found in the objectives.

2.7. Data Analysis.

The exact statistical tool was used to analyze the data includes: percentage, frequency, and paired t-test the significant difference between variables.

2.8. Data Scoring.

Scoring to determine the ship relative motion lines (RML) of multifarious ship contacts A, B, and C.

Scale	Description
2	Students able to determine the ship RML of multifarious ship contacts A, B, and C.
1	Students unable to determine the ship RML of multifarious ship contacts A, B, and C.

Scoring to predict whether own ship change course, speed, and time due to the ship relative motion lines (RML) of multifarious ship contacts A, B, and C.

Scale	Description
2	Students able to predict whether own ship change course, speed, and time due to the ship RML of multifarious ship contacts A, B, and C.
1	Students unable to predicts whether own ship change course, speed, and time due to the ship RML of multifarious ship contacts A, B, and C.

T-test was utilized to measure the significant difference between ship relative motion lines (RML) of multifarious ship contacts A, B, C and predict whether own ship change course, speed, and time.

3. Results.

Table 2: Ship relative-motion lines (RML) of multifarious ship contacts A, B, and C.

Ships Contact	*New RML*	*Frequency*	*Percentage*	*Total*
A	280^0	*64; **36	*64%; **36%	100%
B	051^0	*65; **35	*65%; **35%	100%
C	028^0	*69; **31	*69%; **31%	100%

Legend:
** no. of respondents able to determine ship RML.*
*** no of respondents unable to determine ships RML.*

Source: Authors.

Table 2 shown the ships relative motion lines (RML) of multifarious ship contacts A, B, and C. After plotting, findings revealed that the new relative motion line of Ship *A* was 280^0, Ship *B* target 051^0, and Ship *C* target 028^0. For the three ship contacts, majority of the students determined ship contact C that obtained (69%), then ship contact B (65%), and ship contact A (64%). This implies that more students acquired the knowledge regarding relative motion lines of multifarious ship contact.

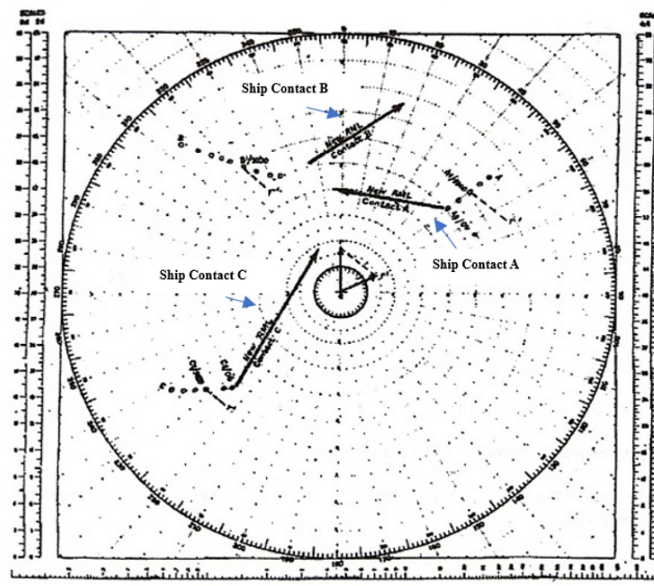
Table 3: Prediction of whether own ship changes course, speed, and time due to the relative-motion lines of contacts A, B, and C.

Details	*Previous Own ship Contact*	*Predicted Own Ship Contact*
Course	000^0	065^0
Speed	20 knots	15 knots
Time	1000 hours	1006 hours

Source: Authors.

Table 3 shown the predicted whether own ship change course to 065^0 and speed of 15 knots at 1006 hours. It implies that due to multifarious ships contacts: A, B, and C, own ship altered to its new course 065^0 from 000^0 and reduced speed to 15 knots from 20 knots, and from 1000 hours plotted started time to 1006 hours, respectively. The data emphasized that own ship alter course, change speed, and increasing the time by six minutes in time. This predictive analytics decision of own ship due to new relative motion lines/course of multifarious ships contact A, B, and C was in accordance with the international regulations for preventing collision at sea (COLREGs) to prevent collision in the vicinity *(see Figure 1.*

Figure 1: Predicted change in own-ship course, speed and time due to the relative-motion lines of multifarious ship contacts A, B, and C (relative motion, true bearing, north-up, scale 1:1).



Source: Authors.

Table 4: Significant difference between relative-motion-line determination and predicted changes in own-ship navigation.

Variables	*Mean*	*Variance*	*p-value*	*Interpretation*
Ability to determine the ships relative motion lines (RML) of multifarious ship contacts A, B, & C.	1.65	0.0838	0.000281173 *P(T<=t) one-tail 0.000562346 **P(T<=t) two-tail	No significant difference between variables, since *p-value* is less than *0.05* level of significance both one-tail and two-tail.
Predicts whether own ship change directions due to the new RML/Course of contacts: A, B, & C.	1.79	0.0797		

Source: Authors.

4. Conclusions.

The study concluded that the relative motion lines (RML) of multifarious ship contacts A is 280^0, ship contact B is 051^0, and ship contact C is 028^0. It had been predicted that ship contacts: A, B, and C maintaining true course and speed, *e-m* vector remains static, while own ship's *e-r* vector is rotated about *e* to the new course 065^0 and changed in magnitude corresponding to reduce the speed from 20 knots to 15 knots at 1006 hours to avoid collision. There was no significant difference between relative motion lines and predicted whether own ship change course, speed, and time due to RML of multifarious ship contacts A, B, and C.

Recommendations:

1. The instructor must apply more simulation exercises to the students that unable to determine the relative motion lines (RML) of multifarious ship contacts A, B, C and unable to predict whether own ship change course, speed, and time due to new RML of multifarious ship contact during navigation at sea to avoid collision.
2. The students that able to determine the RML of multifarious ship contacts A, B, & C must apply complex situations to establish critical thinking analysis for better decision-making in collision regulations.
3. The administrators and faculty in Maritime Higher Education Institutions (MHEIs) should formulate learning activities and trainings that suitable to the learning styles of the students for better understanding of the concepts and life-long learning.

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