A Portrayal Experiment of Under Keel Clearance Service Area

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Agenda

I. Introduction

II. Algorithm for calculating UKC and determining the UKC service area

III. Case study

IV. Conclusion

I. INTRODUCTION

I. Introduction

Background

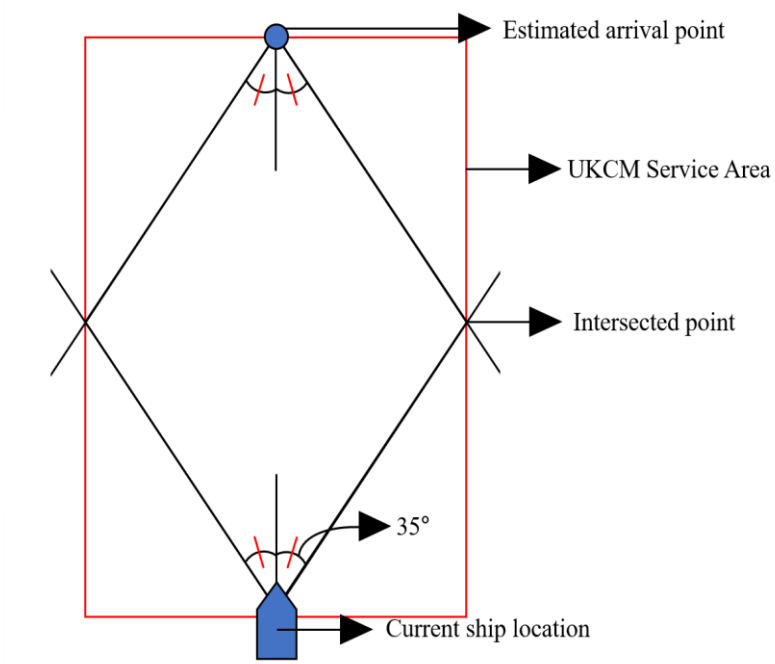
- At the 7th meeting of the S-129 Project Team, the definition of the UKC (Under Keel Clearance) service area on electronic navigational charts was discussed as a critical issue
- This research contributes to this field by proposing a maximum steering angle for defining UKC service areas
- Building upon the International Standard for Ship Maneuverability Testing, MSC.137(76), which provides guidelines on maneuvering metrics, our study aims to bridge the existing gap by suggesting an algorithm for the definition of the UKC service area.

II. ALGORITHM FOR CALCULATING UKC AND DETERMINING THE UKC SERVICE AREA

II. Algorithm for calculating UKC & determining the UKC service area

Algorithm for determining the UKC service area

- The amount of time required to reach the expected arrival point, which has been arbitrarily set at 2 minutes, can be adjusted for convenience.
- When the required time is set to 2 minutes, the clearance depth information is updated and displayed every minute, allowing for continuous display in the service area.
- To determine the coordinates of the intersection point of the rotated line with a steering angle of ±35°, we utilized spherical trigonometry to account for the curvature of the Earth.

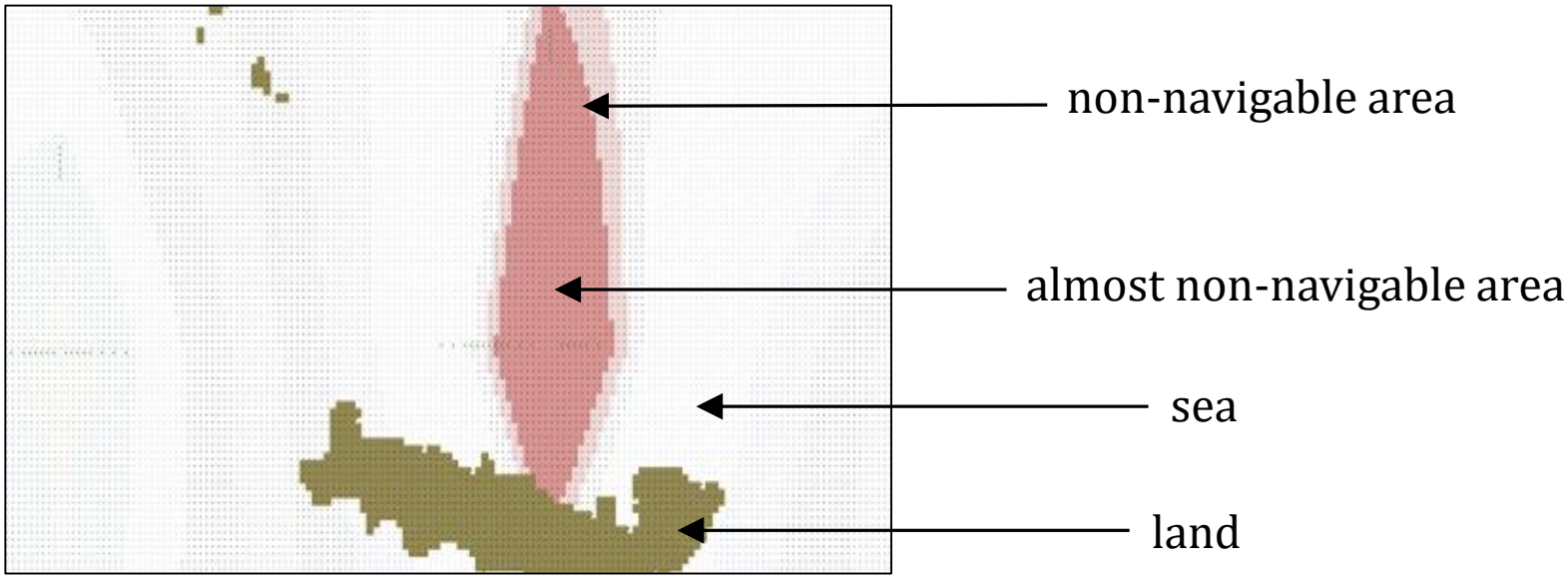


<The algorithm for determining the UKC service area reflects the maximum steering angle>

II. Algorithm for calculating UKC & determining the UKC service area

Algorithm for deriving the UKC edge coordinates

- By applying the formula for calculating under keel clearance, it is possible to differentiate between areas that are non-navigable and almost non-navigable based on the resulting minimum safe depth values.



<Deriving UKCM service area from UKC value table>

II. Algorithm for calculating UKC & determining the UKC service area

Algorithm for deriving the UKC edge coordinates

- The results of the under keel clearance calculation, with dark colors indicating non-navigable areas and light colors indicating almost non-navigable areas.
- The latitude and longitude coordinates that correspond to the threshold value with negative under keel clearance values.
- These coordinates serve as fundamental data for displaying the areas on a map.

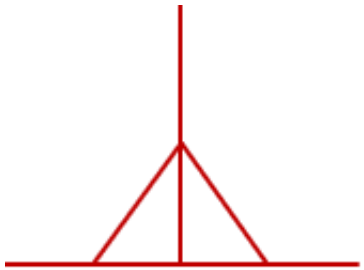
<Deriving UKCM service area from UKC value table>

	non-navigable	almost-navigable
2	37.364476,126.349385	37.364476,126.335385
3	37.363476,126.349385	37.363476,126.335385
4	37.362476,126.349385	37.362476,126.335385
5	37.361476,126.349385	37.361476,126.335385
6	37.360476,126.350385	37.360476,126.336385
7	37.359476,126.350385	37.359476,126.336385
8	37.358476,126.351385	37.358476,126.336385
9	37.358476,126.352385	37.357476,126.336385
10	37.357476,126.353385	37.356476,126.336385

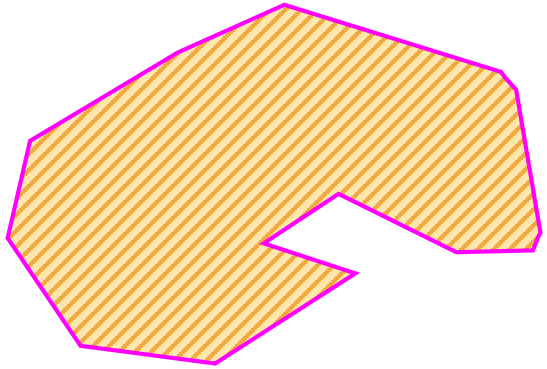
II. Algorithm for calculating UKC & determining the UKC service area

Suggestion of UKCM portrayal symbol

- To display information on under-keel clearance for electronic charts based on S-100, the S-129 standard for under keel clearance management is utilized.
- The almost non-navigable area is depicted as an orange-colored area with hatch fill, while the non-navigable area is represented by a dot symbol located at the corresponding coordinates.



<Potential point symbol of S-129 (non-navigable area)>



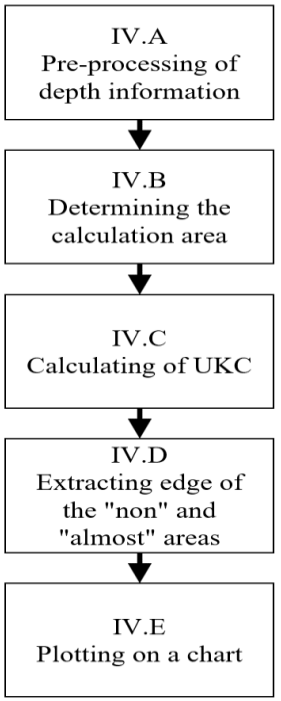
<Potential area symbol of S-129 (almost non-navigable area)>

III. CASE STUDY

III. Case study

The experiment for calculating UKC and portraying UKC area

- First, we specify the calculation area, and the under keel clearance can be calculated. Finally, the boundary coordinate values were extracted to be displayed on the chart.
- The process of calculating the under keel clearance involves utilizing depth data and determining the location coordinates that correspond to the threshold value, which can then be applied to the chart.
- We implemented it using the C++ MFC library for automating data collection, calculation, and storage.



<Process of deriving and displaying the UKC service area>

III. Case study

Preparation of the experiment

- The experimental site was chosen to be the Incheon coast of South Korea.
- The specifications of the ship were based on those of T/S HANNARA, the training ship of Korea Maritime and Ocean University.

<The experiment area for determining the depth>

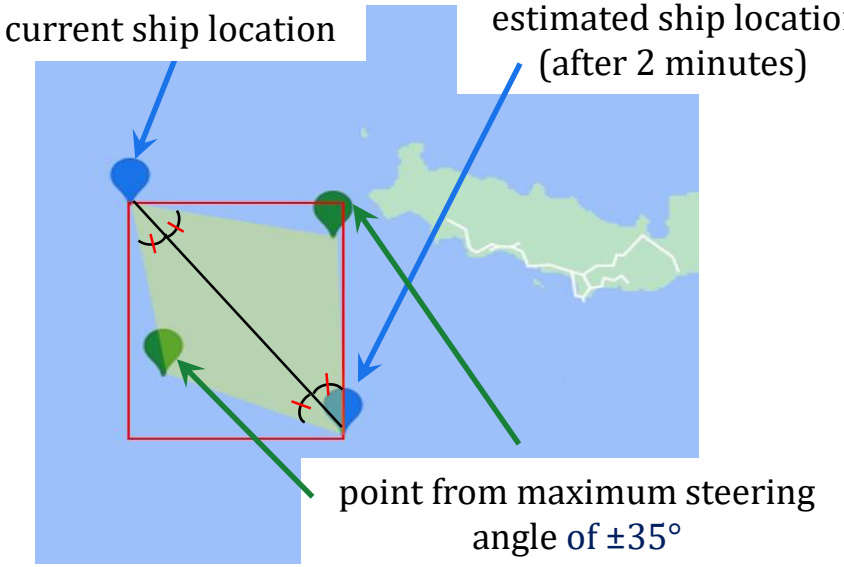
Gross Ton.	9,196 M/T
L.O.A.	133.00 M
Breadth	19.40 M
Depth	11.05 M
Max Draft	6.4 M
Built	2019.02
Complement	239

<The vessel particular information of the T/S HANNARA>

III. Case study

Determining the UKCM service area

- The estimated time of arrival to the destination has been set to 2 minutes, and the maximum steering angle has been set to 35°.
- The blue marker represents the ship's current location and its expected arrival point in 2 minutes.
- The green marker indicates the intersected of the straight line formed by the maximum steering angle of ±35°.
- The area containing the diamond shape is indicated by the solid magenta line, and the depth data within this area is measured and calculated.

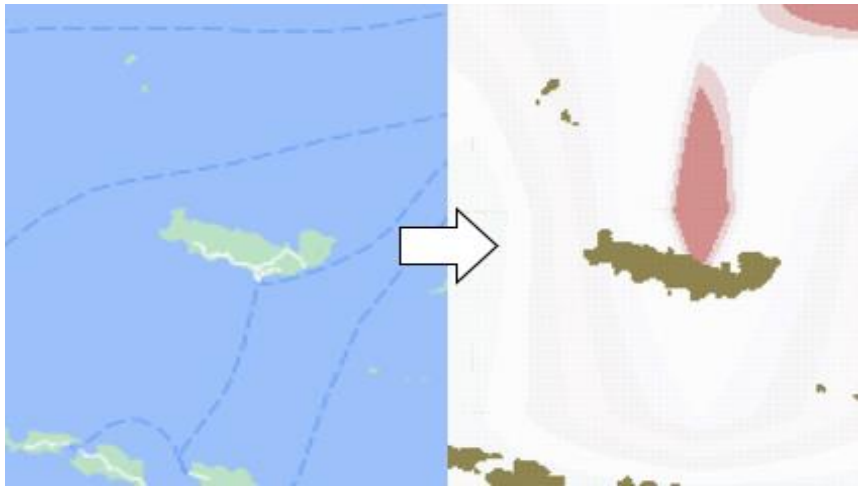


<Determined UKCM service area
after calculation>

III. Case study

Calculating UKC

- Using the formulas provided in section Ⅲ.B, you can calculate the UKC.
- The CSV file is divided into three categories based on the k coefficient and color.
  - Non-navigable Areas are represented by a dark color and have a k coefficient of 0.15.
  - Almost non-navigable areas are represented by a light color and have a k coefficient of 0.2.
  - The lands are represented by the color brown.



<The UKCM service area that corresponds with the actual map>

III. Case study

Extracting edge of the “non-navigable” and “almost non-navigable” areas

- We can extract the boundaries of areas where the calculated under keel clearance value is less than or equal to 0.
- The boundary values are derived by converting each CSV index to GPS coordinates and it is saving in a new file.

	non-navigable	almost-navigable
1		
2	37.364476,126.349385	37.364476,126.335385
3	37.363476,126.349385	37.363476,126.335385
4	37.362476,126.349385	37.362476,126.335385
5	37.361476,126.349385	37.361476,126.335385
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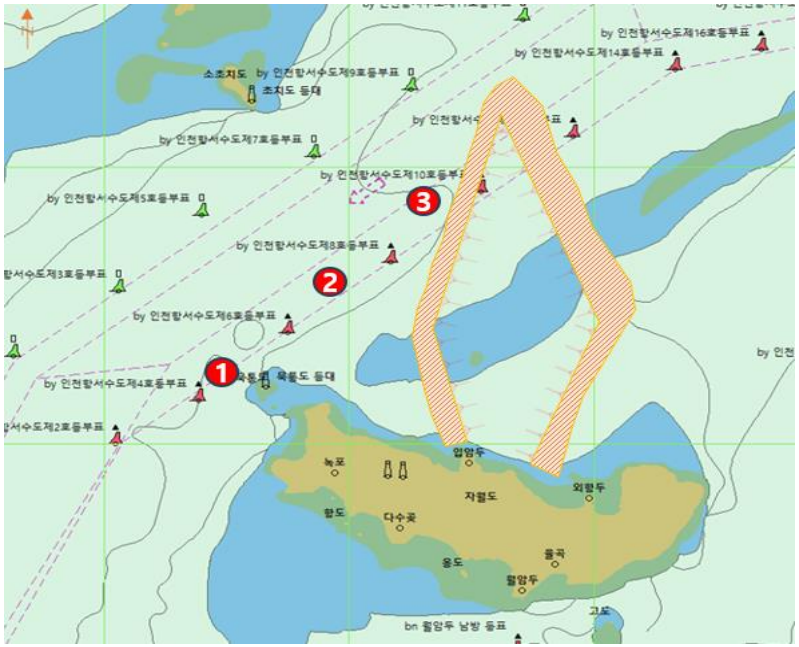
<The extraction GPS coordinates from the UKC calculation table>

III. Case study

Plotting on an electronic chart – entire coverage

- The map focuses on the coast of Incheon.
- The vertical line in the symbol represents the direction of the non-navigable area, while the horizontal line represents its boundary.
- The almost non-navigable area is marked with orange stripes.
- Figure displays the entire area of the electronic chart without defining service areas.

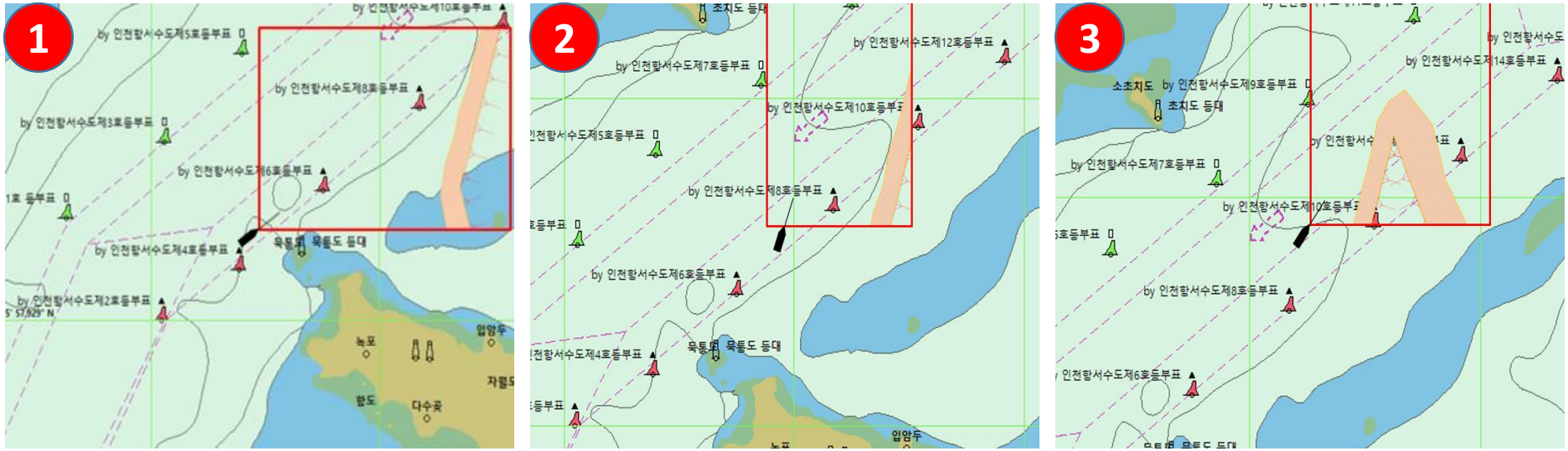


<Example of portrayal (entire)>

III. Case study

Plotting on an electronic chart – each partial coverage

- The following figures represent the application of UKCM service areas, from left to right, at one-minute intervals.



<Example of portrayal (partial)>

IV. CONCLUSION

IV. Conclusion

- The experiment underscores the significance of the S-129 UKCM service as an indispensable navigational instrument, offering a precise and current representation of UKC zones.
- The T/S HANNARA water depth data collected from the Incheon coast has corroborated the system's efficacy.
- This dynamic assessment capability empowered mariners to make informed decisions regarding safe operating zones, using continuously updated bathymetric data to avoid hazards.
- Future research endeavors will aim to enhance the accuracy of UKC calculations by incorporating a broader spectrum of variables that influence a ship's positioning in the water.

Q & A

Contact Us

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Thank you