Input paper: [[1]](#footnote-2) ENAV30-5.1.2.4

Input paper for the following Committee(s): check as appropriate Purpose of paper:

**□** ARM **□** ENG **□** PAP **□** Input

**X** ENAV **□** VTS **X** Information

Agenda item [[2]](#footnote-3) 5.1

Technical Domain / Task Number 2 …………………………………

Author(s) / Submitter(s) ……China MSA…………..

Ships’ Air Draft Remote Measurement Technology Review Using Guideline G1153 Template

# Summary

A certain amount of ship-bridge collision accidents occur because of navigators’ poor watchkeeping and false assuming of vertical safe clearance of the bridge over her route. The height difference between the ship’s air draft and the vertical clearance of a given navigable hole of a bridge is the key to determining the possibility of safe passage. The local authority in charge of marine safety usually is concerned more about the air draft situation of those ships that intend to cross a bridge, since the vertical clearance of bridges practically had been monitored by the local hydrographical office.

Shanghai Maritime University, which is also one of China MSA’s technical service providers, has developed Ships’ Air Draft Remote Measurement Technology (hereinafter referred to as SADRMT) and conducted an application effectiveness test in Zhoudai bridge water in November 2021. It is suggested that the SADRMT system could be used for ships’ air draft remote measurement and traffic monitoring to support traffic organization service delivery in VTS areas. Based on the technical test result, a preliminary technology review was conducted by using the Emerging Technology Review Table which is provided in Guideline G1153 *TEMPLATE FOR THE REVIEW OF EMERGING TECHNOLOGIES FOR POSSIBLE USE BY IALA MEMBERS.*

Considering the practicability and effectiveness of this Guideline for relevant authorities when making a technology application decision at the early stage as well as the utilization potentiality of the technology itself, this paper is to provide some relevant information and comments.

## Purpose of the document

Provide information and comments on candidate technology for review using the template contained in G1153.

## Related documents

IALA Guideline G1153 Template for The Review of Emerging Technologies for Possible Use by IALA Members

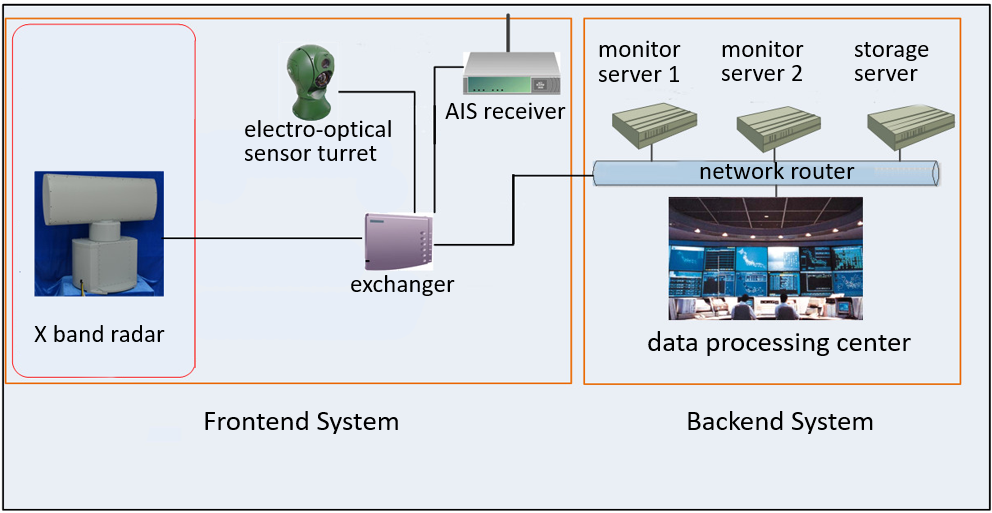
# Background

The SADRMT system was tentatively developed to assist local VTS authorities in better delivering traffic organization service and waterway management in Zhoudai bridge water, and a subsequent application effectiveness test had been conducted in November 2021. Based on the data obtained from the test, a technology review was recently carried out by using the template contained in guideline G1153, of which the relevant information is to be shared with ENAV committee members.

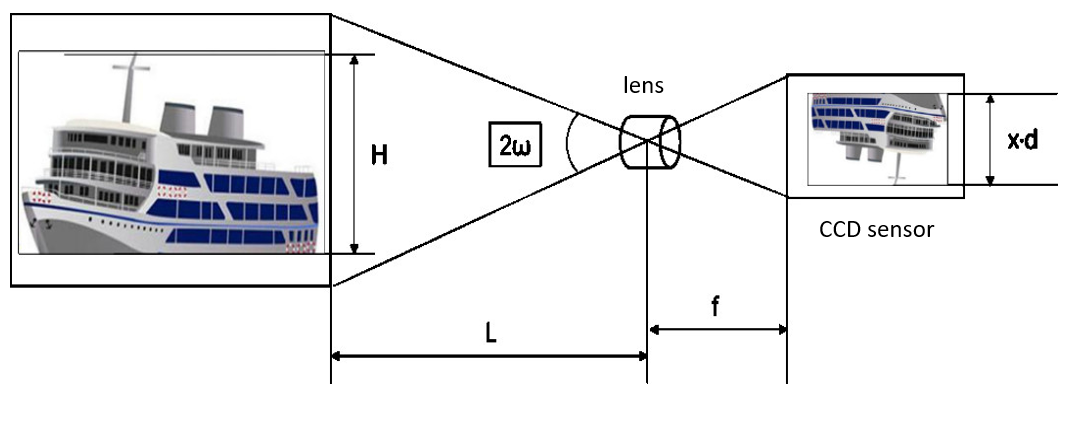
# Discussion

## Candidate technology introduction

The SADRMT system consists of a frontend sensor part and a backend control platform, the frontend part to be installed at the site of a bridge which includes an X band searching radar, a high precise electro-optical sensor turret, and an AIS receiver, the backend control platform which usually connected with frontend system by network routes, is the data processing and analysis centre that supported by corresponding software and various supporting servers, such as exchangers and storages. Based on the integration of radar, AIS and imaging data, the system could observantly locate and identify all ships as well as acquire their air draft data within its operating range. The system structure is illustrated in figure 1. The radar interacts with the electro-optical sensor turret through an exchanger, once a target is detected and tracked by radar, the electro-optical sensor turret can then immediately capture and observe the target accordingly, and the target ship’s identification information will be synchronously displayed.



1. System structure



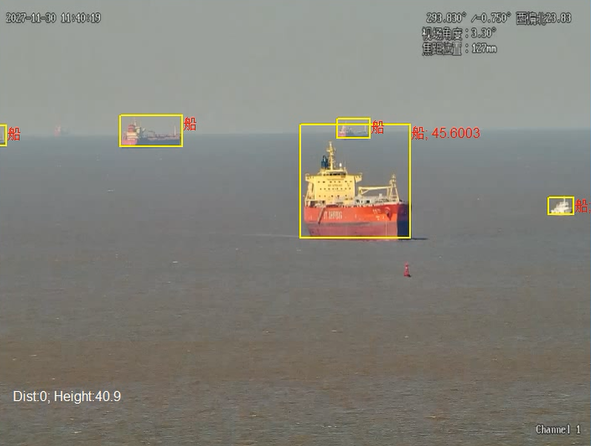
1. Ships’ air draft measurement principle

Figure 2 has illustrated that the ships’ air draft remote measurement was based on the principle of visual imaging and similar triangle. And the calculating [formula](javascript:;) is as follows:

The namely is the air draft of a target ship. The refers to the distance between the target ship and the electro-optical sensor which can be acquired by radar. The refers to the current focal length of the electro-optical sensor which can be obtained by a focal length measuring potentiometer. And the value of the is the height of the target ship’s image which is the product of pixel count and size.

## Technology application test

In November 2021, three different sizes of ships have been deemed as test targets of the SADRMT system in Zhoudai bridge water, north of Zhoushan Island. Three targets are Target A, a large tanker; Target B, a patrol boat; Target C, a floating crane ship. Once the test began, these target ships were asked to approach the Zhoudai bridge at a speed of 6 knots from 15 kilometers east of the bridge. Figure 3 shows the targets monitoring screen day and night time, and figure 4 shows the frontend equipment and system operating UI at the test site.



1. Targets monitoring in day and night time



1. Frontend equipment and system UI at the test site

The test result shows that the system could automatically and quickly acquire, and track several targets as well as effectively obtain their air draft data within a nearly 10 km range, and the target ships' air draft measurement error margin can be less than one meter when target ships proceeding into the range of 5 km. And the system responding time is less than 0.3 seconds within its operating range. Removing the influence of islands and sea conditions, the accuracy and sensibility barely met the precision and capability requirements. The test result on target ships’ air draft in the range of 5-9 km is shown in table 1.

1. Test results in the range of 5-9 km

|  |  |  |  |
| --- | --- | --- | --- |
| Range | Target A | Target B | Target C |
| 5 km | 40.5 m | 21 m | 38.4 m |
| 6 km | 42.5 m | 20.8 m | 39.2 m |
| 7-9 km | 40.3 m | 21 m | 44.4 m |

1. System performance in the range of around 9km

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Test items | Range of first capture(m) | | | Responding time(s) | | | Air draft(m) | | |
| Target A | Target B | Target C | Target A | Target B | Target C | Target A | Target B | Target C |
| Result | 8997 | 9555 | 9005 | 0.2 | 0.1 | 0.3 | 40.3 | 21 | 44.4 |
| Error | / | / | / | / | / | / | 0.55 | 0.1 | 1.6 |

Table 2 shows the system capability detail in the range of 7-9km, of which the maximum operating range is 9555 meters and the maximum responding time is no longer than 0.3 seconds. *Note: responding time in table 2 refers to the period between the beginning of target capture and the air draft of target ships to be obtained.*

1. Error Statistics

Table 3 shows the error statistics in the range of 5-9km, which indicates that the ships’ air draft measurement error is under the one-meter control line within the range of 5 km.

## Potential use

As one of the components of the dynamic dimension of a ship underway, air draft data obtained and portrayed by the SADRMT system could be taken by the VTS officer on watch as an important reference to support traffic organization service delivery, waterway management, and bridge passage planning, to reduce administrative burden and reduce the risk for miscommunication due to external interference.

And such a data obtaining system could also be integrated into a comprehensive information service system in the context of E-navigation.

## Technology review and comments

According to the steps described in Guideline G1153, a technology review table, of which the ‘Technology Candidate Response’ column has been filled as fully as possible, is provided in Annex.

Based on the test performance and preliminary review, the following summative comments can be given to the SADRMT:

* Has extensive backward compatibility, and its system can be overlayed with a variety of other relevant data, which also has great application potentiality in China.
* Currently in prototype test stage and needs to be tested in more different weather conditions.
* Capability and precision need to be further improved.

# References

1. IALA Guideline G1153 Template for The Review of Emerging Technologies for Possible Use by IALA Members
2. MSC.1-CIRC.1610 - Initial Descriptions of Maritime Services in the Context Of E-Navigation

# Action requested BY the Committee

The Committee is requested to note the above-mentioned information and take action as appropriate.

1. Input document number, to be assigned by the Committee Secretary [↑](#footnote-ref-2)
2. Leave open if uncertain [↑](#footnote-ref-3)