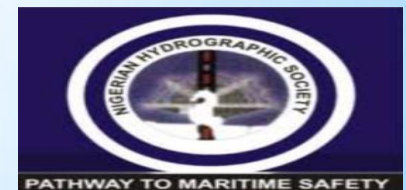


WORLD HYDROGRAPHIC DAY 2021

A PRESENTATION

ON

ADVANCEMENTS AND THE FUTURE OUTLOOK OF CHARTING THE NIGERIAN NAVIGATIONAL CHANNELS



INTRODUCTION

What is Hydrography?

Hydrography as defined by the National Ocean service “is the science that **measures and describes the physical features** of the navigable portion of the Earth's surface and adjoining coastal areas. Hydrographic Surveyors study these bodies of water to see what the "floor" looks like”.

Hydrographic Survey still remains the only means in which spatial information about our marine environment (oceans, seas, rivers etc.) are acquired for charting purposes. Therefore preserving its methods and accuracy is of utmost importance.

HYDROGRAPHY

Hydrographic surveys are conducted using multibeam echo sounders.

multibeam echo sounder beams sweep the seafloor as the ship passes over the survey area

multibeam echo sounder beams bounce off the seafloor and return to the ship where the depth is recorded

Hydrography is the science that measures and describes the physical features of bodies of water and the land areas adjacent to those bodies of water.

Surveying with multibeam echo sounders is the primary method of obtaining hydrographic data.

HYDROGRAPHERS

measure water depth, and search for shoals, rocks, & wrecks that could be hazards to navigation. They also collect information on:

- water levels & tides
- currents
- temperature
- salinity

What products are made from hydrographic survey data?



nautical charts
essential maps for safe marine navigation



hydrographic models
baseline data for research and marine geospatial products and services

By mapping out water depth, the shape of the seafloor and coastline, the location of possible obstructions, and physical features of water bodies, hydrography helps to keep our maritime transportation system moving safely and efficiently.

Fig1: Hydrography and products obtained from hydrography. Source: National Ocean Service

INTRODUCTION

As can be seen in *Fig1*, the two major products of hydrographic surveying according to the National Ocean Services are;

1. Nautical charts, which are essential for safe marine navigation.
2. Hydrographic models: baseline data for research and marine geospatial products and services

One of the **duties** of the **Nigerian Navy** is the making of charts and coordinating national hydrographic surveys

This means that for safe marine navigation, nautical charts should be made with **very high precision**.

This paper therefore points out to the future outlook look of making Nautical charts by both private hydrographers as well as the Nigerian Navy

INTRODUCTION

HYDROGRAPHIC OPERATIONS

Hydrography is simply carried out to deduce underwater topography from numerous discrete observations of depth at positions throughout the area.

Hydrographic survey operations are carried out to:

1. Provide basic data for nautical charting
2. Obtaining site detail for alongshore or offshore construction
3. Assessing the condition of port and marina facilities
4. Measuring the quantities in dredging projects and
5. Determination of the extent of siltation and for numerous other reasons.

This presentation will be based on **nautical charting or nautical chart making**

AIM AND OBJECTIVES

The Aim of the paper to point out the advancements made in hydrographic surveying from where we were **yesterday**, where we are **today** and the **future** outlook of hydrographic surveying.

The objectives of the paper are:

1. Reviewing the progressive trend of Hydrographic Survey methods in terms of nautical chart making.
2. Recommending the future outlook of the practice of hydrography in Nautical chart making in Nigeria, in order to maintain a solid foundation built on accuracy.

NAUTICAL CHARTS

Nautical Chart according to the National Ocean service “is a map of the sea.” They further described it as a map that helps those travelling on sea to navigate safely and efficiently. Nautical charts are what maps are on land.

All Nautical charts start with data collection- Basically measured water depths and positions.

We will be further focusing on the instruments in charting waterways.

TRENDS OF HYDROGRAPHIC SURVEY

The constant need for accuracy in mapping marine bodies (oceans, seas, rivers etc.) have been the driving force in the advancements of the survey methods used in charting navigational channels. For as these methods progressed, sophistication of equipment(s) and methodologies progressed directly too. These methods have gradually advanced from **Direct Methods** which produced incomplete and interpolated information to the present day **Indirect Methods** which give more reliable and comprehensive information on any marine environment of interest.

TRENDS OF HYDROGRAPHIC SURVEY

DIRECT METHODS (Methods used in the past)

- Lead lines and Graduated Poles
- Wire Drag Surveys

■ INDIRECT METHODS (Present and future methods)

- Echo sounder (Fathometer)
- Side Scan Sonar
- State-of-the-Art Technologies employed in Hydro

TRENDS OF HYDROGRAPHIC SURVEY (DIRECT METHODS)

The earliest use of direct methods for hydrographic survey cannot be traced, as there are no official records to its first use and invention. But it is important to note that because there was little or no information (Nautical Charts) for sailing ships on coastal waters, the United States congress in 1790 began authorizing specific and limited surveys of the coast (NOAA, 2017). Which involved the use of weighted lines and graduated poles to take direct measurements to the seabed to determine depth differences and positions of features on the seabed

Inasmuch as this method was accurate on its own, it was laborious and time consuming and the nautical charts produced using these methods were interpolated because of limited coverage

TRENDS OF HYDROGRAPHIC SURVEY (DIRECT METHODS)

WIRE DRAG SURVEY

The invention of the Wire Drag method in the early 1900 revolutionized the practice of Hydrographic survey.

The methodology of the Wire Drag Survey had the attachment of each edge of a wire net (at a specific depth to two different vessels as seen in **Fig2**), and while the vessels moved and encountered an obstruction, it would make a V shape exposing the location and depth of the obstruction (NOAA as cited in Donald and Parnell, 2018)

TRENDS OF HYDROGRAPHIC SURVEY (DIRECT METHODS)

WIRE DRAG SURVEY



Fig 2 showing Wire Drag Survey. Source: NOAA as cited in Donald and Parnell, 2018

TRENDS OF HYDROGRAPHIC SURVEY

INDIRECT METHODS

- Bathymetric Surveys
- Identification of physical features
- State-of-the-Art Technologies employed in Hydro

TRENDS OF HYDROGRAPHIC SURVEY (INDIRECT METHODS)

BATHYMETRIC SURVEY

1. Bathymetric survey is concerned with the measurement of water depths of any marine environment of interest. In order to produce seafloor topographic map. Unlike in the past when Bathymetric surveys were carried out using weighted lines, graduated poles, sextant etc. These days Echo Sounder is the dominant equipment used in Bathymetry.
2. The Titanic disaster of 1913 drove German Physicist Alexander Behm to discover the use of sound pulses to determine water depths from the top to the bottom of the sea, while the 1930's saw the implementation of single beam sounder then advancing to the preferable use of Multi beam Echo Sounder which sends out a spread of sound waves in one ping with a better coverage than the single beam Echo Sounder as seen in *Fig3*

TRENDS OF HYDROGRAPHIC SURVEY (INDIRECT METHODS)



Fig 3: A simulated image showing the multi beam Echo Sounder. Source: Ocean News and Technology Magazine(2019)

TRENDS OF HYDROGRAPHIC SURVEY (INDIRECT METHODS)

BATHYMETRIC SURVEY- LITERAURE REVIEW

1. (Tata et al, 2019)- Lagos lagoon using Echo Sounder, GPS (Absolute positioning), PowerNav etc.
2. (Badejo and Adewuyi, 2019)- Badagry Creek and Yewa River using Echo Sounder, RTK-GPS, Hypack, ArcGIS etc.
3. AKK Gas Pipeline Project- Bathymetric Survey specifications (Nigerian National Petroleum Corporation, 2019)
4. Chukwu and Badejo, 2015)- Bathymetric survey of the Lagos Lagoon to study seabed Topographical Changes over a six (6) year period from 2008-2013

TRENDS OF HYDROGRAPHIC SURVEY (INDIRECT METHODS)

IDENTIFICATION OF PHYSICAL FEATURES

In accessing the progressive evolution of the hydrographic methods used in mapping seafloors, the 1950's to 1970's saw the offering of Side Scan Sonars and Multi Beam Swathe systems to provide a qualitative means of mapping our seafloors and identifying positions of wrecks and features (NOAA, 2017).

This on its own solved the problem of incomplete depth determination as encountered in the Single Beam Echo Sounder (SBES) and the limitations in identifying physical features as encountered in the Wire Drag method.

TRENDS OF HYDROGRAPHIC SURVEY (INDIRECT METHODS)

IDENTIFICATION OF PHYSICAL FEATURES

These days, in the execution of various marine projects applied in engineering, navigation etc. full spread Bathymetric and Geophysical surveys are recommended, as such combination provides a better understanding of the interest marine environment.

Geophysical Surveys are **not** basically Hydrographic survey, and it is **totally different** in its entirety but its principles and equipment(s) have applications in most underwater projects including mapping of navigable waters.

TRENDS OF HYDROGRAPHIC SURVEY (INDIRECT METHODS)

Here are some related scope of works associated with the identification of physical features.

1. Bathymetric Survey to determine depth variations, preferably using a Multi Beam Echo Sounder
2. Identification of debris and wreckages on the seabed, using a Side Scan Sonar which provides a recorded video/pictorial imagery of inherent positions of debris and wreckages.
3. Determination of geo-hazards: especially metallic anomalies underneath the seafloor, using a Magnetometer.
4. Navigation and Positioning using mainly Satellite Based Augmentation System (SBAS).
5. Data Processing and Charting using software(s) like Hypack, AutoCAD, Surfer etc.

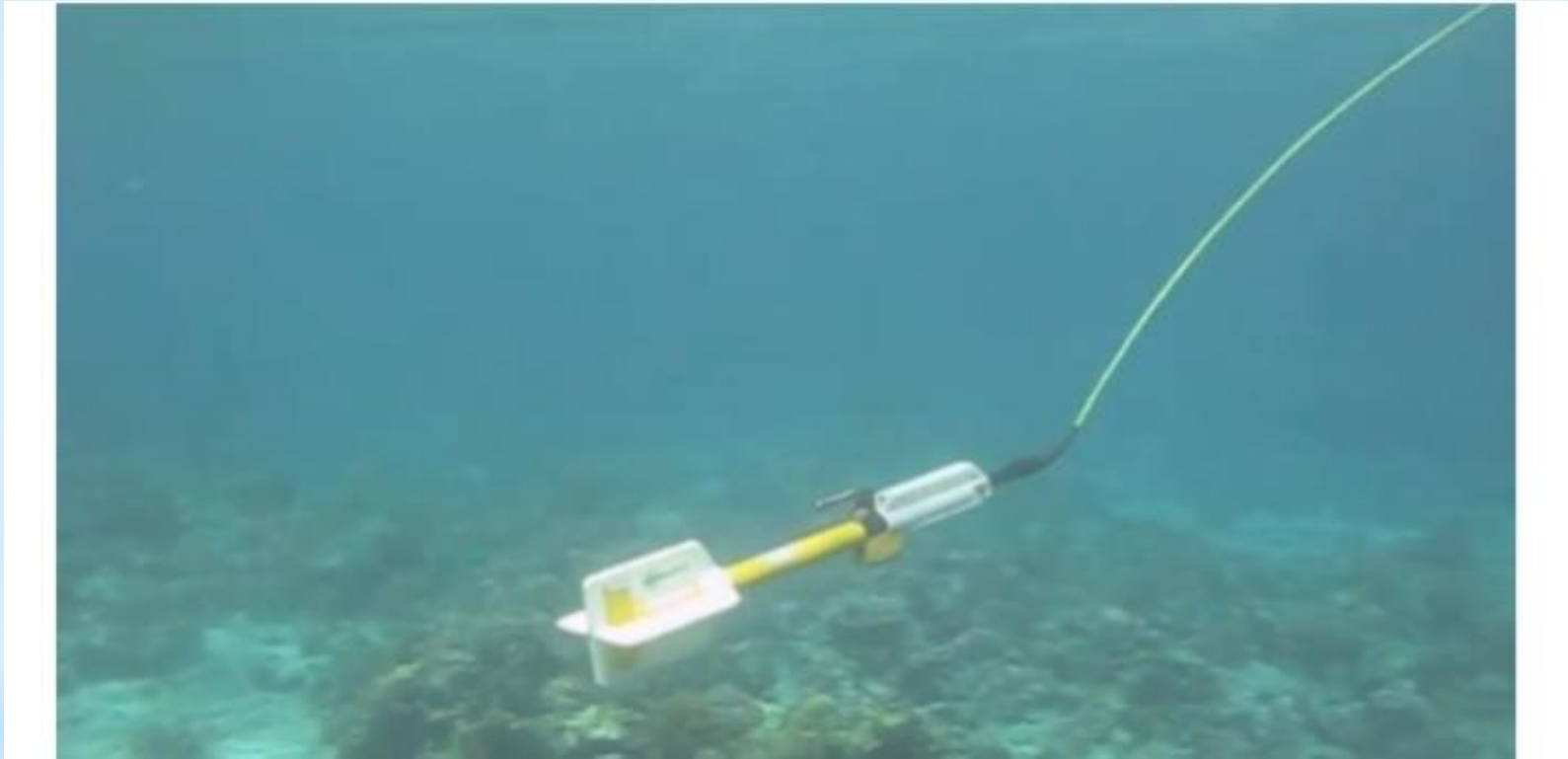
GEOPHYSICAL SURVEY



Fig 3 showing a SSS image on display on Topside, and showing a wrecked boat.

Source: JW Fishers (undated)

GEOPHYSICAL SURVEY



*Fig 5: G-882 Geometrics Magnetometer deployed in Nampula Mozambique.
Source: Arqueonates Worldwide (undated)*

TRENDS OF HYDROGRAPHIC SURVEY (STATE-OF-THE ART TECHNOLOGIES)

Some of these new techniques which have been applied in Bathymetric data collection have been described as “non-traditional” (Leder et al, 2020). They include

- Light Detection and Ranging (LiDAR) Platform
- Satellite Derived Bathymetry (SDB)

LIGHT DETECTION AND RANGING(LiDAR)

LiDAR uses the propagation of light waves to determine information on any phenomenon of interest.

(Leatherman, 2003) classifies LiDAR based on two purposes, for either Topographic purpose or Bathymetric purpose, where the Bathymetric LiDAR which is hydrography related can be used in data collection of coastline and shallow waters (Leder et al, 2020), with its major advantage being able to collect data in areas inaccessible to survey vessels.

SATELLITE DERIVED BATHYMETRY (SDB)

- SDB is defined as the determination of depth information by analyzing satellite images (Sagawa et al, 2019).
- SDB uses remote sensing techniques to understand seabed topography by employing multi-spectral and hyper-spectral sensors.
- SDB has the potential to become one of the main low cost sources of spatial data especially in Hydrographic Surveying (Leder et al, 2020)

RECOMMENDATIONS

To achieve the paper's aim of preserving the precision in mapping the Nigerian navigational channels, the progressive trend in hydrographic survey had to be reviewed from direct to indirect methods ushering in more sophisticated equipment(s).

The following recommendations if implemented could redefine the practice of hydrography in Nigeria with accuracy being its driving force.

RECOMMENDATIONS

- INVOLVEMENT OF KEY PLAYERS- Calling for research works and projects carried out on all Nigerian waters as base information for uncharted waters.
- SATELLITE SYSTEMS: Explore the technologies in satellite systems for more remote charting of our navigational channels
- QUALITY CONTROL: A team that regulates the practice of hydrography in Nigeria for the maintenance of standards and uniformity in practice.
- TRAINING: Adequate training or an improvement to existing curriculum of Nigerian military academies, universities, polytechnics and colleges of education.

CONCLUSION

The understanding of the progressive trend was crucial to recommending of the future outlook of charting the Nigerian navigational channels. This progressive trend has graduated steadily from the direct methods to the dominant indirect methods. But it is noteworthy to say that all succeeding methods were solutions to the limitations of the previous methods which were driven by the need for better accuracy and sophistication. Inasmuch as this paper has tried to proffer some recommendation, the future still seems unpredictable as it is probable that better methods and equipment(s) are expected to redefine the limitations of the present day dominant methods.

THANK YOU