

# Research on application of holographic navigation marks in the upper reaches of Yangtze River

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**Abstract:** The section of the upper reaches of the Yangtze River is complex, so the layout of the visual navigation marks is dense, the maintenance work and the risk is great. The holographic navigation marks projection facilities are laid on the shore with wide coverage, which can effectively reduce the labor intensity and labor risk. Compared with the traditional marks, the holographic navigation marks is easier identification especially at night, hardly damaged, and easily repaired, which can significantly improve the navigation safety level in the upper reaches of the Yangtze River.

**Keywords:** navigation safety; holographic navigation marks; Research Trends.

## 1. INTRODUCTION

The navigation marks in the upper reaches of the Yangtze River are dense for complex channel. The navigation marks are located in navigable waters or nearby, to indicate the location of waterways, anchorages, beach risks and other obstructions, and to direct traffic in narrow waterways. The upstream channel is narrow and the flow pattern is disorganized. The water level rises and falls steeply under the influence of flood and Three Gorges reservoir. The diurnal variation can reach more than 6 meters, and the annual variation of water can reach up to 20m.

The maintenance work of the navigation mark is highly demanded with high risk. When setting up the marks, such tools as floating crane and hanger are not applicable due to water depth. In the summer flood period, tall trees and bamboo are flooded down the mountains, piled on navigation marks, which can cause heavy damage. Occurrence of insect and snake bites and other accidents, work on limited space or on craggy waterway, extremely long hours especially during the flood period put maintenance workers in difficult position, as shown in Fig. 1.

**Figure 1: hard work during the maintenance**



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## 2. CURRENT NAVIGATION MARKS

The commonly used navigation marks are mainly divided into visual marks, audible marks and radio navigation mark. Visual aids contain lighthouses and beacons, lights, buoys, and various pile lightship beacon. Audible marks use prescribed sound to navigate, which can express obstacles or dangers to nearby ships during foggy and snowy day, including foghorn, fog bell, fog gun etc. Radio navigation marks provide navigation aids for positioning and navigation information by means of radio wave propagation characteristics. Radio navigation marks mainly include radar reflectors, radio beacon, and radar responder.

In October 29, 2011, Shanghai Yangtze River Waterway Administration successfully set up 4 AIS virtual marks in Sutong Bridge waters. The AIS base station sends the virtual beacon information (name, location, etc.) in the format of the VHF link, and the carrier AIS receives this information through the application software in the PC machine, and outputs the information to the electronic chart to realize the navigation function. The virtual beacon must be equipped with AIS equipment and ECDIS, otherwise the virtual navigation will not be displayed normally. It also requires that the AIS network system have very high reliability (the high mountain area in the upper reaches, the signal is unstable). Considering that the driver can not directly observe the lighting, target, etc. of the actual navigation equipment, there will be some problems in the practical application [1].

In 2015, Intelligent navigation system was brought up. Based on AIS communication signal, every navigation mark equipped with AIS creator, with its location, water speed, temperature, and 3 G network real-time beacons and ship condition monitoring, which can effectively improve monitoring efficiency and reduce the cost. System of independent research and development, operation has completely independent intellectual property rights, especially suitable for port and waterway applications[2].

## 3. DESIGN OF HOLOGRAPHIC NAVIGATION MARKS

### 3.1. Basic principle of holographic projection

Based on the diffraction theory, the holographic projection technique uses coherent plane waves to irradiate the pure phase hologram, and the projected image is the intensity distribution of the Fraunhofer diffraction pattern produced by the pure phase hologram, and reproduces the real three-dimensional image of the object [2]. The viewer can watch without needing to wear 3D glasses, so as to achieve the real 3D projection. The hologram process is shown in Fig. 2. The reconstruction process of hologram is shown in Figure 3.

Figure 2: The hologram process

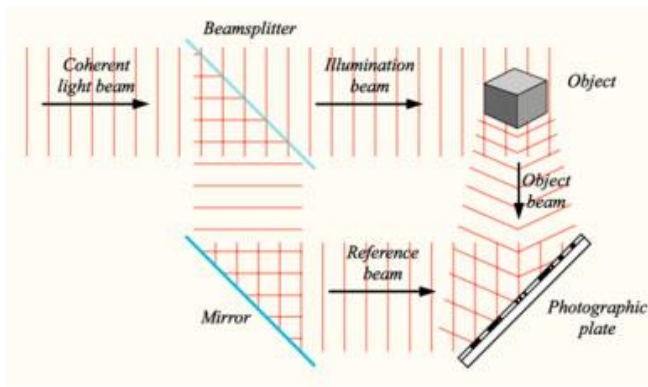
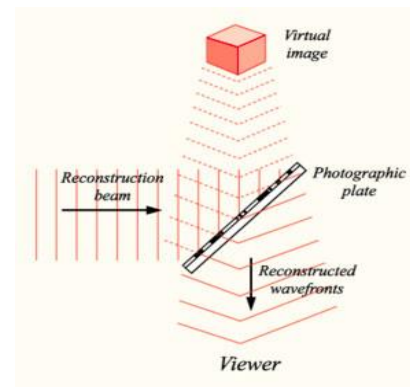


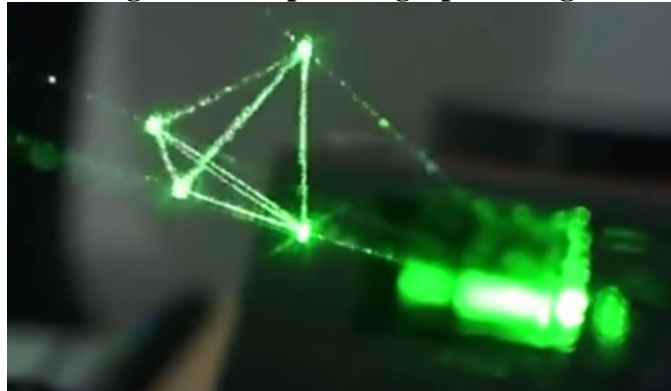
Figure 3: The hologram process



### 3.2. Common application of holographic projection in displaying

Based on the produced procedure, there are on screen, water vapor, or on the air by laser beam. The image is projected on the mirror, and then the mirror is rotated at a high speed to produce a stereoscopic 3D image. Some technique projects the image on the uneven vibration among the molecules of water vapour. The laser beam technique is considered to be the most complex projection, which takes burning nitrogen and oxygen mixture as projection, but the image can last a very short time, which is shown in Figure 4.

**Figure 4: simple holographic image**



According to the display angle, there are three classes:  $360^\circ$ ,  $270^\circ$ ,  $180^\circ$ . The current holographic projection is mainly used for in-door display, such as concerts, museums, exhibitions and so on.

$360^\circ$  holographic projection technology can make the stereoscopic image suspended in the free space outside the equipment without any screen or medium, and no matter from which angle the three-dimensional image is displayed, the storage of information is large, the actual product is not necessary to the scene, and the colourful and three-dimensional vivid exhibition can be displayed through the recorded image. It is suitable for displaying large, complex or valuable items, such as cars, forklifts, watches. Simple actual 3D images can be achieved in Figure 5.

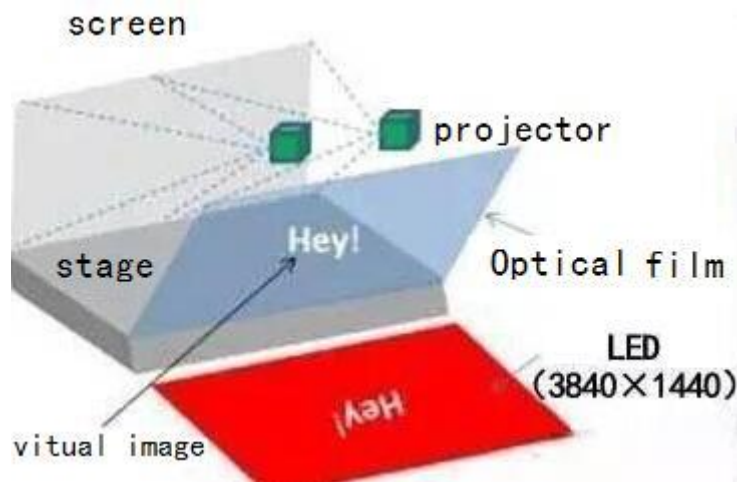
**Figure 5: simple holographic image**



270° holographic projection is suitable for the items that show the details or the internal structure, and can also show the characters, the cartoon image, the precious relics, the precious objects and so on. It is suitable for all kinds of exhibition halls, conferences, expositions, museums, science museums, etc.

180° holographic projection records and restores the real images of the characters or objects through professional technology, and reproduces the recorded images on the holographic imaging film, and the results are vivid. It is suitable for the interior of science and technology museum, exhibition hall, theme park, cultural centre and landmark building. It can display characters, objects or signs in digital form, which is suitable for the image reproduction and image display of large stadiums and gymnasiums, shown as in Figure 6.

**Figure 6: 180° holographic image**



### 3.3. Consumption of application in the upper reaches of Yangtze River

In the course of the construction of the Yangtze River safe waterway, the holographic navigation mark can realize the functions of temporary rapid setting; identify special waters and optimize the distribution of the special river navigation marks, without hindering navigation. It can be a great important supplement and improvement for entity navigation marks[3].

The holographic navigation mark can be set rapidly after accidents. When a water traffic accident occurs in a waterway, a ship sunk, the channel department needs to set up a special sign in the position of the wreck to remind the passing ships to be safe and safe to navigate. Since the accident occurred, it is difficult to set up a special sign in the first time and bring some hidden dangers to the safe navigation of the ships. The holographic navigation mark project can be set on hills, communication tower, or even tress nearby. Without riprapping, drowning injury will highly decrease.

The holographic navigation mark does not hindering water traffic. There are many special waters such as anchorage, mooring area and gyratory water area on the Yangtze River channel. In order to facilitate the identification and rational use of these waters, a number of special marks should be set up to identify the water boundaries, but most of the mooring areas are close to the main channel, which may bring obstacles to the ship navigation. The holographic navigation mark rebuilding marks with virtual image, poses no threat to the safety of water traffic.

The holographic navigation mark can cover large range, as large as the light can covers. It can built all the marks needed in certain sections, as long as built the projection equipment in solid conditions with precise geographic information.

The holographic navigation mark can be set in special narrow channel. For example, the waterway in the upper reaches is very narrow. While there are many berths in the right bank of the waterway, solid navigation mark will block the traffic, so boats are navigating with left navigation marks only. The holographic navigation mark can build image like beacon, tower, line or even number in different shapes, project on waterway surface, effectively separate the main channel and the terminal, and play a very significant role in improving the navigation environment in the area.

The holographic navigation mark can provide effective support for the Yangtze River digital waterway construction. With the combination of navigation channel chart, it can realize dynamic monitoring and timely maintenance, ensure the accuracy of the navigation information, offer better service to meet the safety requirements of the ship, so that to promote the safety construction of the Yangtze River Economic Belt.

### **3.4. Disadvantage of holographic navigation marks based on current technique**

The current holographic projection technology is not clear enough when the sunshine condition is good when used as navigation marks. The current civil holographic projection technology is mainly used in indoor venue design or night display, such as industrial display, clothing performance, and so on. The darker light in the surrounding environment is better, but the image and line of the holographic projection of the navigation mark may not be very clear in the upper reaches of the Yangtze River except on rainy days and at night.

Proven technology of holographic projection may not suitable for navigation, and further promotion is needed. Some projection technology is aided by projection medium which would hinder navigation. For example, clothing performance requires acrylic or glass screens as a holographic projection film, and the setting and fixing of the film may obstruct the water traffic. Some imaging time is short and the effect is vague. By using laser beams, the nitrogen and oxygen in the air are constantly exploding to form a 3D image[4], although the solid projection film is not needed, but the 3D image formed is short and unstable.

There is still a long way to go before holographic projection used in navigation marks.

### **3.5. Design of power supply system**

In the inland river basin of China, the humidity is large and the fog is heavy especially in winter time. The continuous fog and haze weather may cause the navigation system unable to work normally because of insufficient power supply. The power supply system gradually becomes the bottleneck of the development of the multi-function navigation mark in the inland river. Wind and solar complementary multi-function navigation aids power supply system can ensure continuous and stable power supply of multi-function navigation marks[5].

## **4. CONCLUSIONS AND PROSPECTS**

Holographic navigation marks have great potentials for future. Combined with development of augment reality, holographic navigation marks can avoid trees and bamboo's damage, can be easily repaired without high aloft work, saving maintenance workers from high strength and high risk labor. In addition, less damage lead to less cost, so that the investment can be used in other area of need.

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