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NAVIGTAION SYSTEMS

Abstract. The article is about history of navigation systems. The modern navigation methods are also discussed.
Key words: navigation, local navigation, global navigation, navigation methods.

INTRODUCTION

Since ancient times, people had to be guided in the area. To do this, they used landmarks, guided by the sun, stars, definite natural and artificial high objects. Later maps, astrolabes, compasses appeared. [1]

For the first time, the need for orientation was exacerbated by sailors. For orientation, they used the stars, the sun, and, later, and the first navigation devices, such as the compass. One of the devices for orientation served, and still used beacons. [1].

HISTORY

Lighthouse is a means of sea-going equipment in the form of a tower-type capital construction, designed to denote dangerous places, passageways for ships. This structure has a bright contrasting color, which visually allocates it against the background of the surrounding area. The beacons are equipped with a strong light source and are usually provided with optical means to amplify the light signal to be clearly visible at night. [2]

The lighthouse can also give the vessels a sound signal or transmit a radio signal to perform its function also under conditions of insufficient visibility (temporary, either during fog or constant - for example, caused by terrain conditions). [2]

The beacons were built from ancient times - the most famous beacon in history is one of the wonders of the world - the Alexandria Lighthouse, built in the 3rd century BC. e. And the Greeks and the Phoenicians by the fire of the fires mark dangerous passages. [2]

To ensure the high efficiency of the beacon, light concentrates. In the old lighthouses, the light:

• Concentrates and radiates in a horizontal plane;

• Horizontally concentrated light is emitted in several directions, the direction of the beam periodically changes, thus, on the one hand, the entire horizon is covered, on the other, due to concentration, the light is visible from a greater distance. [2]

The concentration of light is ensured by the assembly of rotating lenses. In very old lighthouses, light sources were kerosene lamps, the rotation of the lenses was carried out by a clock mechanism, driven by the lighthouse caretaker. A collection of lenses to reduce friction was immersed in mercury. In modern beacons with rotating mirrors, the clock mechanism is driven by an electric motor. [2]

Effective concentration of light for omnidirectional radiation requires heavy and thick lenses of a large size. Especially for lighthouses, Fresnel lenses are used, which, at given parameters, require significantly less materials in production than lenses manufactured using traditional technology. [2]

In modern automated beacons, the system of rotating lenses is replaced by a source of extremely bright light, which emits short omnidirectional flashes, that is, light concentrates in time, not in space. The principle of operation of these lighthouses is similar to aerodromes and parking lights on high structures. Instead of a permanent light source, the observer sees short bursts of repetition. [2]

Also, radio beacons and sound are often used. Especially with poor visibility and special features of the relief. [2]

Radio beacons gave an opportunity to determine the place of the ship in the sea with sufficient accuracy, regardless of the state of weather and visibility.

For the use of radio beacons on ships, special radio-detectors are set up, the description of which is given in the relevant technical and mass literature.

The main types of radio beacons are radio beacons of circular and directed radiation.

The principle of the radio beacon of circular radiation is reduced to the following. Electromagnetic energy emitted by the antenna of the beacon extends uniformly on all sides, which makes it possible to determine the bearings from the ship to the radio beacon with the help of a ship's radio-leak detector. Each radio beacon is assigned a certain call sign, which the navigator finds interested in his radio beacon and produces radio navigation.

Let's see what a situation has broken in aviation.

At the dawn of the aviation, there were no radar, so its location the aircraft crew determined independently and reported it to the dispatcher. The crew was oriented visually on settlements, lakes, rivers, hills and found its place on the map. A similar method required constant visual contact with the land, which was simply absent in bad weather, limiting flight possibilities. [3]

The first navigation means were the N-Directional Beacon (NDB) transmitting a recognition signal (that is, two or three letters of the Latin alphabet, transmitted by the Morse code) at a certain frequency in a circular directional diagram. Well, the receiver on the aircraft indicates the direction of such a radio beacon. To determine the exact location of at least 2 radio beacons (two azimuths from them), and the aircraft began to fly from the lighthouse to the lighthouse. So there were the first airships for flights by gear, including in the clouds and at night. True, the accuracy of the determination of the coordinates soon became insufficient. Then a high-frequency omni-directional radio range (VOR) was created by radio engineers. VOR passes its cognitive index to Morse code with three Latin letters. [3]

The need to know two azimuths to determine their position required too much radio beacons. To solve this problem, a so-called Distance Measurement Equipment (DME) equipment was developed, and it was possible to find out the distance from the DME with the aid of a special receiver on board. And if the VOR and DME devices are located at the same point, it's easy to calculate their location by azimuth and deleting from the VORDME system. [3]

Fig.1 - VOR compatible DME lighthouse

However, to place lighthouses everywhere, they need too much, and most often you need to more precisely define your position. So there were so-called "points" (fixes, intersections), which always had known azimuth from two or more radio beacons. That is, the aircraft could easily determine that it is at this point right above this point. Now the airways began to pass between radio beacons and dots. The appearance of VORDME systems allowed to stir points not only on average azimuths, but on radials and distance from VORDME objects. [3]

MODERN NAVIGATION SYSTEMS

Modern navigation systems can be divided into two categories:

- global navigation system;
- local navigation system.

Global navigation systems are also divided into:

- Satellite systems;
- Non-satellite systems.

Satellite navigation systems are more widespread. In addition to the famous GPS, GNSS, NAVSTAR, GLONASS, GALILEO and others are also being scammed. Let's consider some of them.

GLONASS - Russian Global Navigation Satellite System was developed in the early 80's by specialists of the Soviet Aerospace Force. The number of satellites in orbit reaches 24 units. Of these, 21 satellites are provided by the system, while others are in a suspended state to replace active devices in case of their failure. [4]

The system is divided into three orbital plans, each of which consists of 8 satellites, which are united by the slot number: 1-8, 9-16, 17-24. The orbits of GLONASS satellites are 19100 km away from the Earth, and are slightly below GPS satellites. Circle around the Earth each of the n satellites takes about 11 hours. At least one satellite receiver must have at least one satellite at a time. The system's efficiency

ensures accuracy of the location of 55 meters horizontally and 70 meters vertically in the C / A standard. Unlike the American system, the exact signal is available only for military receivers. [4]

NAVSTAR GPS 1 is a satellite navigation system developed and maintained by the US Department of Defense to determine the current location and speed of the objects. [4]

For the most accurate determination of the coordinates of the object, "visibility" of the four satellites is required. The location is determined by measuring distances from satellites with known coordinates to the object, taking into account the time delay of signal propagation. [4]

Galileo - the satellite navigation system of the European Union and the European Space Agency, developed as an alternative to the US GPS system and Russian GLONASS. A project worth $ 10 billion is named after the Italian astronomer Galileo Galilei. [4]

The system is designed to solve navigational tasks for any moving objects with an accuracy of less than one meter. In addition to the European Community, agreements on participation in the project and other states - China, Israel, South Korea and Ukraine - have been reached. In addition, negotiations are under way with representatives from Argentina, Australia, Brazil, Chile, India, Malaysia. [4]

The navigation system "Beidou" or the Satellite navigation system "Beidou" - the Chinese satellite navigation system. It is planned that the space segment of the navigation satellite system Beidou will consist of 5 satellites in the geostationary orbit, 3 satellites in the geosynchronous orbit (with a slope of 55 °) and 27 satellites in the medium Earth orbit (~ 21,500 km). [4]

The system was launched commercially on December 27, 2012 as a regional positioning system, with a satellite group of 16 satellites. It is planned that the system will be fully operational by 2020. [4]

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