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Contemporary Problems of Navigation Nearly Pole

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ABSTRACT: The problem of navigation at geographical poles is considered. Means and methods of its realization are offered within the framework of classical navigation. Brings an attention to the question on production of pseudomercator′s navigational charts.

1 INTRODUCTION

The Arctic Ocean represents an enormous reserve of mankind for the most various aspects.

At first the Arctic Ocean is extremely favourable sea way through all east hemisphere.

At second the Arctic Ocean is an enormous source of natural resources, which use else begins.

The most active in part of development of Arctic regions demonstrates Russia. The activity of Russia in Arctic Ocean speaks parameters of load transportation by Northern sea way. Russia is the unique country in the world which has the nuclear ice-breaking fleet of ten units.

2 NUCLEARS ICE-BREAKERS FLEET OF RUSSIA

First nuclear ice-breaker *"Lenin"* has been constructed at the Admiralty factory in 1959 years. The next nuclear ice-breakers should be were building at the Baltic factory of Saint Petersburg. The nuclear ice-breakers *"Tajmyr"* and *"Vaigach"* have been constructed in Finland, and a nuclear stuffing was installed at the Baltic factory of Saint-Petersburg.

At time of industrial depression in Russia the nuclear ice-breaking fleet has been compelled to search for sources of financing. For this purpose nuclear ice-breakers twenty years make tourist flights to North Pole.

Ice-breakers of a class *"Arctic"* make a basis of the Russian nuclear ice-breaking fleet. Six ice breakers from 10 concern to this class. This series of a vessels was under construction during 30 years, therefore the last of vessels have essential differences. The vessels of this type have characteristics:

- Length - 150 m. - cancel fullstop (136 on a waterline);
- Width - 30 m (28 on a waterline);
- The draft - 11,08 m.;
- The height - 55 m. - cancel fullstop (from keel) up to top of mast;
- The maximal speed - 23,8 knots;
- Crew - 150 person
- Passengers - 100 person (in 50 cabins)
- Power installation – two reactors OK-900 capacity on 171 MW every.

These ice-breakers have the double body. Thickness of the external body in places ice contact is 48 mm, and in other places 25mm.

At normal operating mode it is enough one of two reactors, but during navigation are involved both (at less than 50 % of capacity).

3 EXPANSION TO NORTH POLE OF RUSSIA AND OTHER COUNTRY

From 1989г. nuclear ice-breakers go to North Pole with tourists. Cost of cruise makes about 25000 $.

Ice breaker "Yamal" (see fig.1) in july - august specializes on tourism, having made already more than 50 campaigns to a pole.

In 1998 years the nuclear ice-breaker "Arctic" for the first time has carried out nearly pole ice posting of German scientifically research ice breaker *"Polarstern"*. At 2004 years the ice-breaker "Soviet Union" together with Swedish diesel ice breaker *"Oden"* provided ice safety of chisel works on North Pole from a vessel "*Vidar Viking*".

Recently Russia and the USA have submitted for consideration the United Nations a question on expansion of the shelf territories in area of Arctic ocean.

Fig.1 Nuclear ice-breaker *"Jamal"*.

For a substantiation of the claims Russia has made researches in area of North Pole. It was immersed on a bottom the deep-water device in a point of North Pole. It was established at the bottom a memorable sign of Russia from the titan.

Claims of a similar sort on expansion of territories of shelf zones are possible as on the part of Canada, Iceland, Denmark and Norway. Similar claims is explained by presence in the Arctic zone of the big stocks of oil and gas.

Already practical development of Arctic ocean by Russia in area of Shtokman oil field begins. All this will inevitably lead to wider use of the Arctic water areas for navigation and economic activities.

4 THE PROBLEMS OF EXOTICAL NAVIGATION TO NORTH POLE

The navigation nearly of geographical poles has a general difference to traditional navigation.

For the poles it is lose sense such major classical concepts of navigation, as a meridian of observer, a parallel of observer, a course of vessel, a bearing of subject, rhumb line bearing, great circle bearing.

For single (exotic) expeditions there is long prepare, all beforehand is thought over and rehearsed, involved scientific forces and means.

In conditions of mass actions (development of sea and bottom's resources) there is a question on the maximal simplification of process of navigation in these areas. It is necessary to make a navigation in the maximal degree similar to conditions of usual navigation with use of standard means and methods.

The greatest convenience for plotting gives the map of Mercator projection. This projection is equiangular. The line of a constant course – rhumb line is represented on a map by a direct line. This circumstance does a work of plotting of a way extremely simple and convenient.

The main lack of such projection is so, that with change of geographical latitude the scale of a map changes proportionally to $\sec\varphi$, in this connection, in latitude more 85º use of mercator projections is inexpedient basically.

Difficulties of the Arctic navigation are not limited to problems of use habitual mercator maps.

In these latitude there is practically unsuitable a gyrocompass. On a pole, a gyrocompass we shall fail basically, and the concept of a course degenerates owing to absence of a meridian of the observer.

At navigation nearly magnetic poles which are located far enough from geographical poles for navigation there is completely not suitable a magnetic compass. The directing moment of a magnetic compass on a magnetic pole is equal to zero. From this reason a magnetic compass is disabled. Here it is necessary to notice, that by definition the magnetic compass is a device for the indication of a magnetic meridian. However in a point of a magnetic pole all magnetic meridians is crossed. The concept for meridian of observer from this reason is degenerates.

The position of northern magnetic pole for 1st January of 2005 year is situated at $\varphi = 82^0 07' N, \lambda = 114^0 04' W$. The coordinates of a southern magnetic pole for 1st january of 2004 year is $\varphi = 63^0 05' S, \lambda = 138^0 00' E$.

Nearly of magnetic poles the gyrocompass has a admissible accuracy, and the map of Mercator quite provides a requirements of navigation.

Apparently, usual navigation will be completely paralysed only at geographical poles.

Classical navigation near to geographical poles it is possible to provide by magnetic compass and pseudomercator's map. Pseudomercator's map differs from mercator's map by the way of construction.

The axis of Mercator's cylinder passes through the centre of the Earth and geographical poles. The axis pseudomercator's cylinder passes through the centre of the ground and a corresponding magnetic pole of the ground (northern or southern).

Thus, the angle between axes of Mercator's and pseudomercator's cylinder is equal to the polar distance Δ measured from a geographical pole up to the corresponding magnetic pole (fig. 2).

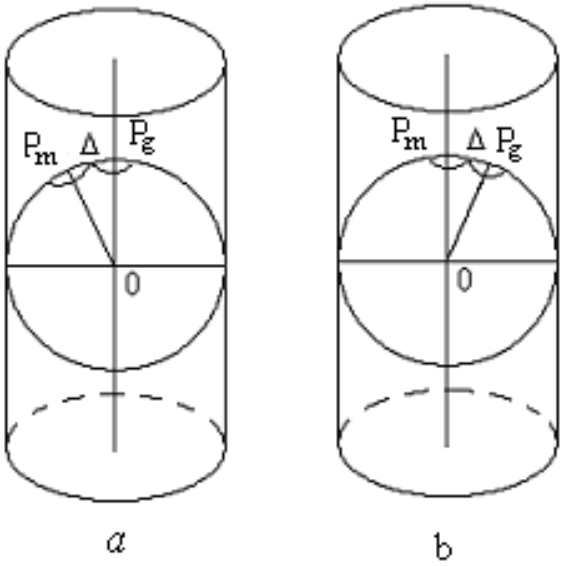

Fig. 2 The projection cylinder for Mercator's and Pseudomercator's maps a – Mercator's projection, b – Pseudomercator's.

The turn of the projective cylinder at pseudomercator's projection leads to respective alterations of the habitual image of a ground surface which was observed at mercator's map. These changes, however, do not render a special influence on perception of a map through navigator, so as habitual mercator's projection also deforms the form of terrestrial objects and the more strongly, than they are closer to poles.

The polar cap at a geographical pole from a parallel 85^0 and above excludes use of Mercator maps and a gyrocompass.

At the pseudomercator's projections this polar cap is situated outside the new restrictive circle.

It will allow at navigation near to geographical poles to use a pseudomercator's map in aggregate with a magnetic compass and to continue navigation as usual.

Thus, means allowing to carry out classical navigation at subpolar areas look how it is shown in table 1.

Table 1 Means of classical navigation at navigation in subpolar areas.

Kind of water area	
Near to a magnetic pole	Near to a geographical pole
1. Navigating Mercator's chart 2. Gyro compass	1. Navigating pseudomercator's chart 2. Magnetic compass

Realization of classical navigation near to geographical poles demands new type of a map, namely, maps in pseudomercator's projection.

The grid of such pseudomercator's projections by the form will differ nothing from a grid of mercator's projections, but coordinates of all points of a surface of the ground should be in appropriate way counted.

The coordinates of magnetic poles on surface of earth changes position. For example, the point of northern magnetic pole recently will annually get mixed up on a terrestrial surface approximately 40 km. In this connection, it is required to trace periodically these changes and to bring corresponding corrections for recalculation of a map's grid. For electronic maps this procedure does not represent any complexities.

Here it is necessary to notice, that magnetic poles are located far from being in opposite points of the Earth. This circumstance compels to make a grid of pseudomercators map for northern geographical pole and southern pole in separate execution.

The role of a true meridian at pseudomercator's map will be carried out a line directed on magnetic pole. As well as in mercator's map, vertical lines of a cartographical grid are considered as true meridians from which true courses and bearings are considered.

A sizes of variations V for pseudomercator's map should be rendered in view of a changed coordinate grid. The formula for finding of the amendment to recalculation of variation ΔV enters the name as:

$$\Delta V = arcctg\left(ctg\Delta \cdot \cos\varphi \cdot \cos ec\Delta\lambda - \sin\varphi \cdot ctg\Delta\lambda\right)$$

where:

Δ - polar distance of a magnetic pole;

φ - geographical latitude of the ship;

$\Delta\lambda$ - the difference of geographical longitudes of a magnetic pole and the ship.

5 CONCLUSION

Unification of plotting at use of pseudemercator's maps allows to avoid navigating discomfort at navigation in areas of geographical poles, to remove unnecessary stressful situations and by that to raise safety of navigation.

LITERATURE

www.travel.rn/news/2003/05/21/23003html
http://www.luxe.ru.