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Analysis of the main bases of the coastal zone, as a pathway for the movement of special vehicle and monitoring complexes

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Abstract. The key point of the article, developed in Nizhny Novgorod State Technical University n.a. R.E. Alekseev is Autonomous mobile robotic complex for monitoring of coastal zones. The classification of coastal zones as the pathway for special vehicle and mobile complexes of coastal zones monitoring is considered. The analysis of traffic conditions is carried out. It is concluded that the dominant in the coastal zones, which account for most of the supporting surfaces, can be considered sand-gravel and sand areas, as well as snow pathway in the winter.

1. Introduction

About 40% of The world's population lives on a narrow coastal strip along the oceans and seas. Coastal zones of the Russian Federation occupy about 2/3 of its borders and about 10% of the coastal zones of the land surface of the Earth. In addition, most of the population lives along the coastal zones of inland water bodies, in particular, lakes, ponds, rivers, streams, artificial reservoirs. For many observations, the coastal zone is the boundary area of land and water environment, consisting of the shore itself, determined by the level of water fluctuations at tides and tides, the coastline and the coastal slope. The width of the coastal zone can be from several tens to several hundred meters. The main factors that determine the nature of the coastal zone-geological, climatic, engineering human activities, etc. The coastal zone is characterized by temporary instability and changes its position depending on the time of year, storm conditions, the phase of the tide, atmospheric pressure and many other reasons.

Coastal zones and coastal territories are the place of residence for large number of people and the areas of their cultural activity. As a result, the accompanying industries, forest, agriculture and fish farms are widely spread there. The production of natural minerals, oil and gas, ores also take place in such areas. The alternative power engineering is also developed there. The coastal zones were always the objects for tourism and rest and the research activity areas. Therefore, the safety of human activity, state and ecological (technogenic and natural) safety for these territories is an important and relevant task.

The monitoring of the coastal territories and adjacent water areas in a wide spatio-temporal framework is necessary for the safety control. Monitoring can be implemented by means of a large number of stationary posts, or by the means of the mobile complexes. The mobile land complexes for monitoring of coastal zones look like the most reasonable solution now. An Autonomous mobile robotic complex (AMRC) for monitoring coastal zones was developed as part of the project conducted at NNSTU n.a. R. E. Alekseev [1, 2]. Chassis of AMRC is shown in Fig. 1.

Fig 1. Fragment of the AMRC test.

Special operating conditions, which are not typical for conventional land-based complexes, determine the development of methods and research to obtain characteristics of road and ground surfaces in the coastal zone. Therefore, the analysis was carried out, the classification was developed and the dominant surfaces in the coastal zones were identified.

2. Classification of the coastal zones

The analysis made it possible to develop a classification of coastal zones as a pathway for transport technological vehicles (TTV) and mobile complexes of coastal zones monitoring.

From the perspective of Geology, [3, 4] the following structures are distinguished: morphological-steep banks, with a bar, low — lying, etc.; structural-longitudinal, transverse, diagonal banks; dynamic, taking into account the initial relief, bottom slopes, wave intensity and direction, geological structure and sediment balance; genetic, which is based on various principles [3, 4].

From the point of view of the movement of TTV support surfaces are classified according to: microprofile determining the hilly, microprofile important for assessing the smoothness of the course and the bearing and shear characteristics of the soil determining the possibility of movement of any vehicle. Coastal zones are distinguished by the size of the water body - a river, lake, sea ocean.

The type of soil is the next classification feature. The most typical are like sand (different grain size), clay (differ in plasticity), rocky (rocky, vary according to the size of a pebble), mixed.

From the point of view of the presence of plants areas with vegetation and without can be identified. Moreover, flora can be different, so on the shore areas can grow shrubs and fast-growing trees, representing some difficulty for the movement of TTV, and in some areas there are only herbaceous plants that do not present difficulties for movement.

In winter, Snow, ice, sludge, ice are the difficulty to move in winter.

The entrance to the coastal area is also important. You can select areas with the possibility of descent, hard to reach and impossible to descend for the vehicle. For the latter, the possibility of movement is determined by the presence of adjacent sections in the border areas.

The movement of TTV and AMRC is almost always carried out with some roll. These modes will be determined by the longitudinal angle of the coastal zone. Therefore, you can select areas with a large transverse slope and traffic on the road without a transverse slope.

You can highlight areas on the uniformity of the characteristics of the movement from the point of view of the movement of AMRC. This is the constancy (within certain limits) of the traction

characteristics of the surfaces of motion, the characteristics of macro and microfile, including the presence of flooded areas and bays.

As the humidity of the soil surface approaches the water, this classification should also vary accordingly.

The characteristics considered will be variable in time with some periodicity, for example, day or season. Variability during the day is determined by tidal activity.

From the point of view of the formation of characteristics and mainly the geometry of the shore, natural and anthropogenic (man-made) factors can be identified.

The structure and classification features are shown in the Figure 2.

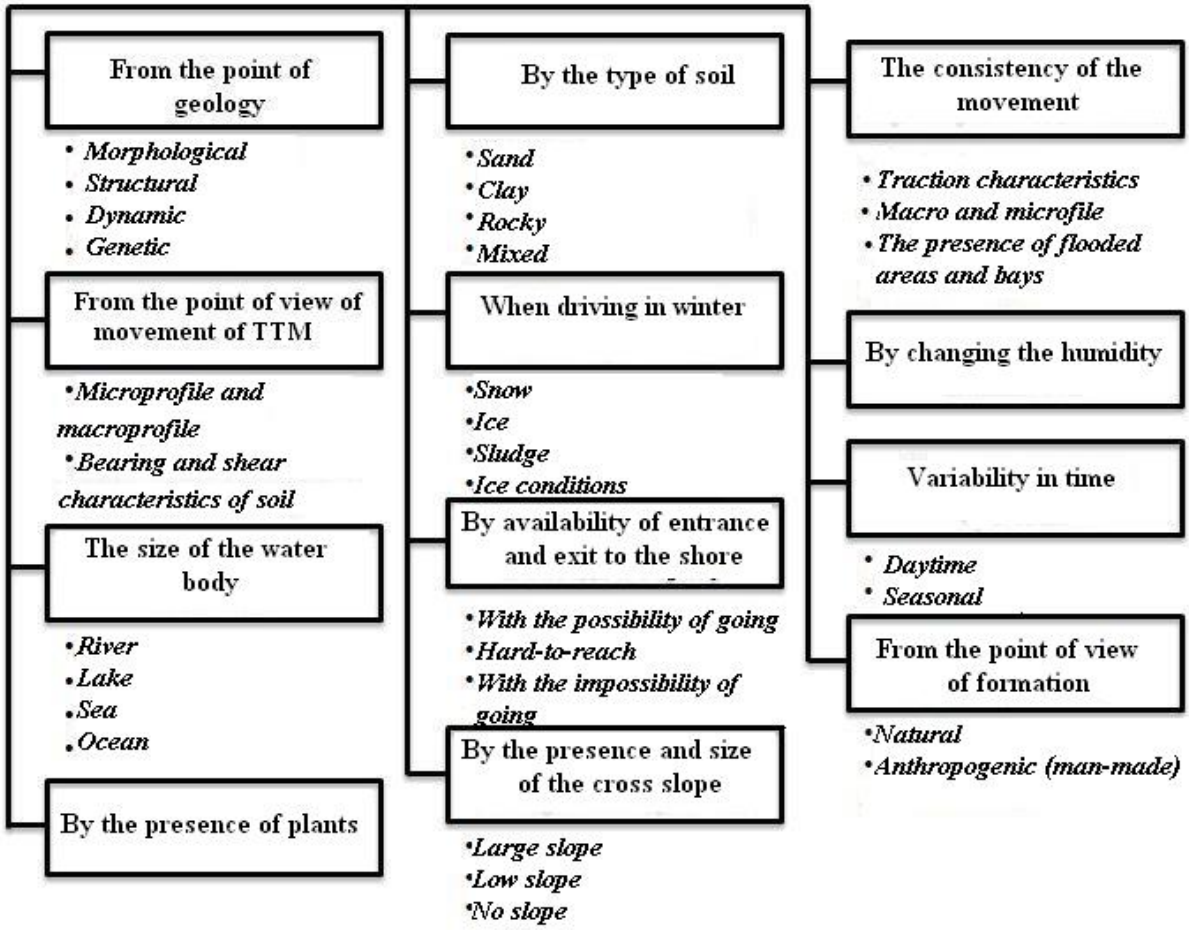

Fig 2. Structure and classification of coastal zones

The use of this classification will allow to systematize the data on coastal zones as the pathway for TTV and AMRC, which in turn will give the opportunity to predict their mobility [5].

Despite the variety of supporting surfaces of coastal zones presented in this classification, to determine the basic parameters of the chassis is enough to know only the dominant conditions of movement.

3. Analysis of dominant surfaces in coastal zones

The coastal zone is composed of Sands, pebbles (accumulative phases), coarse clastic and crushed material (abrasive phase) and sediments brought by rivers and winds from the depths of continents to the sea coast.

The abrasive shore is a high steep receding shore of the reservoir, destroyed by the action of the surf. The main elements of the relief of this type of shore are: abrasive underwater slope (bench),

coastal ledge (cliff), wave-hole and underwater abutment terrace. Accumulative shore is coming the shore, built with sediments brought by waves and surf..

Potential traffic surfaces of TTV and MARK as the dominant traffic area are beaches or coastal terrace. Movement on coastal terraces in most cases is no different from the movement of cars on conventional soil surfaces. The beaches of coastal zones are of the greatest interest as the surface of the movement due to the fact that their physical and mechanical properties can change with high frequency during the day, due to the instability of climatic conditions and the action of tides in the coastal zone.

The coastal zone has unique reserves of various mineral materials, primarily sand and gravel [6]. The analysis of materials composing the support base for the motion of TTV and AMRC chassis in the coastal zone can be limited to the consideration of sand and gravel materials.

Since the use of transport and technological tasks in the coastal zone is carried out year-round, in regions with a cold climate, sand-gravel and stone bases in the winter period are covered with ice and snow.

The analysis of the conditions of movement of TTV and AMRC conducted in the works of the authors of the article, as well as data from the works [7-9] showed that it is possible to cut out the dominant surfaces in these areas, namely sand and gravel areas, as well as snow pathway in the winter

4. Conclusion

According to the results of the study described in the article, the following conclusions can be made:

- The topicality of development of special ground mobile complexes of coastal zones monitoring is shown. An example of an Autonomous mobile robotic complex (AMRC) developed with the direct participation of the authors is given.
- The classification of routes in coastal zones as the pathway for transport and technological machines is developed. The classification features of coastal zones associated with Geology, theory of vehicle traffic, with the size of the water body, type of soil, the presence of plants, taking into account the movement in the winter, the presence of the entrance and exit to the shore, the presence and size of the cross-slope of the shore, with the constancy of the characteristics of movement, humidity change, taking into account the variability of characteristics in time, taking into account the creation.
- It is established that in coastal zones dominant supporting surfaces are sand-gravel and sand areas, as well as snow pathway in the winter season.

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