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NAVIGATION SYSTEMS FOR AGRICULTURAL MACHINES

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ABSTRACT
The article describes the benefits of installing a navigation system for agricultural machines. Using a navigation system, a satellite-based system for managing agricultural activities is presented. The GLONASS navigator has many uses on land, in water and in the air. Basically, a satellite navigator allows you to record or set location points on the ground and helps to move from these points to them. GLONASS navigator can be used everywhere except in places where there is no signal reception, i.e. Indoors, in caves, parking lots and other places located underground, as well as under water.
KEY WORDS: *GLONASS / GPS, GLONASS navigator, GLONASS,*

INTRODUCTION

Navigation systems, GPS microchip, Navigation systems for agricultural machinery. In air and on water, GLONASS is mainly used for navigation, while on land, the application is more diverse. For various purposes, GLONASS navigators are used by scientists. Surveyors are doing most of their work using the GLONASS navigator, which significantly reduces the cost of reconnaissance work, and also provides tremendous accuracy.

Mostly reconnaissance equipment provides accuracy of up to one meter. More expensive systems can provide accuracy within a centimeter! In the field of recreation, the use of the GLONASS navigator is as diverse as the types of recreation. GLONASS navigator is becoming more popular among tourists, hunters, climbers, skiers, etc. If you are fond of a sport or any activity where you need to track your location, get directions to a specific place or know which direction and how fast you are moving, you will appreciate all the advantages of GLONASS navigation [1].

GLONASS / GPS navigation is quickly becoming commonplace in cars. Some built-in systems provide support in emergency situations on the road - by pressing a button, the current location of the car is transmitted to the dispatch center.

More advanced systems can display the location of the car on an electronic map, allowing drivers to control the route and look for the desired addresses, restaurants, hotels and other objects. Some GLONASS / GPS navigators can even automatically create a route and alternately give directions to the specified destination.

Perhaps one of the most important areas that has received completely new opportunities thanks to the GLONASS system is transport. In particular, over time, radio navigation will reduce the “airplane” routes, reduce the intervals between flights. You can use the global navigation system wherever a satellite signal is received. For example, airborne GLONASS / GPS receivers are widely used in aviation for piloting aircraft. Prototypes of a system are already being tested that allow aircraft to land in unmanned mode. However, this requires additional ground stations, allowing to determine the coordinates of the liner in space.

Especially the control of vehicles with the help of satellite navigation in various regions is in demand in those enterprises in which the activity is associated with the supervision of a large traffic flow. The monitoring system makes it possible to qualitatively monitor the movement of any vehicles to the longest distances and helps to effectively coordinate the various flows of vehicles. GLONASS / GPS receivers are built into cars, cell phones and even watches. All ships are equipped with GPS receivers. Chips have also been created that combine a miniature GLONASS / GPS receiver and a GSM module - it is proposed to equip dog collars with

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devices based on it so that the owner can easily find a lost dog [2].

For example, the American company AVID Identification Systems has developed a GPS identification microchip (the size of a grain of rice) that implants a dog at the withers. Each microchip is assigned a unique number. With the help of such a microchip, you can quickly find a lost dog. In addition, the GLONASS / GPS system is a reliable guide to fishermen, tourists, hunters, extreme travelers to all countries.

Quite interesting is the possibility of using GLONASS by many scientists and researchers as a source of accurate time, because determining the transit time of a radio signal lies at the heart of the very idea of GLONASS. To this end, the internal clock of the receiver is constantly synchronized with the atomic clock mounted on the satellites. This allows for accurate time measurements from micro to nanoseconds. Therefore, when conducting scientific experiments, it becomes possible to have absolutely accurate time stamps everywhere. Satellite navigation is already used in agriculture, where it is used for automatic processing of land by combines, now it can significantly reduce production costs, reduce the cost of production. The range of applications of satellite navigation technologies is constantly expanding, and now it's even hard to imagine what other areas of application of space navigation systems will appear. Figure 1.

Figure 1. The use of GLONASS for civilian purposes.

Currently, in the agricultural sector, navigation systems are widely used for agricultural machinery and mobile energy facilities (tractors). The main task of such systems is to ensure that the tractor with the implement passes through the field so that each subsequent lane lies exactly along the edge of the previous lane without gaps and overlaps. Navigation systems are an integral part of control and monitoring systems, precision farming systems, automated driving systems for agricultural machinery and parallel driving. In reality, with traditional methods of processing fields, without the use of navigation systems, there are overlaps and omissions, as a result of which the processed field looks as follows. Figure 2

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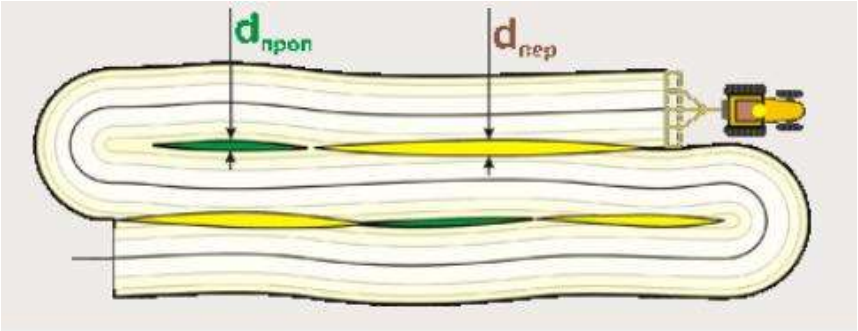

Figure 2. Gaps and overlaps when processing the field in the traditional way.

1) Setting visible landmarks (landmarks) during plowing, on which the machine operator will be guided during operation;
2) The use of flow or foam markers;
3) Use of satellite navigation systems.

Even an experienced and conscientious machine operator when working with wide-grip machines does not withstand the exact distance of butt passages without resorting to the help of markers or signal assistants. The problem of accurate driving of tractor units is compounded with an increase in the working width of modern agricultural machines [4].

The following is an example of a satellite image of a field processed using satellite navigation systems. Figure 3

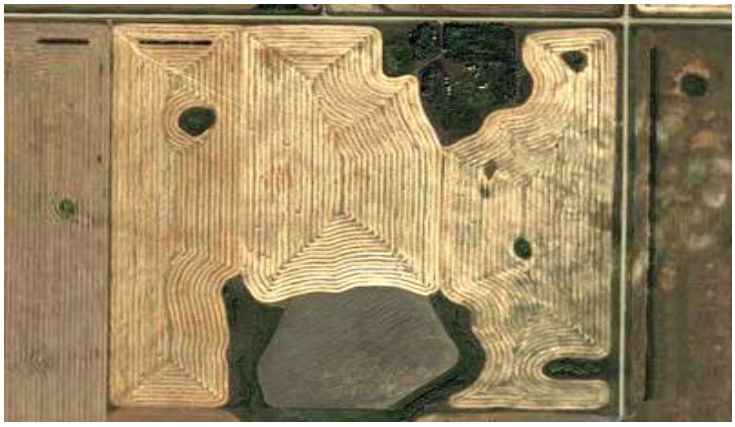

Figure 3. Space images of a field processed using satellite navigation systems.

CONCLUSIONS

The advantages of satellite navigation to ensure the required trajectory of the tractor are as follows:

- No preliminary marking of the field is required;
- No additional consumables for marking rows;
- The maximum width of the unit is used, overlapping of adjacent rows is minimized;
- Excludes gaps between adjacent rows;
- The load factor of equipment increases;
- Provides the ability to work in conditions of poor visibility;
- Increases comfort, reduces fatigue of the driver.

Below are some methods for processing fields using satellite navigation systems. Figure 4.5

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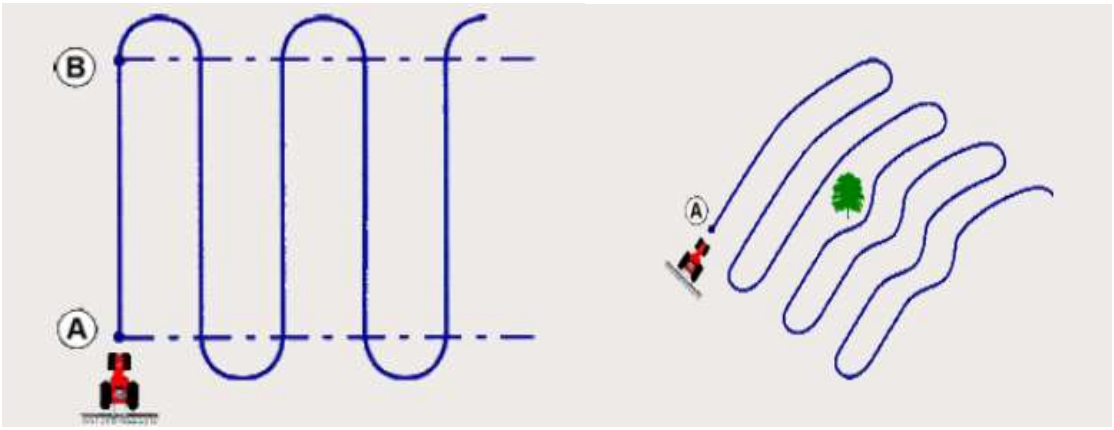

Figure 4. Basic mode (on the left) - corners parallel to the basic straight line AB, Adaptive Curve mode (on the right) - each subsequent corral repeats the previous one.

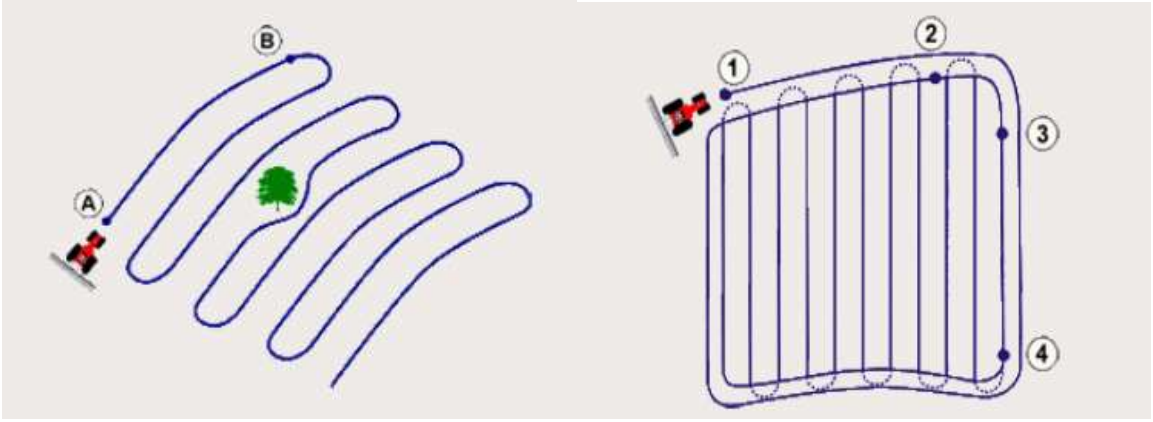

Figure 5. "Identical curve" (left) - all subsequent corners repeat the initial curve AB, preliminary processing of the reversal zones along the contour (right), followed by processing of the field with corners parallel to the base line.

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