THE SYSTEM OF MONITORING THE STATE OF ENERGY CROPS FOR OBTAINING BIOMETHANE

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Over the last decade in 15 European countries began to develop intensively production of biomethane projects (BM). BM Filing a network of natural gas takes place in 11 countries (Austria, Czech Republic, Germany, Denmark, Finland, France, Luxembourg, Netherlands, Norway, Sweden, UK). To apply biomethane technology is used in pipelines, through which ensured the separation of CO2 from biogas (landfill gas) and biomethane getting content to 95 - 98%. Ukraine has significant potential biogas / biomethane from waste agriculture, municipal and industrial wastewater, which is estimated at 3.2 billion. M3 CH4 per year. Another 3.3 billion. M3 CH4 can be obtained by cultivation of various energy crops (EC) on the area of 1 mln. Ha (3% of the total arable land Ukraine).

One of the directions of solving this problem is the widespread use of special systems for monitoring and forecasting of the existing EC promising base for their processing into biogas complexes (BGK) to obtain the maximum amount of biomethane.

The results of the analysis of scientific papers show that at present not fully considered the development and application of monitoring yields (CMB) energy crops for their conversion into biomethane.

The purpose of research - the study of the functional structure of the monitoring system yields the EC.

Materials and methods of research. EC yield monitoring system - is an information system that is able to provide on-line information on the current status of the EC in certain areas.

Depending on visibility (the size of the territory controlled system) distinguish SMV local, regional and national (or transnational) levels, but they usually consist of the following subsystems:

information;

processing and analyzing information;

dissemination of information.

For information technology and widely used methods of remote sensing (RS). In order to process and analyze information using geographic information systems (GIS), and for its distribution - technology Internet.

Remote Sensing (Remote Sensing of Earth) - is to obtain information about objects on the earth's surface, as well as the processes and phenomena occurring on our planet in the absence of direct contact with the objects of study, that is "from afar." Depending on the method of placing recording devices of remote sensing methods are divided into land, air and space, but they all have one thing in common: to obtain information is by recording electromagnetic radiation (EMR) emitted or reflected earth's surface. Thus, methods of remote sensing, like all other methods of obtaining information, have their limitations and advantages, and are characterized by a certain accuracy. The advantages of remote sensing techniques primarily include the fact that getting information is way, ie without any interference with the object of study. Second: remote sensing methods are characterized by high visibility (the ability to simultaneously receive information from large areas), allowing to identify and explore phenomena and processes that can not be observed from a short distance. Thirdly, various sensors used in remote sensing systems, able to record in many ranges EMR spectrum - visible, infrared, microwave and radio, which greatly increases their informative and expands the range of tasks.

An important trend is the use of remote sensing technology inventory of agricultural land and land management. In particular this applies to aviation remote sensing techniques and satellite imagery with high spatial fragmentation on the ground to create thematic maps and plans of different scales for the purpose of Land Management and cadastre. Data space shooting have maximum coverage and relevance of existing data - not always high. For some areas satellite imagery data have to wait for months. Technology aerial photography and air laser scanning with high accuracy, but the average coverage. Their use requires great financial cost. The use of UAVs is justified when it is necessary to quickly obtain accurate data on a small area of the territory. Moreover, the cost of unmanned aerial order of magnitude lower than with the use of small aircraft that for some projects is undoubtedly an important argument.

Aerial areas - is getting pictures from the air and their subsequent treatment by various methods. Experience of aerophotometric methods shows their high efficiency compared to traditional methods that reduce the complexity and timing of fieldwork. Alternatively, small aircraft and satellite imagery in recent years actively used remotely piloted aircraft.

Automatic navigation and positioning to fly the route, keeping altitude, return to the start point and to effectively track different aspects of agricultural activity. Shooting with UAVs provide an inventory of agricultural land, implementation of operational control of crops at different stages, to identify processes of degradation of land resources, estimate amounts of biomass, to study the dynamics of agricultural land use and exercise control over the farming practices.

Objective information on the status of the plants in each period of their development needs, not only for process control but also for forecasting crop, solving many economic and technical issues associated with the harvest, the pricing of farmed products, etc. In such circumstances, are extremely important to develop and implement efficient, cost-effective monitoring system of crops based on aerial images of UAVs in the short term.

Known method of determining the condition of crops is based on the cartographic basis of land use plans and inspection fields. Conducting a survey of the yield of crops is usually done by visual observation of the field and the subsequent drawing situation on the basis of mapping land use plans. The disadvantage of this method is its costly and the presence of the human factor, which leads to significant errors. Conventional aerial photography, performing for agricultural purposes, are complicated processes. Traditionally they perform with conventional photographic media, such as agricultural aircraft (AN-2) laboratory aerial aircraft (AN-26), helicopters (MI-6). However, the high price of these works, the need for closely spaced and limited airfield altitude (200 m) of such assets makes them inaccessible to the majority owners of the fields. Furthermore, the flight to the place of removal is carried out only in certain "corridors" and the shooting carried out only in designated areas at an altitude of 200 meters, which reduces the resolution of the images. Thus, the above-mentioned disadvantages increase the cost

of aerial photography and reduce profitability. Note that the ratio quality / price in most cases aerophotography is paramount.

The problem is solved by a special method that includes a definition section of the field, its aerial photos analysis. Photographing certain conduct surface from a height of 50 to 200 m using remotely piloted aircraft, with the possibility of obtaining images with high resolution planting system, their analysis determine the acreage. After the shooting in the area of UAV starts flying around. Throughout the flight the camera holds a series of images, which allows overlapping images for further processing. Planned character shooting achieved stabilization system that keeps UAV in the horizontal plane, preventing rotation and dive apparatus. After taking the unit returns to the starting point for landing. Photos uploaded to the appropriate software environment for processing.

Consider solve the following problem: given pictures of the same area taken at different times. It is assumed that some (in the ratio is small) part of the territory for the time elapsed between the shootings, has undergone changes. You must identify areas of change.

Progress solution: take a couple of shots and sequential build regression - on the first shot prophesy value of the second picture. Conditions that changes undergone minor part of the hope that:

forming a second image on the first can be quite accurate;

those areas for which noticeably significant differences prevailing and real values and a change area.

Regression constructed using neural networks. Data for processing are stored in the project GRASS, and used the photos - the MODIS.

Consider, for example, two consecutive shots to give the territory: on 03/05/2015 (Fig. 1) and 05/12/2015 (Fig. 2).

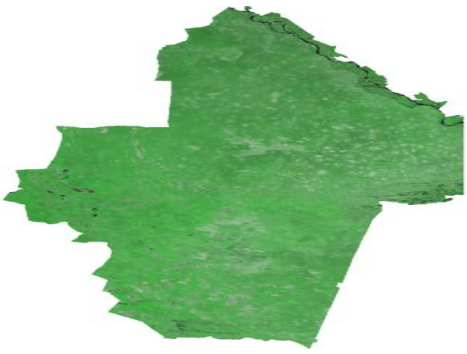

Fig. 1. Snapshot territory on May 3

Fig. 2. Snapshot territory on May 12

Pattern Recognition includes a number of stages:

1. Perception images (technical measurement).

2. Pre-processing of the received signal (filtering).

3. bold required characteristics (indexation).

4. The classification of the image (the decision).

In the first stage for the perception of images used two channels - (1) red and (2) the near infrared).

At the second stage the valuation of output values to a range of changes in the function activation (0, 1).

The third and fourth stages of pattern recognition is usually combined with pattern recognition system (SRO), which is a key element of such intellectual complex. The algorithm synthesis SRO spent enough:

1. training sample.

2. Select the method of data presentation and significant characteristics.

3. Development of ranking criteria.

4. Training SRO.

5. Check the quality of work with the possibility of a return to step 2 (or even to step 1).

For pattern recognition Multilayer Perceptron building, which is at the entrance mentioned first and second channel images of 3 May, and the output returns predicted values of the first and second channels to images from the 12th of May.

Activation function of neurons take sigmoid type:

$$f(u) = 1 / (1+ \exp(-u)). \quad (1)$$

To work with neural networks, primarily because of the speed, it is advisable to use a package AMORE, which has several packages that allow you to create multi-layer network.

According to recommendations of neural network is created as follows. Because the data is to train a sufficient number (around 700 thousand. Pixels), then the number of neurons can take relatively large. To start a network of sufficiently large size - with two hidden layers 20 and 10 neurons in each (2-20-10-2); activation function for all neurons is selected as the sigmoid (logistic). Training supply is within 500 iterations. In the training set will be adjusted to the weight of the network.

Learning Network is subject to the following algorithm.

Step 1. initialize elements of weight matrix (small random values).

Step 2: Submit one of the inputs of input vectors that network must learn to distinguish and calculate its output.

Step 3: If the output is correct, proceed to step 4.

Otherwise - calculate the difference between the ideal d and Y values obtained released:

$$\delta = d - Y. \quad (2)$$

Modify the weight according to the formula:

$$w_{ij}(t+1) = w_{ij}(t) + \eta \delta x_i, \quad (3)$$

where t and $(t+1)$- number of the current and the next iterations; η - Ratio of speed training, $0 <\eta<1$; i - room entrance; j - the number of neurons in the layer.

Obviously, if d> Y, then the weights would be increased and, thus, reduce the error. Otherwise, they will be reduced, and Y is also reduced, approaching d.

Step 4. Run cycle with step 2 until the chain stops wrong.

During the experiments, the most successful network was network with one hidden layer neurons and five in it. As a result of this study was achieved network error on the training set: 0.0188.

After learning network calculations made by feeding a network of trained data first shot. Before comparing neural network created screens with real images, they need denormalize.

As a result, we get two raster containing values for the first and second channel respectively, provided neural network. Rather than compare the significance of the direct and raster images, it will be convenient to find the difference between real value. This bright areas correspond to large in absolute value differences pale plots - small (Fig. 3).

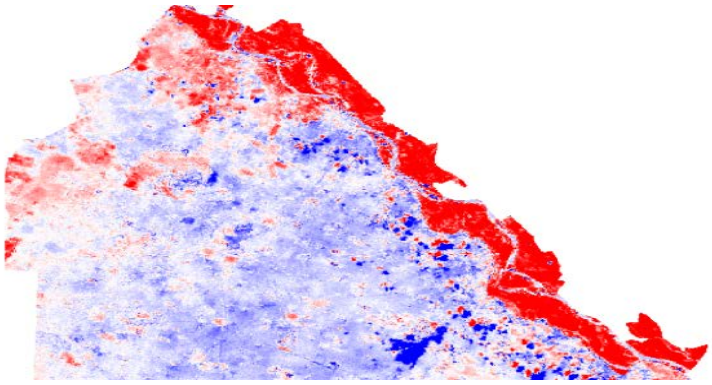

Fig. 3. The difference between the images 3 and 12 May

Visually, the picture quality may distinguish space and poor growth in PC and using software to determine the difference between the total area of the field and area of poor growth of EC, which is the effective area of sowing. You can also identify areas alkalinity, pollution and contamination of fields and more.

Conclusions

Thus, compared to existing examination methods yield territory field, the proposed method has higher efficiency and accuracy of the results of monitoring. The data make it possible to calculate the effective area of crops, an area of land and sifting fields that

require agro-technical measures. SMV total cost significantly less than traditional monitoring methods because they do not require fuel.