

UDC 65.011.56:633.1 (045)

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²O. S. Halatenko**IMITATION MODELING OF EXPRESS SYSTEM OF GRAIN QUALITY PARAMETERS DETERMINATION**E-mails: ¹svm@nau.edu.ua, ²vita_eat_brevis@mail.ru

Abstract—System of express analysis of grain crops for estimation the effectiveness of the work is developed, simulation model is built.

Index terms—Express analysis; imitation modeling; grain-crops.

I. INTRODUCTION

Ukraine is the powerful agrarian state that has large chances to become a leader from an export at the grain market. To attain this result, we must strictly control and adhere to the requirements of quality. Today in the conditions of development of international trade the question in relation to providing of quality of grain-crops became especially active.

Production, processing and export of grain in our country give significant cash receipts to the budget and are important sectors of employment of the population.

Today in Ukraine there are many agricultural enterprises that are engaged in receiving and inspection of agricultural products. To ensure quick and accurate work of these organizations, we should improve process of receiving of grain. Special attention need to providing the control of quality on the initial stage for the operative decision of questions of determination of quality of grain, to the

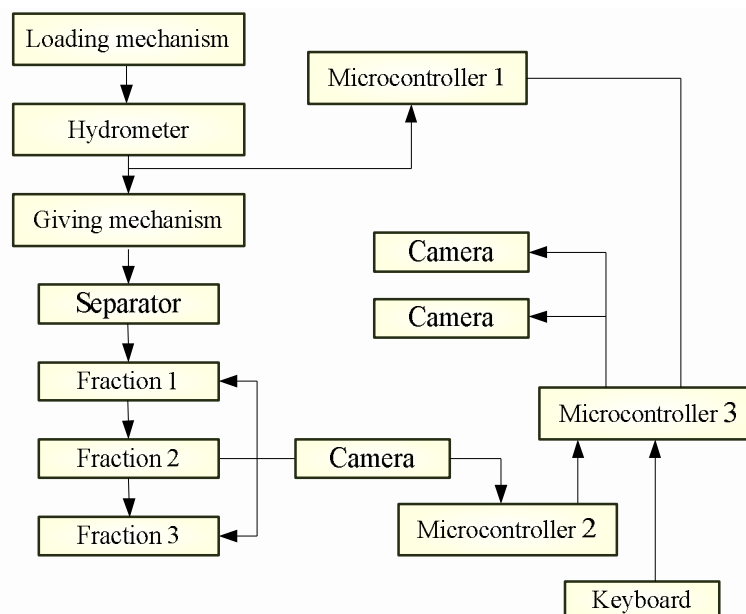
organization of traffic flow and improve the quality of employees work.

It is necessary to develop a system that provides an integrated assessment on the basis of criteria for determining the quality of the grain, which allows to make the process of the rapid test more accurate and fast. We must pay attention to the machine vision systems in agrarians, namely the building of video digital systems of quality assurance and identification of grain. However, before delivery of such system on the production the simulation should be done to verify all aspects of the work in order to achieve the best results, because the theme of this work is urgent.

II. DEVELOPMENT OF THE BLOCK DIAGRAM AND OPERATION ALGORITHM

Connected the processes of verification of major indexes of express analysis of grain, it is possible considerably to shorten time of reception of transport.

The operation algorithm can be represented as follows (Figure).



The block diagram of express analysis

1. Measuring humidity W using electrometric method.

Classification of grain that is investigated, in accordance with PSU.

2. Separation of grain for three fractions.

3. Analysis of of video images each fraction.

3.1 Processing of of video images each fraction (previous image processing, segmentation, identification of points of contours, contour analysis, correlation analysis).

3.2 Determination of the number of impurities P_1 (%).

3.3 Determination of the number of pests P_2 (%).

4. Determination of the integrated index of quality of grain.

$$I = k_1W + k_2p_1 + k_3p_2,$$

where k_1, k_2, k_3 weighting coefficients (determined experimentally)

III. ANALYSIS OF GRAIN FOR THE IMPURITY CONTENT

For each grain crop there are certain standards for determination the parameters of the quality, so has been taken soft wheat to demonstrate the work of imitation scheme.

Impurities of organic and inorganic origin are divided on grain and waste.

– The grain admixture:

– broken grain;

– shriveled grains (during the sifting passes through a sieve with apertures of 2.0 mm / 20.0 mm);

– sprouted grain;

– heat damaged grain;

– grain eaten by pests;

– grain of cereal crops;

– grain with painted germ.

– Waste impurities:

– mineral impurities (retained in the a sieve with the holes 1.0 mm / 20.0 mm);

– organic impurities;

– harmful impurities;

The order of analysis:

1. A portion of the wheat with mass 50 g is sifted through a sieve with oblong holes with size 1.0 mm 20.0 mm during 30 sec. The remainder of sieves – is broken grains, damaged grains, grains of cereal crops, sprouted grains, grains eaten by pests, damaged by frost and unripe grain (green), mineral, organic, harmful impurities and spoiled grain.

2. The grain that is left, is sifted through a sieve with oblong holes 2.0 mm/20.0 mm within 30 seconds. All that has passed are small and shrunken grains [1].

For examining of analysis it is necessary to have an imitation model of this process.

The block diagram of the imitation model is represented on Fig. 2.

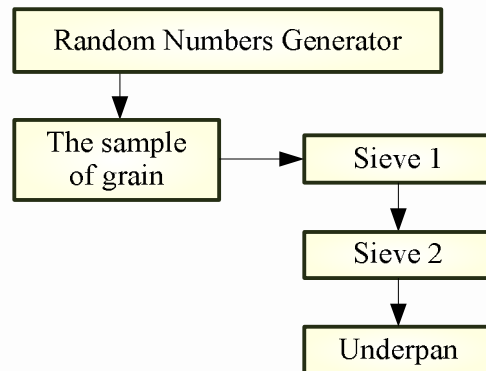


Fig. 2. Block diagram of the imitation model

IV. PROCESSING OF VIDEO IMAGES OF FRACTIONS

A mathematical model of the image can be represented as

$$z(x, y) = g(x, y) + \varepsilon(x, y),$$

where $g(x, y)$ a formal record of the image in the absence of noise; $z(x, y)$ is a formal record of the image at the output of the measuring system; $\varepsilon(x, y)$ is obstacle that arises as a result of the measurement process; x, y is pixel coordinates; $(x_{\min} < x < x_{\max}, y_{\min} < y < y_{\max})$, $x_{\min}, x_{\max}, y_{\min}, y_{\max}$ - the limits of the image. The goal is the determination in according to the result of the image processing, the presence of foreign material and grain impurity, presence of pests in the percent.

Disturbance $\varepsilon(x, y)$ can be represented as:

1. Gaussian white noise with zero expectation and covariance matrix $R(x, y)$.

2. Colored noise with unknown distribution.

3. A pulse signal.[2]

V. IMAGE PROCESSING ALGORITHM

1. Pre-processing of images.

2. Segmentation.

3. Searching of the contours points.

4. Contour analysis.

5. Correlation analysis.

6. Determination grain and foreign material impurities, the number of pests [3].

In terms of identification and analysis of objects in an image, brightness values of objects are not the most informative, but the characteristics of their borders – outlines are the major. The task of selection of contours is to build the image boundaries and contours of objects of homogeneous areas. Typically, the boundary of the object in the image is displayed by brightness difference between

two relatively self-colored areas. Contour of image is the set of its pixels around which there is abrupt change in brightness function. If the original image, except for areas of constant brightness, contains areas with smoothly change brightness, the continuity of contour lines is not guaranteed [4].

VI. THE RESULTS OF IMITATING

In accordance to the phases of the work of the proposed imitation system an initial image is realized, which was formed as a result of filling of grain sample, which is shown in Fig. 3.

As a result of separation, image of factions were got, that represented on Figs 3, 4 and 5. Image



Fig. 3. The sample of grain before separation



Fig. 5. Grain after the second test sieve

CONCLUSIONS

Constructed a simulation model of express analysis system for determination the parameters of the grain, which includes a random number generator, the sensor checks the checksum of test grain, sieve 1, sieve 2 pallet.

Developed the procedure of image processing, which includes the following steps: pre-processing of images, the segmentation, search points of the contours, contour analysis, correlation analysis.

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analysis of different fractions showed that on the first sieve remain whole and damaged wheat; after the first sieve with oblong holes of 2.0 mm / 20.0 mm passing small and shrunken grain (2 %).

After the second sieve with apertures 1.0×20.0 mm passing grain that included in mineral impurities, including contaminants; the balance on the sieve with apertures of 1.0 × 20.0 mm – mineral, organic and harmful impurities, damaged wheat damaged by frost and unripe (green), and also small and shrunken, pests and dust, that as a result is 5 %.

In the fourth phase after separation in the pallet are the smallest components of the whole sample: rubbish and small pests (5 %) (Fig. 6).



Fig. 4. Grain after the first test sieve



Fig. 6. Rubbish and small pests (5 %)

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Received 19 Oktober 2014.

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В. М. Синеглазов, О. С. Галатенко. Автоматизация системы назначения основных параметров качества зерна

Розроблено систему експрес-аналізу зернових культур для оцінки ефективності роботи, побудовано імітаційну модель.

Ключові слова: експрес-аналіз; імітаційне моделювання; зернові культури.

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Разработана система экспресс-анализа зерновых культур для оценки эффективности работы, построена имитационная модель.

Ключевые слова: экспресс-анализ; имитационное моделирование; зерновые культуры.

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Количество публикаций: 2.

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