

Ministry of Education and Science of Ukraine  
**ODESSA NATIONAL ACADEMY OF  
FOOD TECHNOLOGIES**

International Competition of  
Student Scientific Works

# **BLACK SEA SCIENCE 2018**

## **PROCEEDINGS**



April, 4, 2018  
**ODESSA, ONAFT 2018**

Ministry of Education and Science of Ukraine  
Odessa National Academy of Food Technologies

International Competition of Student Scientific Works

# **BLACK SEA SCIENCE 2018**

**Proceedings**

**April 4, 2018**

Odessa, ONAFT 2018

Міністерство освіти і науки України  
Одеська національна академія харчових технологій

Міжнародний конкурс студентських наукових робіт

## **BLACK SEA SCIENCE 2018**

**Матеріали**

**4 квітня 2018 року**

Одеса, ОНАХТ 2018

**UDC 001(262.5):378.4.091.27(08)**  
**BBC 421D221**  
**B64**

Editorial board:

**Prof. B. Yegorov**, D.Sc., Rector of the Odessa National Academy of Food Technologies, Editor-in-chief

**Prof. M. Mardar**, D.Sc., Vice-Rector for Scientific and Pedagogical Work and International Relations, Editor-in-chief

**Dr. I. Solonytska**, Ph.D., Assoc. Professor, Director of the M. V. Lomonosov Technological Institute of Food Industry, Head of the jury of «Food Science and Technology»

**Dr. O. Kalaman**, Ph.D., Assoc. Professor, Director of the G. E. Weinstein Institute of Applied Economics and Management, Head of the jury of «Economics and Administration»

**Prof. V. Volkov**, D.Sc., Head of the Department of Applied Mathematics and Programming, Head of the jury of «Automation»

**Prof. S. Artemenko**, D.Sc., Head of the Department of Computer Engineering, Head of the jury of «IT Technologies and Cybersecurity»

**Prof. B. Kosoy**, D.Sc., Director of the V. S. Martynovsky Institute of Refrigeration, Cryotechnology and Ecoenergetics, Head of the jury of «Renewable Energy Sources and Environmental Protection»

**Prof. L. Morozyuk**, D.Sc., Professor of the Department of Cryogenic Engineering, Head of the jury of «Refrigerating Machines and Equipment»

**Dr. V. Kozhevnikova**, Ph.D., Assistant Professor of the Department of Hotel and Catering Business, ONAFT, Technical Editor

**Black Sea Science 2018**: Proceedings of the International Competition of Student Scientific Works, April 4, 2018, Odessa / Odessa National Academy of Food Technologies; B. Yegorov, M. Mardar (editors-in-chief.) [*et al.*]. – Odessa: ONAFT, 2018. – 827 p.

Proceedings of International Competition of Student Scientific Works «Black Sea Science 2018» contain the works of winners of the competition.

The author of the work is responsible for the accuracy of the information.

**ISBN 978-966-289-181-2**

Odessa National Academy of Food Technologies

УДК 001(262.5):378.4.091.27(08)  
ББК 421D221  
В64

Редакційна колегія:

**Єгоров Б.В.** – д.т.н., професор, ректор Одеської національної академії харчових технологій, відповідальний редактор

**Мардар М.Р.** – д.т.н., професор, проректор з науково-педагогічної роботи та міжнародних зв'язків, відповідальний редактор

**Солоницька І.В.** – к.т.н., доцент, директор технологічного інституту харчової промисловості ім. М.В. Ломоносова, голова журі напрямку «Харчова наука і технологія»

**Каламан О.Б.** – к.е.н., доцент, директор інституту прикладної економіки та менеджменту ім. Г.Е. Вейнштейна, голова журі напрямку «Економіка і управління»

**Волков В.Е.** – д.т.н., професор, зав. кафедри прикладної математики і програмування, голова журі напрямку «Автоматизація»

**Артеменко С.В.** – д.т.н., професор, зав. кафедри комп'ютерної інженерії, голова журі напрямку «ІТ технології та кібербезпека»

**Косой Б.В.** – д.т.н., професор, директор інституту холоду, кріотехнологій та екоенергетики ім. В.С. Мартиновського, голова журі напрямку «Відновлювані джерела енергії та охорона навколишнього середовища»

**Морозюк Л.І.** – д.т.н., професор кафедри кріогенної техніки, голова журі напрямку «Холодильні машини і установки»

**Кожевнікова В.О.** – к.т.н., асистент кафедри готельно-ресторанного бізнесу, технічний редактор

**Black Sea Science 2018:** Матеріали Міжнародного конкурсу студентських наукових робіт, 4 квітня 2018 р., Одеса / Одеська національна академія харчових технологій; Б. В. Єгоров, М. Р. Мардар (відп. ред.) [та ін.]. – Одеса: ОНАХТ, 2018. – 827 с.

Збірник включає матеріали робіт переможців Міжнародного конкурсу студентських наукових робіт «Black Sea Science 2018».

За достовірність інформації відповідає автор публікації.

### **Organizing committee:**

**Prof. Bogdan Yegorov**, D.Sc., Rector of Odessa National Academy of Food Technologies, Head of the Committee

**Prof. Maryna Mardar**, D.Sc., Vice-Rector for Scientific and Pedagogical Work and International Relations of Odessa National Academy of Food Technologies, Deputy Head of the Committee

**Prof. Stefan Dragoev**, D.Sc., Vice-Rector on Research and Business Partnerships of University of Food Technologies (Bulgaria)

**Prof. Baurzhan Nurakhmetov**, D.Sc., First Vice-Rector of Almaty Technological University (Kazakhstan)

**Prof. Andrzej Kowalski**, Dr. habil., Director of Institute of Agricultural and Food Economics (Poland)

**Dr. Olivera Djuragic**, Ph.D., Director of Scientific Institute of Food Technology of University of Novi Sad (Serbia)

**Prof. Mircea Bernic**, Dr. habil., Vice-Rector on Research and Doctorate of Technical University of Moldova (Moldova)

**Prof. Jacek Wrobel**, Dr. habil., Rector of West Pomeranian University of Technology (Poland)

**Prof. Michael Zinigrad**, D.Sc., Rector of Ariel University (Israel)

**Dr. Mei Lehe**, PhD, Vice-President of Ningbo Institute of Technology, Zhejiang University (China)

**Prof. Plamen Kangalov**, Ph.D., Vice-Rector on Education of “Angel Kanchev” University of Ruse (Bulgaria)

**Dr. Alexander Sychev**, Ph.D., Assoc. Professor of Sukhoi State Technical University of Gomel (Belarus)

**Dr. Hanna Lilishentseva**, Ph.D., Assoc. Professor, Head of the Department of Merchandise of Foodstuff of Belarus State Economic University (Belarus)

**Prof. Heinz Leuenberger**, Ph.D., University of Applied Sciences and Arts Northwestern Switzerland (Switzerland)

### **Організаційний комітет:**

**Сторов Богдан Вікторович** – д.т.н., професор, ректор – Одеська національна академія харчових технологій – голова оргкомітету

**Мардар Марина Ромиківна** – д.т.н., професор, проректор з науково-педагогічної роботи та міжнародних зв'язків – Одеська національна академія харчових технологій – заступник голови оргкомітету

**Драгоєв Стефан Георгієв** – д.т.н., професор, проректор з наукової роботи і бізнес партнерства – Університет харчових технологій (Болгарія)

**Нурахметов Бауржан Кумаргалієвич** – д.т.н., професор, перший проректор – Алматинський технологічний університет (Казахстан)

**Ковальські Анджей** – доктор-хабілітат, професор, директор інституту економіки сільськогосподарської та харчової промисловості – Інститут сільськогосподарської та продовольчої економіки (Польща)

**Дюрагіц Олівера** – доктор, директор інституту харчових технологій – Університет в м. Нові Сад (Сербія)

**Бернік Мірча** – доктор-хабілітат, професор, проректор з наукової роботи та докторантури – Технічний університет Молдови (Молдова)

**Вробель Яцек** – доктор-хабілітат, професор, ректор – Західнопоморський технологічний університет (Польща)

**Зініград Михайл** – доктор наук, професор, ректор – Аріельський університет (Ізраїль)

**Лехе Мей** – доктор, віце-президент – Технологічний інститут Нінбо Чжэцзянського університету (Китай)

**Кангалов Пламен** – професор, доктор, проректор з навчальної роботи – Русенський університет «Ангел Канчев» (Болгарія)

**Сичев Олександр Васильович** – к.т.н, доцент, проректор з навчальної роботи – Гомельський державний технічний університет ім. П. Й. Сухого (Білорусь)

**Лілішенцева Анна Миколаївна** – к.т.н, доцент, зав. кафедрою товарознавства продовольчих товарів – Білоруський державний економічний університет (Білорусь)

**Леунбергер Хайнц** – доктор, професор – Університет прикладних наук і мистецтв Північно-західної Швейцарії (Швейцарія)

## DEVELOPMENT OF A GRAPHICAL USER INTERFACE FOR EGG QUALITY ASSESSMENT BASED ON A COMPUTER VISION SYSTEM

Author – Zhelezarova P., Paskova N.

Supervisor – Georgieva T.

*University of Ruse “Angel Kanchev”*

*The paper presents a developed graphical user interface for recognizing defective eggs in the MATLAB environment, based on computer vision. The interface is modular, which allows for the upgrade of the procedures and algorithms that are used. The accuracy of recognition for the four main qualitative groups of eggs was tested. Accuracy ranges is from 0.6 to 2.1%.*

### Introduction

Existing egg sorting systems use different type signs of their classification as color, defects, sizes, etc. In these systems for individual quality indicators are used with separate sensors for their own determination. To determine different types of egg defects is used spectrophotometer system [2, 3]. To determine the size of the eggs are uses computer vision [1]. The disadvantage of existing commercial systems is their high cost, complexity and maintenance because of the specific equipment they need for their proper functioning.

The purpose of the article is to develop a graphical interface with procedures and algorithms to determine defective eggs using computer vision, and to evaluate the accuracy of recognition.

### Materials and methods

#### Types of egg defects

When determining the quality of eggs, attention is drawn to six groups quality indicators characterizing the condition of the shell: the shell, air chamber, egg white, egg yolk, germ, taste and smell of eggs. Often the quality of the eggs is determined by osscoping. That's how it can be establish: the state of the protein, the position and the mobility of the yolk, the dimensions of the air chamber, the integrity of the shell and the presence of

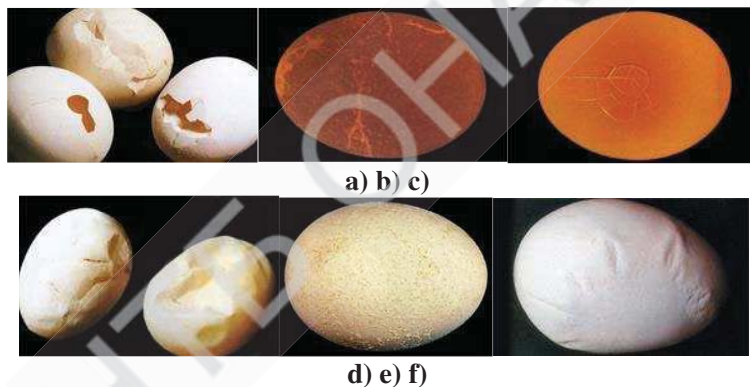
variation in themorphological and construction, presence of defects in eggs, etc.

The shell of all categories of eggs must be of normal texture and thickness, sound, clean and undamaged.

Only eggs may be marketed in the market where the integrity of the shell is not disturbed. Cracked and broken eggs should be used for processing. Attention is also paid to the cleanliness of the shell, since from it to the egg storage is highly dependent. Available for sale only clean or slightly soiled eggs. Heavily contaminated eggs are not subject to sale and storage but must be used for processing.

Common defects in eggs can be the following types:

- rough cracks (Figure 1a) – refers to large cracks and holes that usually lead to a broken membrane of the shell. The incidence of coarse cracks increases with the age of the hen. It varies from 1 to 5% of total production.



**Fig. 1. Egg defects**

- very fine cracks (Figure 1b), generally crossed longitudinally the length of the casing.

- cracks in the shape of a star (Figure 1c) – these are fine cracks, radiating outwards from the central point of impact.

- eggs without shell or very thin shells (Figure 1d) – look unattractive and very vulnerable to disability.

- eggs with coarse shells (Figure 1e) – refer to eggs with roughly shaped areas, often unevenly distributed on the shell.

- flat eggs – when part of the shell is flattened or cut. Often the adjacent part of the shell is wrinkled.

### Computer Vision System

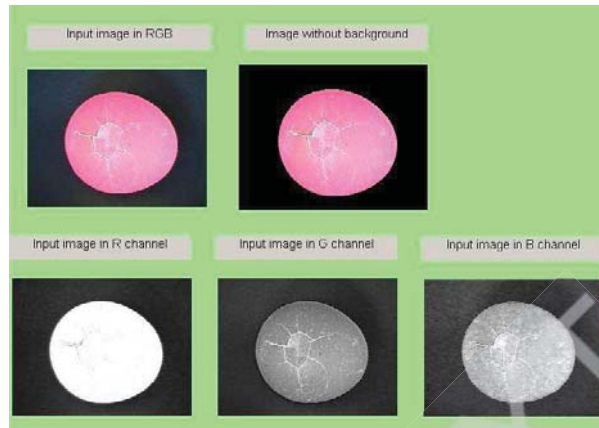
Because defects can be assessed visually, it is used computer vision system (Figure 2) to capture the image of the eggs. The system consists of a stand with an egg stand and mounted lighting for illumination of the egg from above and below; PC in which it is being recorded the image captured with a color digital camera. The output image is in RGB color model with 640 x 480 pixels.



Fig. 2. Computer vision system

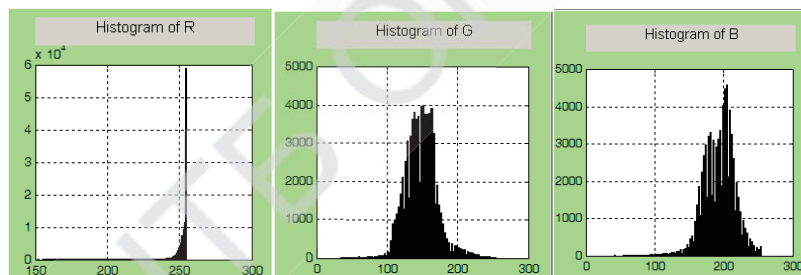
The main step is to select an informative color component to be used to detect egg defects. For this purpose three more color models were used – Lab, XYZ and HSV.

The software platform was used to develop the interface MATLAB. In Fig. 3. a part of the graphical user interface is presented, which was developed to use to visualize the source image of egg (in RGB pattern), image of egg without background (to be processed only pixels of the egg) and the image of the egg in the three components of each color model.



**Fig. 3. Graphical user interface for visualizing the output image, background image and the three color model components**

The interface also incorporates an opportunity to visualize the histograms of these components (Figure 4).



**Fig. 4. Histograms of R, G and B components**

As an informative, the S component of the HSV color model has been evaluated. The defect recognition algorithm for eggs includes the following basic steps:

1. Convert from RGB to HSV color pattern to the egg output image.
2. Remove the pixels from the image background by setting the limits of the H component.
3. Switch to a black and white image by using a MATLAB built-in function for determining the gray level threshold.
4. Display the contours in the image of the egg.

5. Estimating the egg in one of two possible classes (with or without defects) as a criterion for the absence or presence of defects is the number of contours in the image. If there is one loop – the egg is free of defects, if more than one contour is present – the egg is defective.

This algorithm and the procedures used in its individual steps are embedded in the developed graphical user interface, which is shown in Fig. 5.

The developed graphical user interface has been tested with 120 eggs, 30 pieces of the four classes s, m, l, xl. The test results are presented in table. 1.

Eggs are appreciated by an expert and by the developed interface. The last column of the table shows the error of percentages from the incorrect recognition of the eggs.

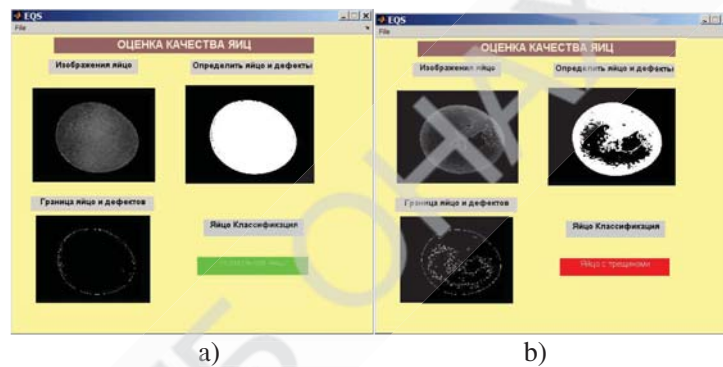


Fig. 5. Graphical user interface for recognizing egg defects an egg without defects, (b) an egg with defects

Table 1 – Test results of the developed interface.

Egg size	Expert		Developed software		Error of percentages from the incorrect recognition of the eggs	
	With defect	Without defect	With defect	Without defect	With defect	Without defect
S	13	17	15	15	0,6%	0,6%
M	14	16	16	14	0,6%	0,6%
L	15	15	12	18	0,9%	0,6%
XL	15	15	22	8	2,1%	2,1%

### Conclusion

The paper presents a developed graphical user interface for detecting defective eggs in the MATLAB environment, based on computer vision. The interface is modular, which allows for the upgrade of the procedures and algorithms that are used. The accuracy of recognition for the four main qualitative groups of eggs was tested. Accuracy ranges from 0.6 to 2.1%.

### References

1. Ibrahim R., Z. Mohd Zin, N. Nadzri, M.Z. Shamsudin, M.Z. Zainudin., Egg's Grade Classification and Dirt Inspection Using Image Processing Techniques, Proceedings of the World Congress on Engineering 2012 Vol II WCE 2012, July 4 – 6, 2012, London, U.K.
2. Lunadei L., L. Ruiz-Garcia, L. Bodria, R. Guidetti, Automatic Identification of Defects on Eggshell Through a Multispectral Vision System, Food Bioprocess Technol, 2012 (5), 3042– 3050
3. Schwagele F, Poser, R. and Krockel, L. (2001) Application of low-resolution NMR spectroscopy of intact eggs – Measurement of quality determining physical characteristics Fleischwirtschaft 81(10): 103-106.
4. <https://www.mathworks.com/>

DEVELOPMENT OF A GRAPHICAL USER INTERFACE FOR EGG QUALITY ASSESSMENT BASED ON A COMPUTER VISION SYSTEM Author – Zhelezarova P., Paskova N., Supervisor – Georgieva T.....	567
DYNAMIC PROPERTIES OF PROVIDING CYBERSECURITY PROCESSES AT THE EXAMPLE OF CYBERSECURITY'S AUDIT Author – Kozlova O., Supervisor – Kononovych V. ....	573
<b>5. RENEWABLE ENERGY SOURCES AND ENVIRONMENTAL PROTECTION.....</b>	<b>598</b>
MODELLING OF PHOTOVOLTAIC SOLAR CELLS BY MODIFYING FINS CONFIGURATION OF THE AIR-COOLED HEAT SINKS FOR POWER GENERATION Author – Siarova A., Supervisor – Shixue Wang .....	598
THE PROSPECTS OF APPLICATION THE GENERATORS WITH PERMANENT MAGNETS FOR SMALL WIND POWER PLANTS Author – Sergienko I., Supervisor – Shevchenko V. ....	614
COMPARISON OF VARIOUS METHODS FOR REDUCING GASOLINE LOSSES DURING STORAGE USING ECOLOGICAL AND ENERGY CRITERIA Author – Oleksenko O., Supervisor – Volhusheva N. ....	636
DEVICE FOR CLEANING OF FLUE GASES FROM SULFUR OXIDES AND CARCINOGENIC RESIN Author – Mukminov I., Supervisor –Kogut V., Boshkova I.....	654
THE IDENTIFICATION OF PLANTS-INDICATORS OF POLLUTION OF TERRITORIES BY HEAVY METALS IN THE ZONE OF EFFECTS OF HEAT-ELECTRICAL POWER STATIONS Author – Konopelko O., Supervisor – Pozniak A.....	663
INTENSIFICATION OF THE MATERIAL DRYING PROCESS WITH USE OF THE MICROWAVE FIELD ENERGY Author – Mykhailova O., Supervisor – Boshkova I.....	676
ECOLOGICAL SAFETY OF FOOD PRODUCTS GROWN WITHIN THE URBOHEOSYSTEM Author – Medvedeva Yu., Supervisor – Nekos A. ....	690
OBTAINING OF $Cu_2ZnSnS_4$ THIN FILMS AS AN ACTIVE LAYER OF SOLAR CELL Author – Musharovskiy O., Supervisor – Hilchuk A.....	710
ELECTRIC PASSENGER TRANSPORT VEHICLES: TECHNICAL CHARACTERISTICS AND ENERGY EFFICIENCY Author – Ivanov R., Supervisor – Koev K.....	725

*Наукове видання*

**Міжнародний конкурс студентських наукових робіт**

**BLACK SEA SCIENCE 2018**

Матеріали

Верстка – Н.М. Ковальчук

Формат 60x84/16. Гарнітура Times New Roman.  
Умовно-друк. арк. 48,07. Тираж 300. Замовлення № 0518-105.

Видавництво і друкарня – Видавничий дім «Гельветика»  
73034, м. Херсон, вул. Паровозна, 46-а, офіс 105  
Телефон +38 (0552) 39 95 80  
E-mail: [mailbox@helvetica.com.ua](mailto:mailbox@helvetica.com.ua)  
Свідоцтво суб'єкта видавничої справи  
ДК № 4392 від 20.08.2012 р.