STUDY PROFILES THERMOGRAMS FOR DETERMINING DISEASES OF THE CATTLE LIMBS

Abstract. The article discusses non-contact thermal imaging methods for determining diseases of biological objects: video digital identification and thermography. When studying inflammatory processes in the body of a biological object using thermograms, one should refuse to register only the native thermal picture, which is static, and it is imperative to assess its dynamics. If a series of thermograms shows local changes in the thermal picture in the form of an increase or decrease in infrared radiation in those areas and at the time that were supposed, only in this case it is possible to speak unambiguously about the objectivity of thermal imaging information. Creation of a methodology for the application of digital analysis of video profiles of the shape and ratio of the dimensions of an object, and comparison of the results with the thermographic picture of a thermal imaging image of a functional thermal imaging of thermograms in normal conditions and with inflammation in a biological object.

Keywords: biological object, thermography, thermal imaging information, digital analysis

At the present stage of development of technology, it is possible to highlight the general trend of the transition to non-contact diagnostics of the definition of diseases. Currently, portable small-sized thermal imaging devices are becoming more common and their areas of application are expanding. For the first time publications on the application of the method of infrared diagnostics for the study of biological objects appeared in the late 60s of the last century abroad (Gershon-Cohen J., 1964, 1965; Williams K.L., 1964, 1965; Brashfield H. D., 1964, 1965 ; GrosCh.M., 1966), and then in Russia. The wide interest in the method of thermal
imaging for diagnosing diseases in medicine has led to the fact that in many countries of the world they began to develop and produce thermal imagers with various methods of recording thermograms, such companies as Old defit (Holland), Furdshitsu Limited (Japan), AGA and AB Bofors (Sweden), Barnes Engineering, FLIR Systems (USA), etc. [1] - [4]

The organization of heat exchange in a living organism is a complex process, but the general rule is that in the focus of inflammation the temperature is always higher, especially in the initial stages, it is almost always performed. The existing practice confirms that the most effective way to solve the above problem is the use of thermal imaging equipment, with the help of which it is possible to take pictures of the distribution of the temperature field of the joints of the limbs of cows. [4] - [7]

The analysis showed that one of the existing methods of thermal diagnostics in medicine is thermography. Thermography is a method of functional diagnostics based on the registration of the human body’s own infrared radiation, proportional to its temperature, with the help of special devices in order to diagnose various diseases and pathological conditions. Thermography is a physiological, harmless, non-invasive diagnostic method. In the early stages of diagnosing diseases, thermography is a very effective way to diagnose many diseases. Video-digital identification is used in agriculture to identify heterogeneous zones within the field, which allows optimizing the use of fertilizers and plant protection products, as well as differentiating the sowing of crops. Precision farming tools are monitoring the current state of crops and analyzing long-term data. To do this, a potential farmer needs to regularly perform a simple algorithm: upload information about the current situation in the field and follow the recommendations obtained on the basis of satellite imagery, simulation of plant growth and the possible development of their diseases. [8]

Thermal imagers are also used in military equipment. New modern technology comes into service today with built-in thermal imaging cameras in its arsenal. Their use makes it possible to conduct hostilities in conditions of poor visibility, to detect the enemy and equipment. In addition, the devices are installed on unmanned aircraft and remotely controlled equipment. [9] Non-contact video digital identification is
widely used in medicine to examine and treat people, such as ultrasound (ultrasound) and magnetic resonance imaging (MRI).

Also in medicine, devices of a thermal imaging system are used that allow you to recognize the nature of the disease, as well as see an infected person among healthy people in terms of body temperature characteristic of a particular disease. Examination with the help of special equipment that reacts to electromagnetic waves helps to detect the inflammatory process with an accuracy of a micron and find the area of pathology. Using the device will allow you to determine whether the patient is sick or healthy, to see the source of the disease, to make a diagnosis. [10]

It is known that thermal imaging devices are widely used in various fields due to the fact that they provide contactless measurement, high speed of data acquisition, and a wide area of coverage of the object surface. As for, in fact, thermal imaging devices and methods of obtaining thermograms, at present there is a fairly large number of this equipment. The main attention is paid to increasing the information content and reliability of thermal imaging information. When studying inflammatory processes in the body of a biological object using thermograms, one should refuse to register only the native thermal picture, which is static, and it is imperative to assess its dynamics. If a series of thermograms shows local changes in the thermal picture in the form of an increase or decrease in infrared radiation in those areas and at the time that were expected, only in this case it is possible to speak unambiguously about the objectivity of thermal imaging information. The bottom line is that information really should be present on thermograms and it should not be speculated. Naturally, such detailed information cannot be obtained with a single registration of a native thermogram. It is necessary to use the methodology of functional thermal imaging, the presence of a certain resolution (the number of spatial points at the minimum size of a fragment of the thermal imaging image) for the correct analysis of the resulting picture (Fig. 1). [11] - [13]

Specifying the field of research, it should be noted that the problem of analyzing thermal imaging images, their "understanding", does not differ from the general problems of technical vision. Nevertheless, the application of the currently developed technologies of technical vision for the problems of early diagnosis of
animal diseases by their thermal imaging images has certain peculiarities. Basically, these features are associated with the nature of the thermal imaging images themselves, the various identified and considered areas of the animal's body.

Fig. 1. Reference database for thermal imaging diagnostics of thermograms [13]

The content of these images does not have any clear form, but is random statistical in nature. Therefore, along with the issues of the quality of the generated thermal imaging images (their dynamic range, clarity, resolution, capacity), the main thing is their informative statistical description, which in the future can be associated with physiological and pathological signs of the health status of a biological object (Fig.2). [14]

The construction of the histogram (Fig. 2 a) is as follows: along the frame contour or a separate area, the temperature value is plotted along the X-axis, and the Y-axis is the percentage of points along the contour that have the specified temperature. Thermal profile provides temperature distribution along the selected straight line. On the profile graph (Fig. 2 b), the X-axis represents the ordinal numbers of points along the length of the line, and the Y-axis represents the temperature value at these points. [15]

It should be emphasized here that the traditional histogram analysis allows one to estimate only the number of microsections of the observed areas of the animal's body that have a particular temperature. However, the histogram analysis does not describe the nature of the mutual distribution of these microsections.
Fig. 2. Thermograms with the assignment of an index to each area and displaying the maximum and minimum temperatures in this area (cow legs)

It should also be borne in mind that non-contact diagnostics using thermal imaging equipment has disadvantages. A significant disadvantage can be considered the effect of ambient temperature depending on the season on thermal profiles; the communication interface between the thermal imager and the signal processing
system should provide such a format for the presentation of image signals that would be compatible with the requirements of the subsequent processing of these signals.

Taking into account the above, it should be noted that one of the main tasks, the solution of which can ensure the widespread use of thermal imaging equipment, is the quality of the obtained thermal imaging images of the inflamed areas of the animal's extremities. to identify the features of monitoring inflammatory processes in animals: the choice of thermal imaging and related equipment; selection of segmentation methods for histogram analysis of thermal imaging images.

Conclusions

Thus, one of the main tasks of the study is the selection of thermal imaging equipment for obtaining high-quality thermal imaging of the inflamed areas of the animal's extremities and the creation of a methodology for using digital analysis of video profiles of the shape and ratio of the object's dimensions, and comparison of the results with the thermographic picture of the thermal imaging image of the functional thermal imaging of thermograms in health and inflammation.

References:

1. Kozhevnikova I.S., Pankov M.N., Gribanov A.V., Startseva L.F., Ermoshina N.A. (2017) The use of infrared thermography in modern medicine (literature review). Siberian Journal of Clinical and Experimental Medicine, p. 39-46.
2. Borodulin A.O. (2016) Thermal imager as a modern instrument / A.O. Borodulin, A.V. Stavitsky // In the collection: Topical issues of science and economy: new challenges and solutions Collection of materials of the International student scientific and practical conference. p. 26-29.
3. Lawson R. (1956) Implications of surface temperatures in the diagnosis of breast cancer, Canad. med. Ass. J., v. 75, p. 309.
4. Vorobiev D.V. (2014) Software tools for the analysis and simulation of the temperature regime of printed circuit boards / D.V. Vorobiev, M.V. Ivankova, I. D. Grab, I.I. Kochedarov, N.K. Yurkov // Modern information technologies. No. 19. p. 128-135.
5. Khizhnyak L.N., Khizhnyak E.P., Maevsky E.I. (2018) The possibility of using miniature infrared cameras of a new generation in medical diagnostics // Bulletin of new medical technologies. No. 4. S. 101-109. DOI: 10.24411 / 1609-2163-2018-16279.
6. Ring E.F.J., Ammer K. (2012) Infrared thermal imaging in medicine // Physiological
INTERNATIONAL SCIENTIFIC DISCUSSION: PROBLEMS, TASKS AND PROSPECTS

Measurement (IOP Publishing). No. 33. p. 33 – 46.

7. Tay M.R., Low Y.L., Zhao X., Cook A.R., Lee V.J. (2015) Comparison of Infrared Thermal Detection Systems for mass fever screening in a tropical healthcare setting // Public Health. No. 129. p. 1471-1478.

8. Zhao, Yi & Ma, Jiale & Li, Xiaohui & Zhang, Jie. (2018). Saliency Detection and Deep Learning-Based Wildfire Identification in UAV Imagery. Sensors. 18.712. DOI: 10.3390/s18030712. learning for infrared thermal image based machine health monitoring, " IEEE / ASME Transactions on Mechatronics, 2017

9. Mittal, Usha & Srivastava, Sonal & Chawla, Priyanka. (2019). Object Detection and Classification from Thermal Images Using Region based Convolutional Neural Network. Journal of Computer Science. 15.961-971. DOI: 10.3844/jcssp.2019.961.971.

10. Bhattarai, Manish & Martinez-Ramon, Manel. (2020). A Deep Learning Framework for Detection of Targets in Thermal Images to Improve Firefighting. IEEEAccess. p. 1-1. DOI: 10.1109/ACCESS.2020.2993767.

11. Lobanov A.A., Kochkin R.A., Andronov S.V., Popov A.I., Lobanova L.P., Bichkaeva F.A., Bogdanova E.N., I. V. Kobelkova (2019) Application of thermography of the face and hands for the diagnosis of adaptation disorders to the Arctic conditions // Bulletin of new medical technologies. No. 4. Publication 3-12. DOI: 10.24411/2075-4094-2019-16405.

12. Mekshina L.A., Usynin V.A., Stolyarov V.V., Usynin A.F. (2012) The use of thermal imaging in the diagnosis of obliterating diseases of the arteries of the lower extremities // Siberian medical journal. Vol. 27, No. 2. p. 15–22.

13. URL: https://www.flir.eu/surveillance/search-and-rescue/ (date of access 05.09.2021)

14. Thermal Imaging Search & Rescue (SAR) Application. URL: https://satir.com/application/thermal-imaging-search-rescue-sar-application (date accessed 04.09.2021)

15. Dahlin Rodin, Christopher & Lima, Luciano & de Alcantara Andrade, Fabio Augusto & Haddad, Diego & Johansen, Tor & Storvold, Rune. (2018). Object Classification in Thermal Images using Convolutional Neural Networks for Search and Rescue Missions with Unmanned Aerial Systems. 1-8. DOI: 10.1109/JIJCNN.2018.8489465.