APPLICATIONS OF THERMOGRAPHY IN VETERINARY SCIENCE AND ANIMAL HUSBANDRY

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Abstract

Infrared thermography (IRT) is an invaluable and non-invasive imaging technique that detects and captures infrared radiation emitted by objects, converting it into visual representations based on heat distribution. Its widespread adoption in veterinary medicine has proven beneficial for disease prevention, control, diagnosis, and treatment. Additionally, its novel application in animal production offers numerous advantages, including low cost, rapidity, efficiency, and the ability to gather critical information without direct contact with the animals. IRT's versatility allows for continuous monitoring of multiple animals simultaneously, facilitating swift identification of health issues or injury, which is particularly crucial in large herds. Its non-invasive nature minimizes stress on the animals and enhances their overall well-being. Moreover, this technology enables veterinarians and farmers to detect potential problems in real-time, improving the efficiency of livestock management practices. In conclusion, IRT is a game-changer in veterinary medicine and animal production. Its ability to assess the heat patterns of various body regions provides vital information about an animal's health, making it an indispensable tool for proactive healthcare and management practices in the agricultural industry. Its non-invasive, cost-effective, and efficient nature revolutionizes the way we care for and ensure the well-being of our farm animals.

Keywords: Infrared, livestock, mastitis, thermograph, welfare

INTRODUCTION

Thermography, or infrared thermography, is a technique that uses infrared radiation (IR) to measure the surface temperature of an object. All objects with a temperature above absolute zero (-273.15°C) emit IR radiation. The intensity and spectral composition of the radiation emitted is related to the surface temperature of the object. A thermal camera's infrared detector absorbs the IR radiation emitted by an object and converts it into electrical signals. The camera then assigns a color to each signal and displays it as a thermal image on the screen.

BRIEF HISTORY

In the year 1800 - Sir William Herschel discovered infrared radiation by using a prism to separate sunlight into its different colors and measuring the temperature of each color with a thermometer. He named his discovery the "thermo metrical spectrum", which was later renamed "infrared". Then in the year 1917 - During World War I, the British developed the first infra-red search and track (IRST) to detect aircraft from a distance of one mile. Hardy established the diagnostic value of infrared temperature measurement in 1934, which contributed to the use of IRT in medical sciences. In 1960, the first thermo graphic devices were developed for non-military use.

IRT is being used today in a wide rang e of applications, such as remote sensing, defe ct diagnostics, medical testing, and the detecti on of animal diseases and more. Benefits include real-time analysis, safety, and non-invasiveness.

APPLICATIONS IN VETERINARY SCIENCE

A. Disease Diagnosis

Mastitis Detection: Early diagnosis through thermal imaging of udders.

Mastitis is a global production disease that needs an intelligent solution to tackle effectively. Infrared thermography (IRT) could be applied for monitoring the animals' udder health as part of regular daily farm operations. When an udder is infected, there is an increase in blood flow and metabolic activity in the affected quarters, leading to a localized rise in temperature

Lameness and Injuries: Identifying inflammation in limbs or joints.

Lameness could indicate an early indication of a musculoskeletal problem, although it is not a distinct disease. The most frequent reason why horses acquire lame is pain. In order to ensure an accurate diagnosis and suitable treatment, a thorough examination of a lame horse is required. Thermography technique creates an image of t he surface temperature of an object. In addition to measuring heat emissions, it can be used to identify inflammation, which may be a factor in lameness. The temperature of an injured area is influenced by blood circulation, which is almost always impacted by disease and injury. Thermography is able to detect "hot spots" of local inflammation because of the increased blood flow to the affected area.

Fever Screening: Monitoring temperature changes due to infections.

Infrared thermography provides a live thermal map over a wide anatomical region, which enables analysis of body temperatures.

B. REPRODUCTIVE HEALTH

Heat detection in breeding animals by analyzing temperature changes in the genital region.

Infrared thermography platform is well-timed to reduce the dairy industry's challenges in estrus detection by providing real-time analyses that could improve the precision of the timing of artificial insemination. In addition to estrus detection, fluctuations in skin temperature could be used to aid in the diagnosis of other disorders in dairy production such as ketosis, mastitis, metritis, lameness, milk fever.

C. STRESS AND WELFARE ASSESSMENT

Identifying stress through thermal patterns in facial regions or extremities.

Infrared thermography (IRT) is a method to record the electromagnetic radiation emitted by bodies. It can indirectly assess sympathetic and parasympathetic activity via the modification of temperature of different body areas, caused by different phenomena such as stress-induced hyperthermia or variation in blood flow. Compared to other emotional activation assessment methods, IRT has the advantage of being noninvasive, allowing use without the risk of influencing animals' behavior or physiological responses

D. RESPIRATORY AND DIGESTIVE DISORDERS

Diagnosing respiratory diseases like pneumonia through thoracic imaging.

Infrared thermography plays an important role in diagnosing respiratory diseases like pneumonia.

E. SURGICAL MONITORING AND REHABILITATION

During surgery, infrared thermography aids in evaluating tissue blood flow and monitoring wound healing and recovery progress.

Applications in Animal Husbandry

A. Herd Management

Screening for early signs or symptoms of diseases in livestock. Temperature monitoring to evaluate the effects of changing conditions.

B. Productivity Optimization

Ensuring animal comfort by detecting heat stress. Assessing thermoregulation in different housing systems.

C. Biosecurity and Disease Surveillance

Early detection of zoonotic diseases in large herds.Use in quarantine areas to screen for fever or inflammation.

Technological Advancements

Latest developments in thermal imaging devices (e.g., portable, handheld). Integration with AI for automated data analysis. Use of drones for large-scale thermal monitoring.

CHALLENGES AND LIMITATIONS

- High initial costs of equipment.
- Training required for accurate interpretation of thermal images.
- Environmental factors like ambient temperature affecting readings.

CASE STUDIES

IRT can be used for study and research in farm animals such as pigs, cattle, sheep and poultry. Currently, IRT has been successfully used in detection of mastitis, estrus and hoof disorders. It is also used in screening of calf diarrhea as well as bovine respiratory complex. In calves experimentally inoculated with BVDV, IRT was able to identify body temperature changes consistent with disease as early as 1 day after inoculation. In that study, orbital temperature was the most reliable indication of disease progression; the orbital IRT temperature readings peaked in conjunction with abnormal clinical scores. Use of IRT to measure the rate of change in temperature at a specific anatomic site resulted in detection of BVDV-infected calves before other diagnostic tests yielded positive results or clinical signs of disease were manifest. Results of that study suggest that IRT can be used as a screening tool for cattle herds and can identify BVDV-infected animals up to 1 week before onset of viral shedding. Infected animals can then be isolated from the rest of the herd prior to becoming infectious, which should minimize virus transmission within the herd and decrease the economic impact of the disease.

FUTURE PROSPECTS

Development of cost-effective solutions for small-scale farmers. Expansion into wildlife conservation and exotic animal care. Enhanced integration with precision farming technologies.

CONCLUSION

IRT can be used for study and research in farm animals such as pigs, cattle, sheep and poultry. Currently, IRT has been successfully used in detection of mastitis, estrus and hoof disorders. It is also used in screening of calf diarrhea as well as bovine respiratory complex. IRT also plays important role in determining welfare status of animal and animal house too. Therefore, IRT can be recommended as a method that can produce important information where the possibilities of conventional diagnostic techniques have been exhausted. There are, however, certain limitations and factors that must be considered when using IRT in animals.

REFERENCES

Schaefer, A. L., Cook, N. J., & Church, J. S. (2007). The use of infrared thermography in the assessment of animal health and welfare. *Journal of Animal Science, 85*(suppl_1), 200–205.

Polat, B., Colak, A., Cengiz, M., Yanmaz, L. E., & Oral, H. (2010). Infrared thermography: A new approach in the diagnosis of subclinical mastitis in dairy cows. *Journal of Dairy Science, 93*(4), 1940–1943.

Luzi, F., Mitchell, M., Nanni Costa, L., & Redaelli, V. (2013). The application of infrared thermography in animal science and production. *Biological Research, 46*(4), 383–390.