UDK 535.8

LENS IMAGE QUALITY ATHERMALIZATION FOR INFRARED MEDICAL CAMERAS

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Application of thermal imaging analysis for body's surface provides the ability to detect any anomalies or potential health issues. This is particularly useful in medical contexts, such as detecting cancer, injuries or inflammation [1]. The accuracy of this analysis primarily depends on the image contrast and quality, which are influenced by the environment temperature during diagnosis. Furthermore, temperature fluctuations can negatively affect infrared lenses, causing a reduction in image resolution. Therefore, designing lenses for infrared systems that can maintain their proper function despite temperature changes is an essential objective.

Medical thermal vision is a fast, non-invasive method that can diagnose many known diseases without physical contact. This technique allows doctors to monitor the treatment process, heal wounds during various stages of morphogenesis, and even prevent further complications. Thermography is highly effective for screening patients for inflammation during early stages of disease. The criteria for thermal imaging diagnosis has developed for over 200 diseases and is constantly growing.

It is common knowledge that different parts of the human body have their own normal average temperatures, due to variations in blood supply and nerve innervations. However, for symmetrical areas, the surface temperature does not usually differ significantly. Therefore, opposite symmetrical regions can serve as control sites when identifying pathologies.

When analyzing thermogram information and making a diagnosis, there are certain rules and patterns. For example, if there is a temperature difference of 1-2°C between oppositely symmetrical body parts, it could indicate the presence of a pathology in the organism. For tumors, a temperature change to a greater side indicates malignancy, while a temperature change to a lesser side indicates a benign tumor [2].

In multi-disciplinary medical institutions, medical thermography is increasingly being utilized. Thermographers working in screening diagnostics often face unstable environmental conditions, which require them to have a high level of expertise. They must consider external factors and the incomplete thermal adaptation of patients during the diagnostic process. Increasing the information content and correspondence of the taken indicators with the real temperature of the observed surface area remains an urgent issue. Additionally, the adequacy of diagnosis depends on the accurate interpretation of thermograms, which can only be achieved with clear images of high quality. These parameters are highly dependent on the operating conditions and environmental factors that affect the design of thermography cameras.

Currently, digital image processing techniques and artificial intelligence technologies are extensively used to automate infrared devices [3, 4]. However, outcome of system primarily relies on the quality of obtained image. The main problem with medical thermography today is the environmental and temperature-related changes that can affect its quality and usefulness [5]. To solve this issue, the thermograph needs to undergo athermalization, a process that stabilizes the optical system and improves its characteristics. This involves synthesizing dioptric objectives with materials that have different magnitudes and signs of thermo-optical constants in combination with a certain material for the supporting structure [6]. This ensures that the infrared device can maintain its frequency and energy characteristics, as well as high image quality, in all over the operating temperature range [7].

Medical thermal vision is a highly-effective and non-invasive way to diagnose various diseases and to monitor their treatment. Its reliability is based on stability of thermal imaging symptoms, which can be used for objective control over pathological processes in the body in various medical fields.

Improvements in thermal imaging technology should concentrate on elevating of thermograms image quality and devising algorithms for the automatic identification of diseases and pathologies. Additional scientific investigations need to be conducted to determine the radiation of various human body parts and tissues, with the aim of identifying the wavelengths with maximum and minimum spectral intensity. This will facilitate the execution of multilayer thermographic diagnostics, expand capabilities of this method and stimulate the spread of thermographic diagnostic among medical institutions worldwide.

Keywords: *athermalization, image quality, medical thermography camera, thermal stabilization, infrared lenses.*

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