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The Role of Dynamic Infrared Imaging in Melanoma Diagnosis

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Abstract

Melanoma incidence and the lifetime risk are increasing at an alarming rate in the USA and worldwide. In order to improve survival rates, the goal is to detect melanoma at an early stage. Accurate, sensitive and reliable quantitative diagnostic tools can reduce the number of unnecessary biopsies, the associated morbidity and the costs of care, in addition to improving survival rates. The recently introduced quantitative dynamic infrared imaging system, 'Quantification Analysis of Induced Thermography' measures differences in the infrared emission between healthy tissue and a lesion during the thermal recovery process after removal of a cooling stress. Results from a clinical study suggest that the temperature of cancerous lesions is higher during the first 45–60 s of thermal recovery than the temperature of benign pigmented lesions. This small temperature difference can be measured by modern infrared cameras and serve as an indicator for melanoma in modern quantitative melanoma detectors.

Introduction

Melanoma is the deadliest form of skin cancer and the number of melanoma cases in the USA increases at an alarming rate.[1,101,102] Early detection is the key to improving survival in patients with malignant melanoma; noninvasive imaging systems that allow accurate quantitative detection of melanoma are instrumental in reducing morbidity and mortality as well as the cost of care associated with this disease.

Infrared (IR) thermography is an IR imaging technique that allows the detection of electromagnetic radiation emitted by an object (the human body in medical applications) in the IR domain of the electromagnetic spectrum, in which the wavelength ranges from 3 to 14 μm (Figure 1). The emissive power, which is the amount of radiation emitted by a surface, depends on its temperature and increases with increasing temperature as shown in the blackbody radiation spectrum in Figure 1. Changes of emitted radiation in the IR domain can therefore be associated with temperature changes. Since IR images of warmer objects stand out against a colder background, humans become visible in a colder environment, even in total darkness. This property of the IR imaging system led to a range of military, surveillance (night-vision systems) and industrial applications, which to date are predominantly qualitative. Military applications have driven a dramatic development in IR technology over the past decades – a trend accompanied by a continuous decrease in the cost of imaging hardware. The decreasing cost has led to the development of consumer products and this trend is expected to continue.

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