http://dx.doi.org/10.21611/qirt.2015.0071

A Computer Tool for Construction of 3D Infrared Thermograms and Anatomical Selection of Characteristic Areas on a Human Body

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The temperature distribution on the surface of the human body is influenced by many biological processes, including those that are pathological in nature, and in many such cases, the changes in surface temperature can be observed much earlier than other clinical phenomena. As a consequence of this, infrared thermography is gaining more and more traction in various fields of medicine, science and clinical practice as a method for functional diagnostics. In particular, thermography is being investigated as a means for early detection of breast cancer. However, standard thermograms, obtained using conventional infrared cameras, are two-dimensional in nature. This significantly limits the precision of the measurement of surface temperature on objects of complex shapes, such as different parts of the human body. Additionally, two dimensional images of thermal distributions make it hard to identify and select the characteristic areas of the human body (regions of interest or ROIs) due to the fact that such selection happens with the help of edge-detection algorithms, which are of limited use with thermal images, due to the fact that temperature boundaries not always correspond to real boundaries on the human body. The solution to this problem is to combine the thermal images with another form of data (for example, through image registration) that presents the relevant boundaries on the body more clearly. As such, there are in development several methods for obtaining 3D thermograms by combining polygonal meshes describing the complex surface with 2D infrared images [1, 2].

In this work we present a 3D infrared thermography system that uses two thermal cameras to measure the surface temperature distribution and two off-the-shelf depth sensors to construct a 3D model of the subject. The data obtained from the depth cameras is registered with the data obtained from thermal camaras, and then the 3D model is put together including the temperature distribution data. When compared to traditional 2D thermal images, this system produces more detailed information that can be used to assist in the identification of suspicious regions. Our system overcomes the main disadvantage of 2D thermal images, the selection of regions of interest, by using the spatial information about the subject available in the form of a 3D model. In addition, having two thermal cameras facing the subject from different angles allows us to obtain a broad, panoramic view of the area of the body under study.

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Keywords: infrared thermography, 3D scanning, ROI selection.