http://dx.doi.org/10.21611/qirt.2015.0079

Detecting and Correcting Image Registration Errors in Thermographic Imaging for Medical Applications

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A new emerging modality in modern breast thermography is dynamic infrared imaging, when a series of thermal images are recorded during cooling or heating. One of the challenges this process presents is the exact match of points across samples, since the variations of pose could affect a lot of data. The main difficulty lies in eliminating the movements of the subject due to voluntary and involuntary movement. This is not always possible using mechanical stabilization and movement can disrupt the surface temperature measurements. In this work, we present a framework to process a series of thermographic images captured with an infrared camera that allows the matching of each point across time in the image series. We also developed a technique for image registration mismatch detection and correction.

Our dataset comes from a series of thermographic images of human subjects who volunteered for the study. The images are registered using the geometric transformation technique used commonly for aligning images in two or three dimensions. This method, even when practical in computer vision problems, is not precise enough for serial thermographic images for medical purposes, given the characteristics of the samples (slight change in distance and pose between shots), however further steps can be made in order to correct the mismatched areas. Capture errors can also be corrected with values closer to the real ones. We detect the unnatural variations in temperature at each point across time and mark the pixels to be corrected in the next step. The paper provides a method to correct the error, consisting on a regression model, which is made in the set of points that had a natural behaviour and the information is used to fill the blanks in the mismatched points. As a result, we have a more reliable sample closer to reality that can be used for further studies, such as a time series analysis, which is a proper approach for classification of suspicious points according to their cooling pattern. This technique ensures fidelity to the subject providing a more precise result, since the cooling process may vary from person to person. Our contribution is a detailed description of a correction process to maximize the quality of samples that leads to more reliable results in experiments and studies involving time series analysis on thermographic images.

Keywords: Thermographic image processing, medical images, infrared thermography, breast cáncer, image registration correction