

The influence of carbon dioxide on dynamic thermography results

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Abstract

This paper presents the assessment of the influence of the CO₂ cooling on active dynamic thermography (ADT) and thermal tomography (TT) results. This influence is great enough that one should consider taking it into account while thermal or dynamic parameters estimation. We try to estimate how much the infrared radiation is attenuated by the cloud of the CO₂ gas present in front of the IR camera lens.

1. Introduction

There are different types of excitation in ADT or TT. We can distinguish from heating or cooling of the examined object. Heating can be achieved by halogen lamps [1], microwave [2], ultrasound [3], etc.. Cooling can be performed by applying stream of cold air [4], cold water, ice, vaporous fluids [5] or as in our application the stream of CO₂ [6]. In biomedical applications cooling has its special role. It causes body physiological reaction to cold which can be analysed to get diagnostic information. Moreover, it doesn't cause pain or discomfort, unlike heating, while e.g.: burn depth estimation.

2. Problem statement

It turns out that the stream of CO₂ disturbs thermal transients recorded shortly after cooling stops. On figure 1a there is an example of such distortion. An unnatural fast grow in temperature return process is caused by the presence of the gas which did not left the space over measured area. This is well illustrated by the differential temperature of consecutive measurements (figure 1b).

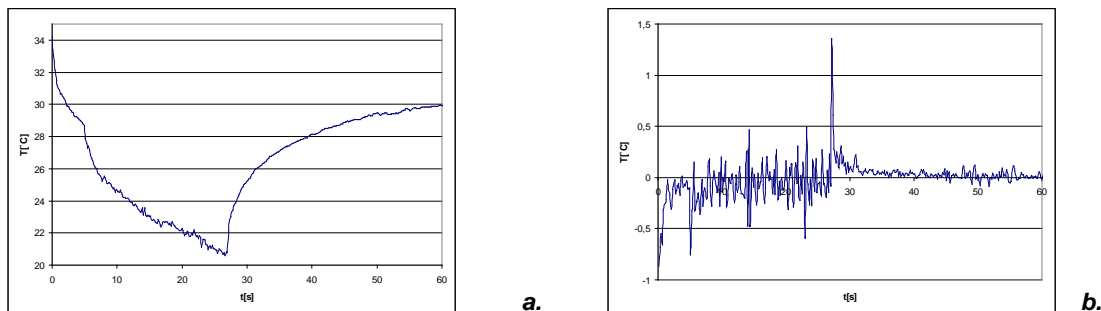


Fig. 1a. Thermal transient during cooling and temperature return phase; **b.** Differential temperature plot; maxima peak represents unnaturally fast temperature rise

3. Results

We experimentally estimated the influence of CO₂ on temperature results. We used: Flir A320G thermal camera to measure temperature in selected region of interest, Fluke 9410 thermal calibrator as the radiation source and CryoT cryotherapy unit as the source of CO₂. Measurements were taken with and without CO₂ in front of the camera in order to calculate temperature change caused by the presence of the gas. Experimental setup is shown on figure 2.

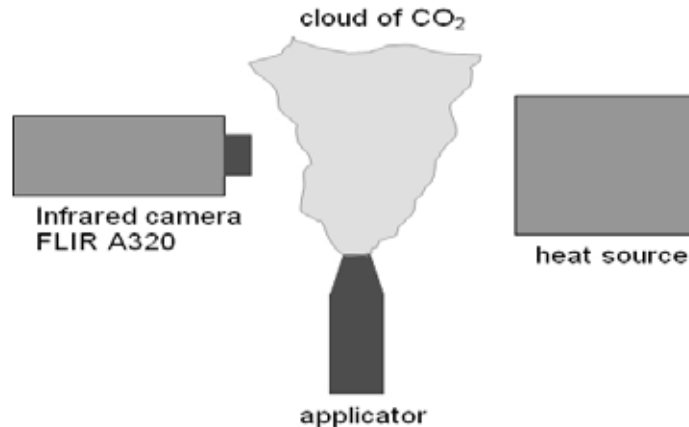


Fig. 2. The measurement set

The results of the work quantify the influence of CO₂ gas on temperature measurement. Clear 'temperature damping' is measurable in the first moments after cooling shutdown. This leads to erroneous thermal or dynamic parameters estimation. To avoid false results we must be aware of time duration and scale of this phenomenon.

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