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Development of a new thermal method for detection of cutaneous melanoma

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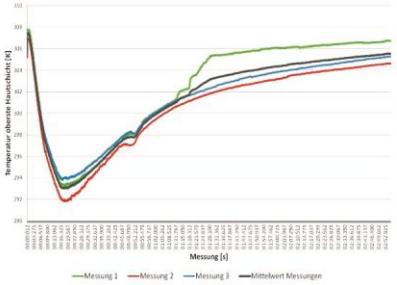
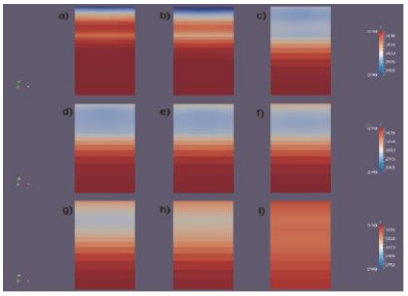
Due too steadily increasing number of skin cancer in the future, the public attention will focus more and more on this subject. As a result, a non-invasive method (to detect early stage melanomas) was developed by the ZHAW spin-off company Dermolockin GmbH.
This paper discusses implementation and results of an experimental arrangement comprising measurements on a experiment setup and a CFD simulation, which simulates the human skin examining how it reacts to external influences.
In the first part fundamental concepts are explained, such as structure of the skin, stages of skin cancer and theoretical foundations of thermal conduction. Furthermore, the experiment setup and measurements will be described as well as the set-up of the OpenFOAM case for the simulation.
The results of the measurements show an interesting behaviour of the skin by cooling it with cold air and then warming it by the ambient temperature. In the heating process, the temperature profile of the top layer of the skin recorded a kink in the graph. This behaviour could be simulated with the OpenFOAM case. Through calculations, the temperature of all skin layers were demonstrated during the simulation. Therefore, it was possible to consider this anomalous reaction of the skin in detail. It was shown that deeper skin layers cooling energy stores during the heating process. This explains the phenomenon of the skin.



Temperature profiles of the top skin layer during a DERMOLOCKIN measurement of 120 seconds.
15 seconds cooling at 0 ° C and heating at 23 ° C with an air stream.
Temperature kink at 50 seconds due to cold storage in deeper skin layers.



Temperature profiles over all layers of the skin at different time points .
a) 10 sec b) 15 sec c) 25 sec
d) 51.4 sec e) 55 sec f) 60 sec
g) 70 sec h) 80 sec i) 120 sec