Zurich University
of Applied Sciences

School of
Engineering

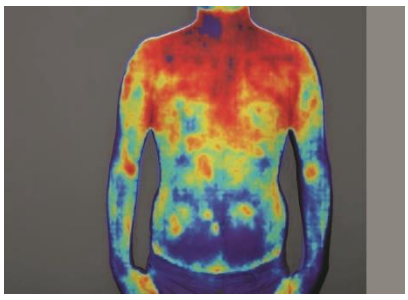
Smartphone-Based Medical Infrared Imaging

The results of perforator flap surgeries can be significantly improved if individual perforators are located prior the operation. This localization is typically carried out with medical imaging systems such as computed tomographic angiography (CTA) and magnetic resonance angiography (MRA). Despite their good results, they feature some severe disadvantages such as long scanning time, intravenous administration of contrast media or radiation exposure. Yet, lacking attractive alternatives, these approaches are commonly employed.
However, a growing number of publications indicates the efficiency of infrared thermography (IRT) with respect to perforator localization. Unfortunately, infrared cameras for medical purposes cost several thousand dollars. On the other hand, recent smartphone-based IR-cameras, featuring a reduced resolution, are available for some 500 dollars. Based on these developments, this thesis aims at evaluating whether such cameras are suitable alternatives in perforator localisation. In particular, the thesis addresses the question, if the IR-camera's small resolution can be compensated by combining the IR-image with a high resolution optical image. Therefore, an Android application should be developed.
To conduct the overlay of these two images, the angles of view (AOV) of a Samsung Galaxy J5, a Motorola XT1072 and the infrared cameras FLIR ONE and Seek Compact Pro were measured. Furthermore, a laser sensor (VL53L0X) and an ultrasonic sensor (HC-SR04) were integrated into a portable device that could be mounted on the smartphone in order to determine the distance to the object. With the measured values, a geometrical overlay was conducted. Subsequently, the accuracy of the overlay procedure was enhanced through a cross-correlation algorithm. As a result, this Android application generates an optical image that overlays a heatmap restricted to the patient's body. This creates the ability to locate hotspots within a high dynamic range. In a further step, occurring hotspots must be confirmed as perforators as this would enable a usage of the process in a medical environment.

Diplomierende
Vincent Michel
Simon Schweizer

Dozierende
Mathias Bonmarin
Martin Loeser

Developed Android application intended to overlay a thermogram from IR-camera FLIR ONE with an optical image from smartphone camera. The smartphone case integrates a laser sensor in order to measure the distance to the object.



Cross-correlation conducted overlay of an optical image with a thermogram. The heatmap, restricted on the patient's body, shows hotspots that can indicate the location of perforators.