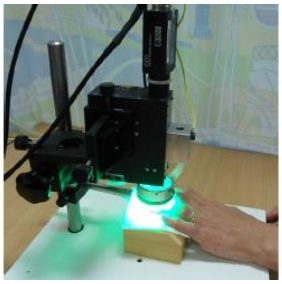
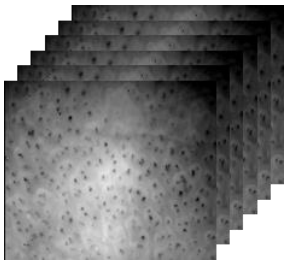
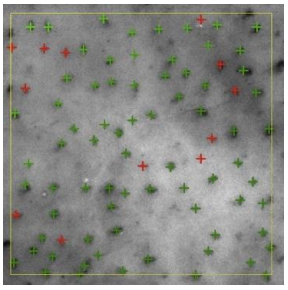
Automatic assessment of skin capillary density







Skin is one of the sites available in humans allowing direct, non-invasive visualization of capillaries at rest and during provocative stimuli. In addition, the cutaneous microcirculation is considered a representative vascular bed to examine generalized systemic microvascular dysfunction. Moreover, it has been demonstrated that the (systemic) effects of obesity and free fatty acids on insulin-mediated microvascular recruitment in muscle can be reproduced in skin. These data strongly suggests that vascular responses observed in skin parallel those in muscle, and thus that measurement of the skin microvasculature is an important tool for the assessment of microvascular function.

Skin capillaroscopy is often used to study the skin microvasculature. Unfortunately, the analysis of skin capillary density from movie files is done manually, and thus is very time-consuming. This impedes the use of this technique in large-scale investigations. Hence, an automated assessment of skin capillary density would facilitate the use of capillary microscopy in larger studies.

In the Maastricht Study, finger skin capillary density is determined using intra-vital video-microscopy in three conditions: baseline, following arterial occlusion, and during venous occlusion. With these conditions, it is possible to test the reserve capacity of the capillaries. The analysis is being done by counting the number of capillaries per square millimeter. Previously it has been done manually; for the last years a semi-automated software is being used. The semi-automated software has too many false positives and false negatives, so the results need to be adjusted manually. The analyses of one patient (3 video clips) still takes about 20 minutes and we have 7000 patients to go.

Project goal

This project is mainly focused on developing a method for accurate and fast detection of capillaries and automatic assessment of skin capillary density in three different conditions for each patient. A subset of Maastricht database will be used for the evaluation (validation with the ground truth) in this project. This dataset has more than 900 video clips (16 s, 400 frames, 640x480 pixels) and the capillaries are manually annotated by experts using the CapiAna semi-automatic software.

Student profile

- Enthusiastic students in electrical engineering, biomedical engineering, computer science, or a related field.
- Able to program in Matlab and Python.
- Knowledge of image analysis and deep learning techniques.
- A good team player with excellent communication skills.
- A creative solution-finder.

This project is part of the Maastricht study (see www.demaastrichtstudie.nl).

CONTACT:

For project details, please contact Dr. Behdad Dasht Bozorg (B.Dasht.Bozorg@tue.nl)