The 'Shengjing Study' study in Shenyang, China:
Validation of retinal imaging biomarkers
in different diabetic stages

PROJECT DESCRIPTION AND GOAL

This is a 3-months externship in Shengjing Hospital in Shenyang, China. The housing is partly supported by project funding, and the project is in close collaboration with another Dutch stagière and our TU/e sister BME department in Shenyang (BMIE). This project is funded by NWO (NL) and MOST (CN).

Introduction:

Diabetes is a systemic disease affecting all parts of the body. In particular, Diabetic Retinopathy (DR) is defined as the damage done to the eye due to diabetes, and a major source of blindness.

The RetinaCheck project (www.retinacheck.org) focuses on the fighting of the diabetes epidemic in China. It is established to build up a computer-aided diagnosis (CAD) software to analyze retinal fundus images (color and laser-scanned) for the early detection of diabetic retinopathy. For this purpose, a large-scale screening in Liaoning province, China for diabetic retinopathy is set up. Teams at TU/e and Northeastern University develop a suite of software packages.

Top: Shengjing Hospital is the largest and most modern hospital of Shenyang, China (2300 beds).

Shenyang, with 8 million inhabitants, is a modern city and an important center in Northeast China, with abundant computer industry. China's largest medical imaging industry, Neusoft Medical Systems, is located in Shenyang. It also houses the only other Forbidden City (Emperor's Palace) in China.

Bottom: Retinal imaging done with a high resolution fundus camera.

In order to validate this software for its predictive and classification power, a study has been set up with simultaneous recording of retinal images and extensive diabetic metadata for a large number of Chinese diabetes patients. The "Shengjing Study" is a collaboration between TU/e and the Diabetes Department of Chinese Medical University and the Biomedical and Information Engineering School of Northeastern University in Shenyang, China.

Diabetic retinopathy can cause observable changes to the retina, such as change in bifurcation angles, retinal arteriolar-to-venular-width ratio (AVR), fractal dimension, vessel tortuosity, length to diameter ratio, which may result in micro-aneurysms, stenoses, angiogenesis, drusen and micro-bleeds vessel leakage. Therefore, analysis of the micro-vascular pattern can provide us with rich features of the retinal vascular tree.

The analysis of digital color fundus images has been the subject of extensive studies. We have developed advanced multi-scale, multi-orientation algorithms [1-5], with which the retinal vasculature can be extracted robustly from retinal fundus images. The vascular and background features can be exploited as biomarkers in a follow-up pattern recognition stage.

Goal of this externship:
In order to understand how diabetes progresses into diabetic retinopathy, it is important to do a clinical study to understand how pathophysiological changes of retinal features develop in different diabetic stages. The goal is to correlate the biomarkers extracted from the retinal fundus images with the diabetes metadata in this clinical validation study. Many combinations will be explored. The externship will lead to a publication.

This project has many innovative and exciting aspects:
- *Compare a laser-scan camera (i-Optics Inc., NL) and a color fundus camera (Canon).*
- *Use brain-inspired multi-orientation and multi-scale mathematical algorithms for vessel tracking and feature analysis*
- *Be part of a complementary collaboration between Biomedical Engineering – Diabetes experts – Ophthalmologic experts*
- *Use advanced classification techniques and exploit large numbers of acquired patient data for the necessary statistical power*
- *Combine phenotyping metadata of diabetes patients with new non-invasive micro-vascular biomarkers*
- *Discover Chinese healthcare and culture in depth.*

REQUIREMENTS
This project is suitable for BMT master students who, after their Biomedical Engineering study, wish to continue their clinical study based on medical image processing techniques. Since this student will carry out multidisciplinary research in a fascinating cultural environment in China, he/she needs to communicate well with researchers, diabetes experts, ophthalmologists, students and patients. A positive attitude and good communication skills are essential.

WORKPLACE, SUPERVISION, LIVING AND TIME PERIOD
The student will work in the Diabetes Department of Shengjing Hospital, Shenyang for 3 months. Supervision will be done by prof. Bart ter Haar Romeny and prof. Han Ping. Northeastern University in Shenyang will partly assist with the housing rental costs during the externship.

PROJECT DETAIL
At this moment clinical data acquisition on Chinese diabetes patients is being performed for the construction of a clinical database. The database contains images acquired from two camera's (SLO and conventional fundus camera) taken from 2 field of views of both eyes of each patient (8 images per patient). Along with the images diabetic metadata is acquired (age, blood pressure, onset of diabetes, …).

Retinal image acquisition in Shengjing Hospital, a Sino-Dutch collaboration project.

Several aspects can be addressed during the externship, to be discussed:
- Statistical analysis of the database in order to reveal the potential/possibilities of the database. E.g., if the distribution of meta-data parameters is known, more specific research questions can be defined.
- Investigate the reproducibility of automated image analysis software for the extraction of retinal (vascular) features. In order to demonstrate correlations between retinal features and diabetic retinopathy, the feature extraction methods should be reliable.
- Contribute to/expand the image processing toolset.
- Analyze/Improve the data infrastructure (from image- and metadata acquisition to data-storage, to (automated) data analysis, to feedback reports).
- Perform a clinical study with the available data and image processing tools (e.g. how does vessel tortuosity relate to different stages of DR, etc.).

CONTACT
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MORE INFORMATION
http://www.retinacheck.org ; http://www.vision-brain.org ; http://english.neu.edu.cn

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