Abstract

The retinal vasculature is the only easily visible part of the human circulation. Changes in the retinal vasculature may reflect changes in the circulation elsewhere in the body (e.g., brain, heart, kidneys). Extensive research by the Singapore Eye Research Institute (SERI) has established that an objective assessment of retinal vascular changes may provide important predictive and prognostic information regarding risk of stroke, coronary heart disease, hypertension, diabetes and other conditions.

In collaboration with SERI, National University of Singapore (NUS) computer scientists developed the Singapore “I” Vessel Assessment (SIVA) software to extract retinal vascular structure and derive quantitative measures from retinal images to describe the retinal vessels' characteristics. NUS’ approach incorporates techniques from wavelet analysis, texture analysis, and curvature ridge/trench analysis, to attain the desired clinical sensitivity.

The SIVA software is a user-friendly system with accurate and robust algorithms that can measure the vascular or blood-vessel structure in retinal images automatically.

SIVA is also flexible and intuitive in gathering feedback to enhance the accuracy of vessel measurement and description. SIVA can automatically compute a spectrum of retinal vascular parameters including retinal vascular caliber, tortuosity, branching angle, fractal dimension and junction exponent deviation from retinal fundus photographs to quantify the retinal vasculature. Other automation of SIVA includes retinal vasculature tracing, vessel type classification (venule or arteriole), optic disc detection and position the measured grid following the Atherosclerosis Risk in Communities (ARIC) Study protocol.

SIVA has undergone a series of validation and improvements to achieve the desired accuracy and robustness needed for large-scale population clinical studies, and used in numerous population-based and cross-sectional studies. To enhance SIVA's utility for clinical use, SERI has also developed a "normal" database for analyzing and interpreting abnormal reading in relation to stroke, heart diseases, hypertension and diabetes. Future developments include developing full automation, detecting retinal vascular changes over time and a predictive function for the early screening of cardiovascular diseases such as heart disease and stroke with the use of retinal images.
Applications

- **Research tool** for investigating early vascular diseases through non-invasive retinal images (e.g. hypertension, diabetes, stroke, heart disease, kidney disease, cognitive impairment)
- Potential **screening and risk stratification** tool for cardiovascular disease in the population.
- Potential tool to evaluate vascular structural response in **clinical trials** for monitoring disease and modifying therapies (e.g., hypertension)

Patents

Patent applications have been filed (Retinal image analysis systems and methods).

Innovators

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Licensing & Collaboration Opportunities

This technology is available for licensing from Accelerate Technologies Pte Ltd (http://www.accelerate.tech). For enquiries, please email Accelerate Technologies Pte Ltd at tech-offer@accelerate.tech

For collaboration and other enquiries, please email SERI (http://www.seri.com.sg) at seri@seri.com.sg

Publications


**Frequently Asked Questions**

1. **We are interested in undertaking some research on the retinal vasculature using your retinal vessel software. What does it measure? Is the software commercially available?**

The Singapore “I” Vessel Assessment (SIVA) software measures a number of retinal vessel parameters, including 1) arteriolar/venular caliber; 2) tortuosity; 3) branching angles and 4) fractals.

We do distribute our software to both academic and commercial partners. Please contact us.

2. **What are the costs involved? What type of training do you provide? Why do the licensees need to be trained at the SERI in Singapore?**

   The cost of the license depends on the scope and terms of use. Please contact SERI or Accelerate Technologies Pte Ltd for enquiries.

   To maximize the results from the SIVA software, we do require your technicians to attend a 2-week intensive training session in Singapore for them to be familiar with our software, during which reliability testing will be conducted before we release the software to you. The 2-week intensive training course costs approx US$10,000 for 2 trainees.

3. **Do you perform studies on retinal vessel analysis? If yes, what conditions apply?**

   Yes, we have a full-fledged Ocular Imaging Centre with a group of dedicated trained graders and state-of-the-art technology. We have in place strict quality assurance tests to ensure quality and consistency of results. We can perform analyses for research, population or clinical studies, and image grading services on different eye diseases such as Diabetic Retinopathy, Age Related Macular Degeneration, Glaucoma, Cataract and retinal vascular parameters. The cost depends on what needs to be graded and the number of subjects or eye images.

   We can also co-operate on an academic and collaborative basis. However, because our group is supported purely on grants, we will need funding to perform the grading and analyses.

4. **What other services do you offer?**

   Our Ocular Imaging Centre is an excellent test-bed for ocular imaging software, as we have the world’s largest database of ocular images with matched clinical data (>20,000 images).

   In addition, we can provide training and certification of graders according to clinical trial standards.

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