VAMPIRE PROJECT

Software application enables efficient, semi-automatic quantification of retinal vessel properties. *Dermot McGrath reports*

There is mounting evidence that the retinal vasculature and its changes can provide biomarkers for a number of high-prevalence conditions, both systemic and eye-related, which can be observed inexpensively in vivo by the latest imaging technologies, Emanuele Trucco PhD, FRSA told delegates attending the 15th EURETINA Congress in Nice, France.

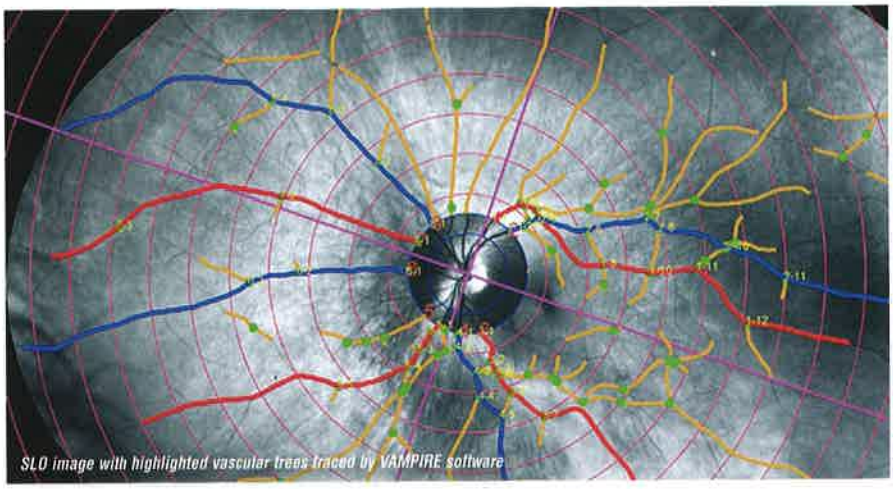
Huge strides have already been made towards identifying and categorising such biomarkers, thanks to specialised software created by Prof Trucco and his team of co-workers at the Universities of Edinburgh, led by Dr Tom MacGillivray, and Dundee, UK, together with input from other research centres in Italy, Singapore, Australia, Japan and the USA.

Known as VAMPIRE (Vascular Assessment and Measurement Platform for Images of the REtina), the software application enables efficient, semi-automatic quantification of retinal vessel properties with large collections of fundus camera images. Pathological signs and changes in the retinal vasculature may reflect similar processes occurring elsewhere, e.g in the cardiovascular system and the brain. Thus the retina represents an accessible site for the study of systemic and neurological disease.

"The system aims to provide efficient and reliable detection of retinal landmarks such as optic disc, retinal zones, and main vasculature, and quantify key parameters used frequently in investigative studies such as vessel width, vessel branching coefficients, fractal dimension and tortuosity. VAMPIRE can compute such measures efficiently, and provide researchers with a large number of quantitative parameters," Prof Trucco told *EuroTimes*.

Non-invasive observation of the retinal vasculature is possible with a fundus camera or scanning laser ophthalmoscope, while optical coherence tomography (OCT) reveals the tissue layers, which permits study of the structure and pathology of the nerve fibre layer. VAMPIRE work involves all of these modalities.

The VAMPIRE 3.1 interface, showing a fundus camera image being processed



SLO image with highlighted vascular trees traced by VAMPIRE software

Courtesy of VAMPIRE Project Team

> We are currently adapting VAMPIRE for fundus images in order to include more measurements...
>
> Emanuele Trucco PhD, FRSA

The ultimate goal is to enable efficient quantitative analysis of large collections of retinal images acquired from multiple instruments. The software has already been used to analyse more than 10,000 images in studies investigating retinal biomarkers for cardiovascular disease, diabetes, stroke, multiple sclerosis, cerebral malaria, Alzheimer's and age-related diseases.

Prof Trucco noted that biomarkers are a key element in identifying abnormalities that may mark the early onset of disease. "The purpose of the studies using VAMPIRE so far has been to find associations between retinal vasculature changes and specific diseases, in order to contribute to defining the constellation of signs that may warn about the insurgence of a disease. The diseases considered are such that early intervention, triggered by early detection, can delay the progress of the disease, maintain quality of life for the patient, and limit costs to carers and national health services," he said.

PUSHING BOUNDARIES

While a lot has been achieved already, VAMPIRE has the potential to exploit ongoing advances in imaging technology and computational power to continue pushing the boundaries in predictive medicine, added Prof Trucco.

"We are currently adapting VAMPIRE for fundus images in order to include more measurements, and incorporating analysis of OCT images, especially the very recent technique of OCT angiography, capable of revealing vascular beds never seen before," he said.

As Prof Trucco observes, the retinal vasculature is just one aspect of a complex system and needs to be considered in conjunction with other patient data in order to maximise its true value.

"It is arguable that the retinal fibre layer, for instance, may also hold valuable information, and we are starting to work on this, beyond its current role in assessing the early risk of glaucoma. I believe that the real treasure trove for early prediction in biomarker research lies in considering the retina together with any other data available about a patient.

"This is the direction that predictive medicine is taking, linking interdisciplinary areas such as big data (analytics), creating increasingly large repositories of clinical data for research, continuously improving image analysis algorithms and software, availability of high-throughput computing platforms such as the cloud, and even crowdsourcing," he said.

Emanuele Trucco: e.trucco@dundee.ac.uk

ESCRS
EURO TIMES
February 2016 | Vol 21 Issue 2

SPECIAL FOCUS
CATARACT & REFRACTIVE LENS

CORNEA
TOPOGRAPHY-GUIDED CROSSLINKING MAY OFFER SIGNIFICANT ADVANTAGES

RESIDENT'S DIARY
PERFORMING SOLO VITRECTOMY: A TEST OF BODY AND MIND

MULTIFOCAL IOLS AND BEYOND

20 YEARS

ESCRS