



## A joint adventure: ADCIS and Ophthalmology

The involvement of ADCIS in the field of ophthalmology started when Bruno Laÿ worked on his Ph.D. thesis for the Automatic Detection of Micro-aneurisms in the field of Diabetic Retinopathy in 1983. At that time, Bruno Laÿ, after an engineering degree, was a student at Mines-ParisTech. He used Image Processing techniques and segmentation to process grey scale images of the retina on 35 mm films<sup>1</sup>.

Bruno's thesis was a joint effort between the Center of Mathematical Morphology and the French NIH. Bruno used morphological functions to detect micro-aneurisms and the vessel network in images of diabetic patients followed by the French hospital Paul Brousse in Villejuif, France.

Professor Coscas of the Centre Hospitalier de Créteil, France was one of the thesis jury members. In the 80's, Professor Coscas was a very well-known doctor in the field of ophthalmology, promoting the use of automated image processing to lower the burden on ophthalmologists who had to analyze hundreds of images on a daily basis. Thanks to Professor Coscas, automated techniques have been well accepted in hospitals and big pharma companies.

Since 1983, Professor Jean-Claude Klein, who directed Bruno's thesis, has been involved in many research projects involving image processing and ophthalmology. His research projects included Aïda, Messidor (**M**éthodes d'**E**valuation de **S**ystèmes de **S**egmentation et d'**I**ndexation **D**édiées à l'**O**phthalmologie **R**étinienne), TeleOphta, RetinOpTIC, etc.

Thanks these projects, a strong partnership between Paris hospitals and more specifically the Lariboisière hospital, the LaTIM laboratory in Brest, the center of Mathematical Morphology, and ADCIS has been created. All these partners worked on the following projects:

- Messidor database generation including retinal images of Lariboisière, Brest and Saint-Etienne hospitals;
- e-ophta-EX and e-ophta-MA databases as a subset of the OphDiat database that includes 150,000 images of diabetic patients with exudates and micro-aneurisms;
- Algorithm development for the automatic grading of diabetic retinopathy.

Since 2014, Evolucare SAS joined the consortium bringing its expertise in the fields of patient management, CE marking, and e-medicine.

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<sup>1</sup> Note: in the UK, Eva Kohner also performed research work on diabetic retinopathy

In 2008, Pfizer, Inc. worked with ADCIS and Mines ParisTech on the development of a project for the detection of early stages of Aged Related Macular Degeneration. At that time, all the big European players in ophthalmology (e.g. José Cunha-Vas in Portugal, Giovanni Staurenghi in Italy and Usha Chakravarthy in the UK) were involved in the project. They brought their expertise and their image database of retinal images with a very large set of Color Fundus, infrared, auto-fluorescence, angiography, ICG, and OCT images. Future collaboration is anticipated with these eminent professors.

At the completion of the TeleOphta project, ADCIS released the Messidor database on its web site to be used by research people working in nonprofit organizations. It allowed monitoring the development of emerging technologies such as Deep Learning in the field of ophthalmology. It is worth mentioning about half of ARVO posters and publications in the field of Diabetic Retinopathy are referring to the Messidor database.

The TeleOphta project, which was completed in 2014, showed that data mining techniques could be used to determine if a patient had to be seen by an ophthalmologist. An eye examination was automatically analyzed by a computer, using both images and patient data. In RetinOpTIC, the follow-up research project after TeleOphta, with the same partner consortium and the addition of Evolucare and the Optical Institute Graduate School of Saclay, it was shown that Deep Learning could be very beneficial to automatically grade diabetic retinopathy, and could diagnose other pathologies such as glaucoma.

The current software product that is the result of the RetinOpTIC project has outstanding performance, with 99% of sensibility, and 87% of specificity.

ADCIS and its partner Evolucare are currently working on the promotion of this new technology, including the automatic detection of other retinal pathologies, and the use of other image capture modalities such as OCT.

For all these reasons, ADCIS is the key player in the field of ophthalmology software products. If your interest is in anterior or posterior segment analysis, in the design of contact lenses, or in clinical studies, do contact the ADCIS ophthalmology experts. They have the right tools to help your daily analysis of eye analysis.