

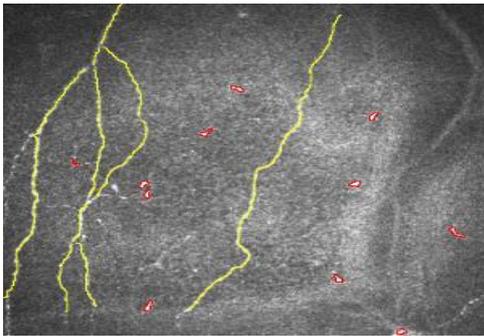
ARIES

3D ANALYSIS OF THE CORNEA

ARIES (AIConfocal Rapid Image Evaluation System) is a software product developed by ADCIS to automatically process images of the cornea acquired by a confocal microscope.

ARIES General Description

Confocal microscopy allows for high resolution, reliable, real time, imaging of the living corneal microstructure including normal corneal morphology, pathogen invasion, dystrophies and degenerations, post surgical management, dry eyes, drug toxicities, endothelial monitoring and contact lens related changes.



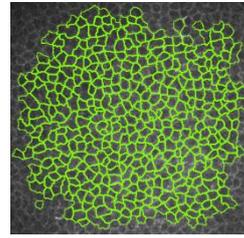
Representative Best Nerve Image Layer

The software has been designed from the ground to address a typical analysis of the cornea using a

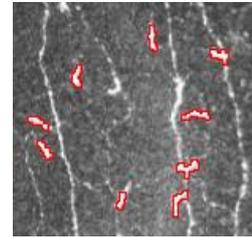
Software Capabilities

Extraction of the image in which the nerves are the most pronounced

The software was designed to detect first, the section of a 3D volume that contains most of the nerve plexus, then to detect and analyze the cells present in the volume from the previously detected



Epithelial cells



Immune cells

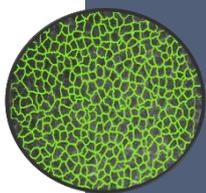
confocal microscope. It analyses cellular structures in the images and generate accurate measurements that are used for medical purposes.

Two modes are available in the software: Fully automatic and Manual.

In manual mode, the user can interactively draw annotations in the image in order to score every cell of every type and save these annotations in a file compatible with other software products of ADCIS.

In automatic mode, the layers of nerves, polyhedral and immune cells are detected automatically. The measures on the nerves and cells detected are calculated. The histogram of a measure selected from measures calculated is displayed with a single click. An annotation mode is also available in this mode for manually edit the cells and nerves previously automatically detected to generate a perfect and rapid detection.

section. Nerves in the confocal images appeared as white objects (on a dark background) with an elongated and thinned shape. Therefore, image processing operators are designed to automatically detect the layer that contains such bright and thin objects. The resultant identified layer is called the best nerve layer image (BNL).



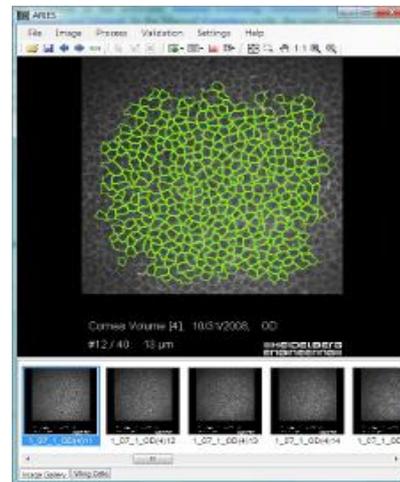
Main benefits of the software:

- Automatic detection of Nerves, Immune Cells and Epithelial Cells
- Manual editing available if needed
- Automatic Cells counting
- Manual and Automatic count comparison
- Shape and statistical measurements
- Export of measurements for further statistical analysis
- 2D and 3D analysis and display



After determination of the best nerve layer image, the software prompts the user to validate the section selection, and eventually to manually select another one after a visual inspection of neighbored sections. Consequently, the newly selected image would be used to set the parameters for the detection of epithelial cells.

ARIES 4.3.2 - Automatic Measurement Summary					
Layer	Count	Density (μm^{-2})	Average Size (μm^2)	Average Length (μm)	
Immune Cell	18	4	0,01517		16,13
Wing Cell	8	444	0,00687	145,50	
Nerve	18	15			95,045



Cells Analysis

Analysis of Immune Cells

The immune cells were detected and analyzed in the best nerve layer image. Immune cells appeared in the images as small, white, and usually compact objects. These cells could occur anywhere in the best nerve layer image: either isolated from the nerves or connected to the nerves (appearing as small branches on the nerve network). In order to analyze these immune cells, the nerves in the same image had to be excluded from the analysis.

Analysis of Epithelial Cells

Epithelial cells (in the center of the epithelium) were targeted for analyses, rather than basal epithelial cells (most posterior in epithelium) or superficial epithelial cells (most anterior in epithelium), for a number of reasons.

ARIES Technical Specifications

ARIES is a stand-alone, software product that can be installed on any personal computer running Windows® 7 and 8. Images need to be accessible from a hard drive or from network storage, and organized in folders to be processed by the software,

Basal epithelial cells may present the following problems in analyses:

- Indistinct cell borders in confocal micrographs, with borders becoming more pronounced in corneas with edema.
- Cellular density that is relatively consistent among some types of corneal disorders, making this layer an unreliable marker of corneal health.
- Density that appears to vary between types of confocal microscopes and between studies.

For these reasons, epithelial cells were chosen for analysis: these cells are the most representative of corneal health because the measures have associated medical and automatic direction detection is relatively easy and very reliable (thanks to the well-marked cell borders).

each folder containing a confocal image series. All **ARIES** measurements are calibrated and output in real-world units. The calibration value is manually entered in the **ARIES** Software as a single value.



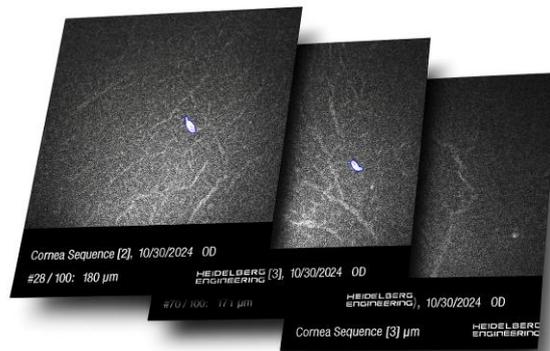
ADCIS S.A.
3, rue Martin Luther King, 14280 Saint-Contest - France
Phone: +33 231 062 300 - Web: www.adcis.net

ARIES Neuroma module

AUTOMATIC ANALYSIS OF CORNEAL NEUROMAS

ARIES now integrates an advanced **deep learning** module for automatic detection, segmentation and quantification of **corneal neuromas**. Leveraging a clinically validated AI model trained on thousands of In Vitro Confocal Microscopy images, this module provides **fast, quantified and reproducible measurements** of neuroma morphological characteristics.

It enhances diagnostic confidence, supports longitudinal follow-up, and reduces manual analysis time from minutes to seconds, enabling clinicians to better evaluate neuropathic corneal pain, dry eye disease, diabetic neuropathies and post-surgical recovery.

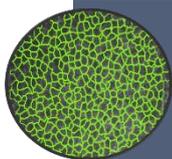


ARIES Neuroma module clinical benefits

Corneal microneuromas are powerful markers for various ocular or systemic diseases. Their automatic detection, segmentation, and quantification using the ARIES neuroma module facilitates a range of clinical analyses:

- Early and reproducible screening for **neuropathic corneal pain**
- Objective monitoring of **postoperative neuropathic complications**
- Detection of nerve damage caused by **inflammation**
- Systematic screening of the **nerve network**, useful for any differential diagnosis

Structure	Layer	Count	Density (µm-2)	Average Area (µm²)	Average Length (µm)	Total Area (µm²)	Average Crofton Perimeter (µm)
Immune Cell	22	11	0.02369		10.1	464	
Wigg Cell	12	408	0.00569	175.69		64655	
Nerve	22	18			97.91		
Neuroma	17	1		38		38	26.68
Neuroma	18	0		0		0	0
Neuroma	19	4		236.25		945	84.79
Neuroma	20	6		285.5		1713	69.61
Neuroma	21	0		0		0	0
Neuroma	22	1		1		1	2.68
Neuroma	23	0		0		0	0
Neuroma	24	0		0		0	0
Neuroma	25	3		118.33		355	45.55
Neuroma	26	6		81.67		490	32.45
Neuroma	27	4		138.75		555	50.69



Main benefits of ARIES Neuroma module:

- Automatic and accurate detection and segmentation of neuromas using deep learning in a matter of seconds, natively integrated into ARIES
- Reproducibility and objectivity of results that cannot be achieved manually, for consistent results across an entire population
- A tool suitable for research, clinical studies, and screening programs



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