COMPACT ADAPTIVE OPTICS RETINAL IMAGER (CAORI)

The compact adaptive-optics retinal imager (CAORI) is a new tool for researchers and clinicians to investigate and monitor changes of retinal microstructures due to disease progression or response to treatment. CAORI is ideally suited to the fundamental research essential for early detection, diagnosis, and quantification of retinal complications in type 1 diabetes (T1D) and other retinal diseases. Visualization of micro-aneurisms, pericytes, temporal and spatial evolution of microvasculature (capillary remodeling and reperfusion), as well as axonal changes is possible using so-called "offset aperture" and "split-detector" approaches in AO-based scanning laser ophthalmoscopy (AO-SLO).

INSTRUMENT CAPABILITIES

- Exploration of the fine cellular and lamellar retinal structure with near-isotropic micron-level resolution
- AO-OCT B-scans or C-scans
- AO-SLO simultaneous confocal and four offset apertures
- Live four offset aperture or four simultaneous split-detector imaging directions for isotropic imaging
- Visualization of retinal capillary networks using the motion of blood cells as contrast mechanism – no contrast agent needed
- Imaging of larger blood vessels to measure their diameter and their wall thickness and to visualize the fine structure of vessels walls - not possible with standard AO-SLO imagers or any other imaging modality
- Software-controlled axial position of the focal plane within retina assisted by the simultaneous OCT B-scan
- Post-processing package that provides alignment of stacks of images from the five SLO channels, average and standard deviation images (motion contrast), split-detection analysis, phase and phase-gradient images, movies showing the blood flow dynamics.

OPTICAL DESIGN PARAMETERS

- Standard image dimensions: 640x 640 pixels
- Max pupil diameter: 7 mm
- Estimated resolution: ~2.5 µm
- Nominal field size: 1-5°(user selectable)
- Field of view: 20°x30° (fixation)
- Frame rates up to 40 Hz

COMPONENTS/FEATURES

- ALPAO DM-69
- X-Y galvo scanners raster/line scans and automated montage
- Integrated USB point-spread function (PSF) camera for AO calibration/image quality estimation.
- Complete GUI software package for AO control, image acquisition, and user interface.

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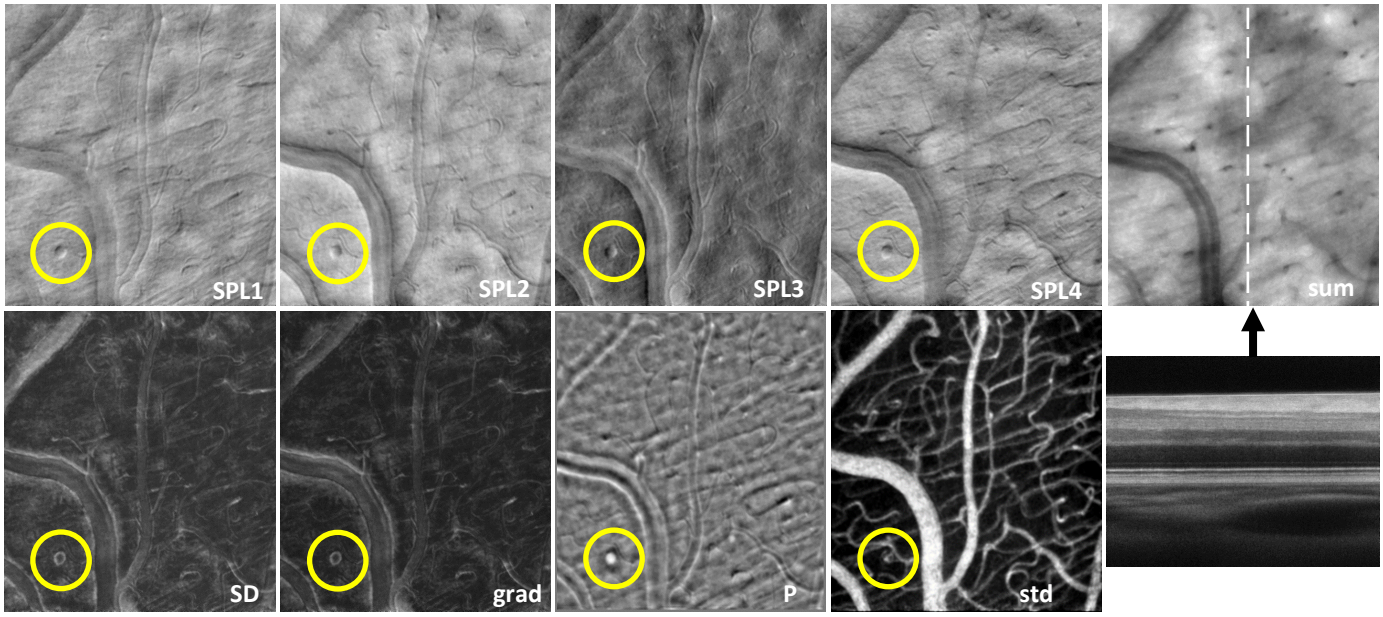
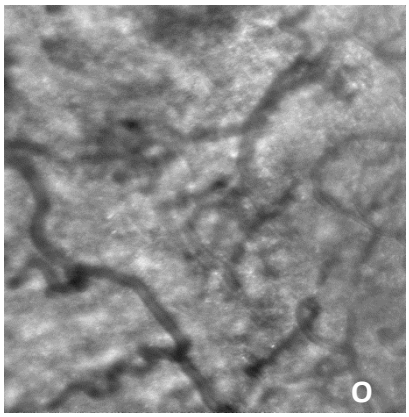
EXAMPLE IMAGES

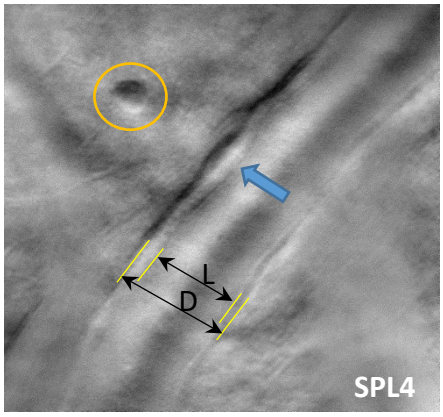


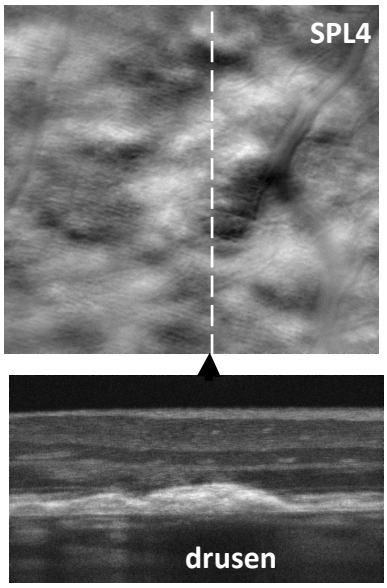
Example of images: split-detector images (SPL1-4), sum of all four offsets, standard deviation among offsets (SD), phase (P) and phase gradient (grad), standard deviation (std) as motion contrast, OCT B-scan.

Tortuosity of vessels seen in an SLO offset (O) image



Local thickening of the vessel wall (arrow); measurement of wall-to-lumen ratio; potential cyst, a lipid deposit, or an activated microglia approaching the injured location (circled)





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