# Internship : Advanced digital holography for ophthalmology. Doppler imaging and computed tomography

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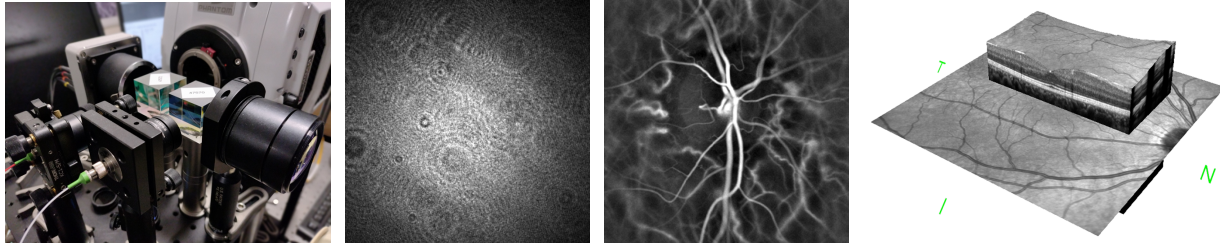
The clinical investigation centers of the Quinze-Vingts Eye hospital and The Foundation Adolphe de Rothschild Hospital, and the Langevin Institute in Paris, have developed a unique expertise in the field of innovative computational laser Doppler imaging, optical coherence tomography, and the evaluation of their medical use in a variety of ocular pathologies, which increasingly demonstrates clinical relevance. Monitoring of tissue structure, blood flow, and cell activity in the retina by digital holography will improve understanding of the pathophysiology of visual loss. The digital calculation of the images acquired by optical interferometry is based on a wave propagation algorithm (laser radar- LIDAR), used to reconstruct the image from the data stream sampled by the camera.

Mission : A team of 3-4 interns will build and optimize coherent near-infrared laser interferometers for clinical measurements. They will develop a prototype imaging device that will be used to provide Doppler and 3D tomographic images of the eye. They will also conduct the experiments and perform data processing in Matlab and ImageJ in order to improve computed tomography and Doppler imaging. They will learn and improve coherent image formation by wave propagation, LIDAR algorithms, fluctuation analysis, statistical filtering and rephasing strategies including digital adaptive optics by Shack-Hartmann analysis in order to compensate eye aberrations. Support for software development is provided by the Digital Holography Foundation (http://www.digitalholography.org), and through the Discord server Digital Holography (https://discord.gg/Z8r8jmcVWa).

References
Diffuse laser illumination for Maxwellian view Doppler holography of the retina
https://arxiv.org/abs/2212.13347
Full-field swept-source optical coherence tomography and laser Doppler holography:
http://arxiv.org/abs/2112.08494

Anterior segment, blood flow imaging, eye tracking, and transparency assessment:
https://arxiv.org/abs/2107.10799
Blood flow reversal in out-of-plane vessels:
https://arxiv.org/abs/2008.09813
Reverse contrast laser Doppler holography:
https://arxiv.org/abs/2004.00007
Real-time principal component analysis:
https://arxiv.org/abs/2004.00923
Spatio-temporal filtering:
https://arxiv.org/abs/2003.10259
Waveform analysis of human retinal and choroidal blood flow with laser Doppler holography:
https://arxiv.org/abs/2106.00634
Choroidal vasculature imaging with laser Doppler holography:
https://arxiv.org/abs/2106.00608
Swept-source optical coherence tomography by digital holography in real-time:
https://arxiv.org/abs/2003.08960
Doppler holography of the human retina:
https://arxiv.org/abs/1804.10066
High speed optical holography of retinal blood flow:
https://arxiv.org/abs/1607.07800
Doppler imaging of microvascular blood flow:
https://arxiv.org/abs/1412.0580
Holographic laser Doppler ophthalmoscopy:
https://arxiv.org/abs/1006.2604