CENTER FOR MEDICAL PHYSICS AND BIOMEDICAL ENGINEERING
MEDICAL UNIVERSITY OF VIENNA

FFG FORSCHUNG WIRKT.

PHOTONICS PUBLIC PRIVATE PARTNERSHIP

PHOTONICS21

OCT on a Chip:

In vivo three-dimensional Swept Source and Spectral Domain Optical Coherence Tomography and angiography using Photonic Integrated Circuits

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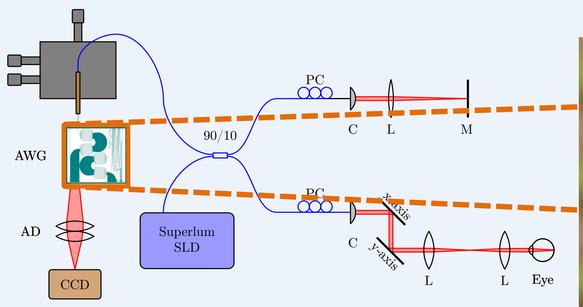
Motivation

In order to significantly **reduce size** and **costs of optical coherence tomography (OCT)** systems, key components were developed on chip-scale using **Photonic Integrated Circuits (PICs)**. Integration of those in OCT setups shall determine imaging quality for ***in vivo* human** retinal imaging.

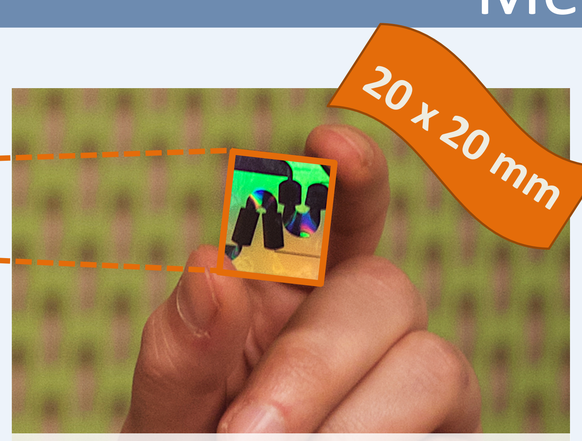
COHESION Spectral Domain OCT

OCTChip Swept Source OCT

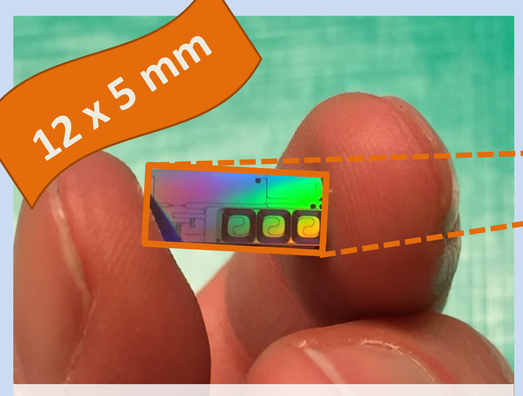
Methods



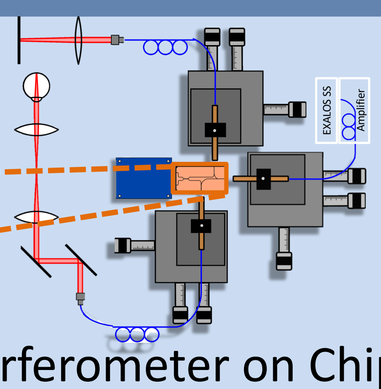
Grating on Chip "AWG" [1]
- 256 channels (22 nm)
- 512 channels (48 nm)



Miniaturized Spectrometer for OCT



Miniaturized Interferometer for OCT

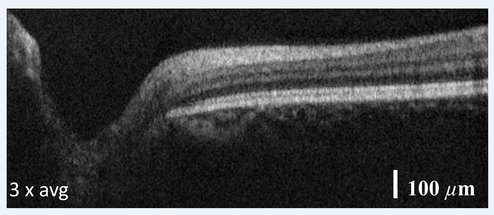


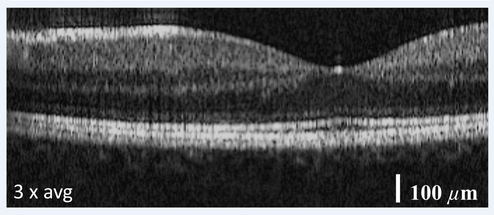
Interferometer on Chip [2]
- 90/10 coupler
- Circulators
- 50/50 coupler

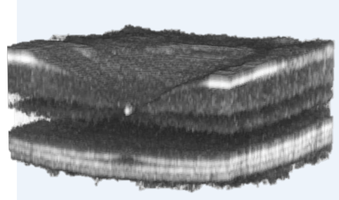
Results

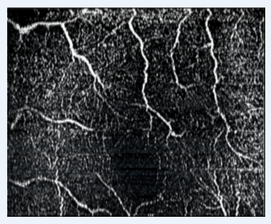
256 Channels [3]

Sensitivity: 91 dB
Ax. Resolution: 11 µm



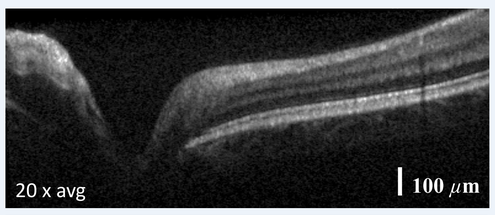


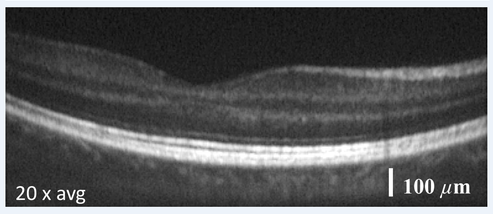


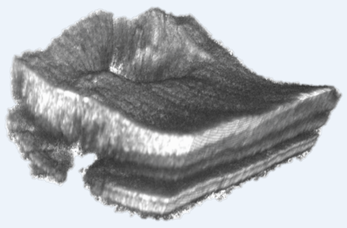


512 Channels

Sensitivity: 88 dB
Ax. Resolution: 7 µm



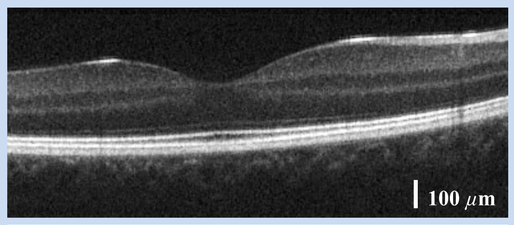


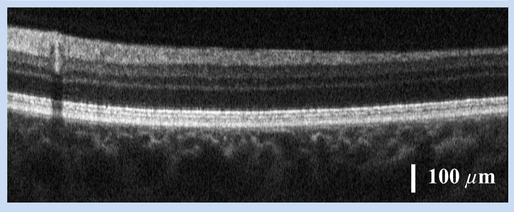


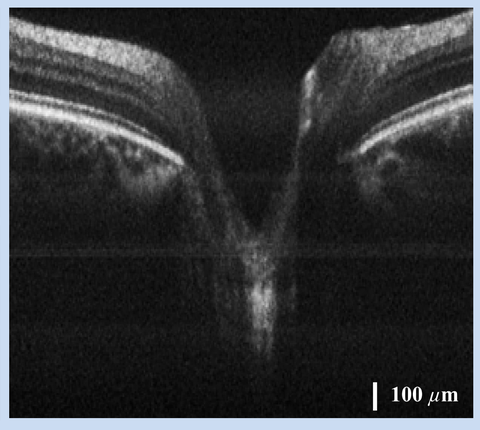
Interferometer

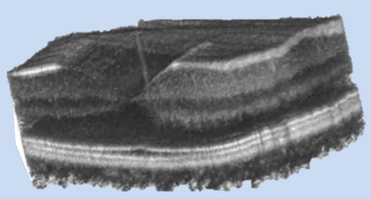
Sensitivity: 94 dB
Ax. Resolution: 5.5 µm

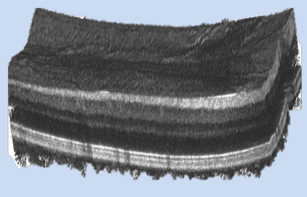
Tomograms: 5x averaged
3D volumes: 4x averaged

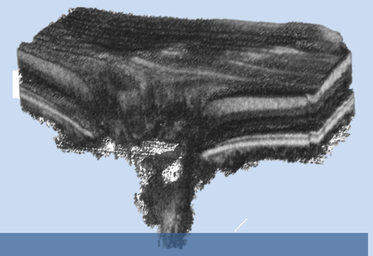




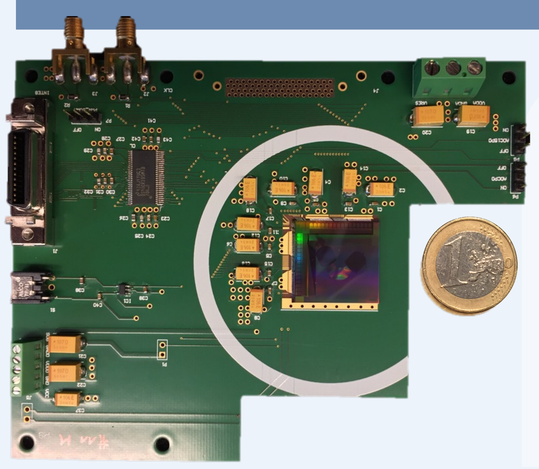






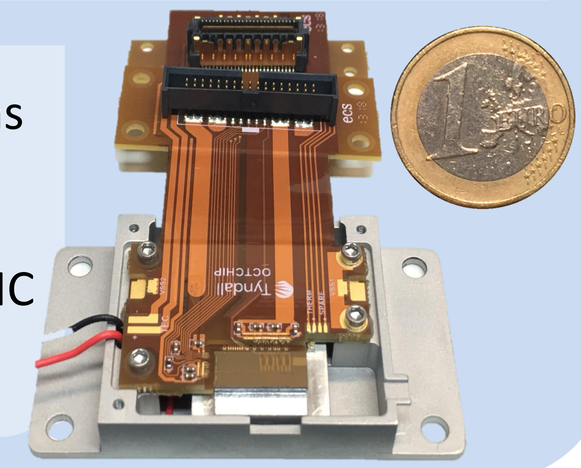


Conclusion & Outlook



Worldwide **first *in vivo* PIC based OCT** tomograms of human retina acquired

Integration of electronics will **further miniaturize** PIC based **OCT systems**



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[1] Seyringer, D. et al. Compact and high-resolution 256-channel silicon nitride based AWG-spectrometer for OCT on a chip. 2019 21st International Conference on Transparent Optical Networks. Angers: IEEE, 2019.
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[3] Rank, E. A. et al Towards optical coherence tomography on a chip: in vivo three-dimensional human retinal imaging using photonic integrated circuit-based arrayed waveguide gratings, accepted Nov. 2020 in Light: Science and application

Acknlowedgements

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