Optical Coherence Tomography (OCT)

- based on white light interferometry [1]
  - high spatial resolution imaging technique
  - low-coherence optical sources
    - depth selectivity
    - generates very narrow and well resolved optical sections of the imaged samples
  - depth scanning capabilities of OCT

\[ I(\tau) = \text{Const} + 2f_0 \sum_{n=1}^{N} a_n z \exp(\tau \omega_n) \cos(\omega_n \tau) \]

Micrometric voxel resolved extinction coefficients algorithm

Beer-Lambert’s law + medium where both absorption and scattering occur [2]:

\[ I(z) = I_0 \exp \left( - \int_0^z \mu(z') \, dz' \right) \]

\( \mu(z) \) is the extinction coefficient, which depends on the medium properties.

Processing algorithm:
- natural logarithm of the data
- iteratively performing linear fits
- allows:
  - determination of \( \mu(z) \) with micrometric voxel resolution.
  - efficient (but costly) signal averaging

Results

- 3D inspection
- OCT (time/spectral domain) probing
- Micrometric Perfilometry

depth resolution
- function of optical source spectra
- decoupled from diffraction limit
- typical values: 1–20 μm

transverse resolution
- diffraction limited
- excellent signal dynamic range
- non-invasive
- contactless technique
- depth imaging of biological samples in vivo and in real time

References


Spectral domain in-fiber system developed for point measurements of micrometric thicknesses films, embedded in transparent materials

- local interferometer, with generation of an interferometric reference near the sample
- demanding mechanical and temperature industrial environments
- depth reflectivity profiles
- acquired channeled spectra are numerically processed by Vandermonde’s algorithms
- standard hardware/software requirements
- LabVIEW (National Instruments, USA),
- one CPU controls the measuring setup, acquisition and signal processing

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