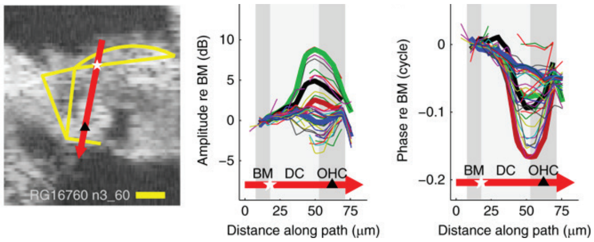
Vibrometry

THORLABS
APP HIGHLIGHT

APPLICATION



Vibrometry Analysis of *In Vivo* Gerbil Cochlea[1,*]

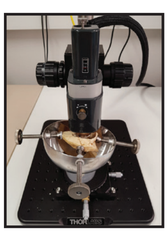
OCT is a powerful technique for studying the mechanics of hearing, as it can be used to locate specific structures within the cochlea via 2D imaging, and to provide vibrational data (amplitude and phase shift) at these specific locations.[1]

QUICK FACTS

- A high A-scan rate is necessary for vibrational analysis. The maximum detectable vibration frequency (Nyquist frequency) is half the OCT system's A-scan rate.
- *In vivo* imaging is possible.[1,2,3,4]
- The external trigger function of the OCT system can be used to synchronize excitation and detection, thereby allowing measurement of the phase shift between excitation and vibration.
- By using OCT phase information, vibrations down to several hundreds of picometers can be resolved. A phase-stable OCT system is necessary for high accuracy.
- Typical interests are the amplitude and phase shift of the basilar membrane vibration at different excitation frequencies, sound levels, and locations.
- No dyes are needed; OCT works by analyzing backscattered light.

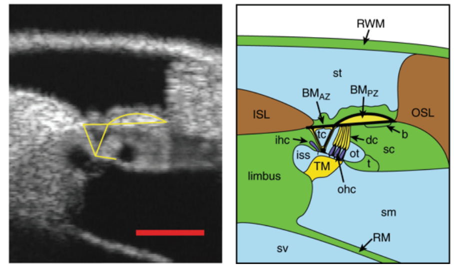
TYPICAL SETUP

- The cochlea is exposed by removing skin and bone tissue. A typical setup with a human skull is shown below.[5]
- A sound generator is used for excitation.
- Excitation and detection are synchronized via a trigger signal.
- *In vivo* imaging of rodents is also possible.[1,2,3,4]

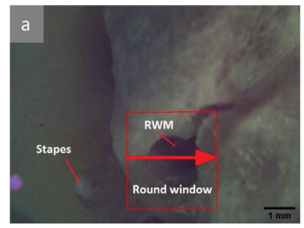


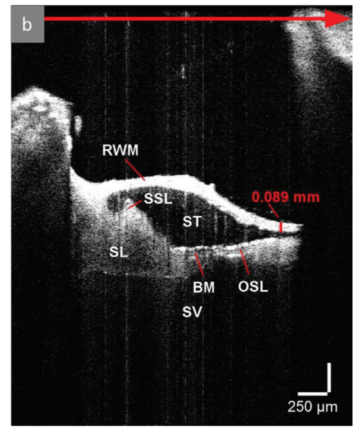
Part of a human skull under the scanner of an OCT system. The skull is positioned so that the region of interest is accessible to the OCT beam.[5,*]

EXAMPLE IMAGES



An OCT image (left) and anatomical sketch showing the structure of the basilar membrane of the gerbil cochlea.[1,*]





(a) *En face* camera image and (b) OCT image of *ex vivo* human temporal bone, capturing the round window membrane (RWM). The OCT image was acquired along the red arrow in (a).[5,*]

RECOMMENDED ITEMS

Choice of OCT System:

- **TEL321C1(/M):** For Imaging Vibrations up to 73 kHz with High Imaging Depth (at 1300 nm)

TEL321C1

- **GAN632C1(/M):** For Imaging Vibrations up to 124 kHz with High Axial and Lateral Resolution (at 880 nm)

Custom Modifications:

- Alternate Lens Kits for Higher Lateral Resolution:
  - 10X Scan Lens Kit:
    4 µm at 900 nm and 6 µm at 1300 nm
  - 20X Scan Lens Kit:
    2 µm at 900 nm and 3 µm at 1300 nm

Interested? Email OCT@thorlabs.com for more information.

PUBLICATIONS

1) N.P. Cooper, A. Vavakou, M. van der Heijden, *Nat. Commun.*, **9** (1), 3054, 2018
2) A.L. Nuttall, A.J. Ricci, G. Burwood, J.M. Harte, S. Stenfelt, P. Cayé-Thomasen, T. Ren, S. Ramamoorthy, Y. Zhang, T. Wilson, T Lunner, B.C.J. Moore, A. Fridberger, *Nat. Commun.*, **9** (1), 4175, 2018
3) N. H. Cho, S. Puria, *Sci. Rep.*, **12**, 18715, 2022
4) S. W. F. Meenderink, W. Dong, *Commun. Biol.*, **5**, 1285, 2022
5) A. Starovoyt, T. Putzeys, J. Wouters, N. Verhaert, *Sci. Rep.*, **9**, 14271, 2019
6) N.C. Lin, C.P. Hendon, E.S. Olson, *J. Acoust. Soc. Am.*, **141** (1), 395, 2017
7) N.C. Lin, E. Fallah, C.E. Strimbu, C.P. Hendon, E.S. Olson, *Biomed. Opt. Express*, **10** (2), 1032, 2019
8) W. Zhou, T. Jabeen, S. Sabha, J. Becker, J.-H. Nam, *J. Neurosci.*, **42** (44), 8361, 2022