Elastography

THORLABS
APP HIGHLIGHT

APPLICATION

Optical Coherence Tomography (OCT) uses back-scattered light to image the structure of organic tissue. In medical applications, being able to differentiate between various types of tissue can be crucial; however, standard OCT fails to provide a good contrast between some tissues. In such cases, Optical Coherence Elastography (OCE) can be used to measure the local elasticity for clear differentiation.[1,2]

QUICK FACTS

- *In vivo* imaging is possible.
- The external trigger function of the OCT system can be used to synchronize excitation and detection, allowing measurement of the propagation of shear waves or deformation following low-frequency compressive loading.
- Additional instrumentation is required to apply load (optical palpation, micro-elastography) or to excite surface acoustic waves.
- Samples do not require dyes.
- Thorlabs' OCT systems are intended for research and industrial applications only.

COMMON VARIATIONS

- **Optical Palpation**
  A technique that maps mechanical variations in soft tissue by applying a load to the surface of the sample. This technique produces an en-face map of stress across the sample surface.
- **Shear Waves**
  A technique in which shear waves are excited with a transducer, and their phase velocity is measured and used to estimate Young's modulus. This technique has poor lateral resolution and is limited to 1D and 2D.[3]
- **Micro-Elastography**
  A compression-based technique that combines phase information from OCT volume scans with optical palpation to produce a high-resolution 3D map of elasticity.[1]

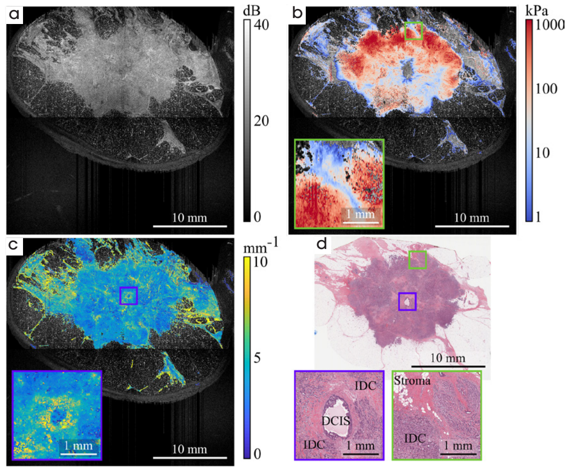
RECOMMENDED ITEMS

Choice of OCT System:

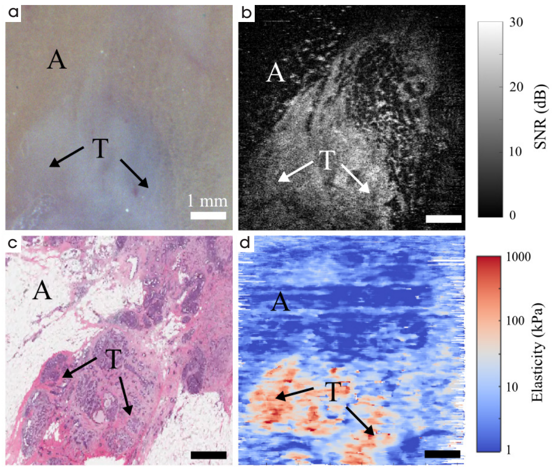
- **TEL221C1** (up to 76 kHz)
- **TEL321C1** (up to 146 kHz)

TEL221C1

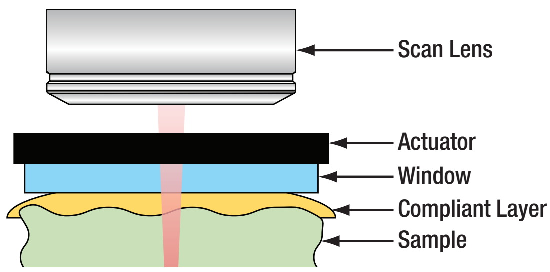
EXAMPLE IMAGES



(a) OCT intensity, (b) micro-elastogram, (c) attenuation imaging, and (d) histology of tissue. Insets show invasive ductal carcinoma (IDC) and ductal carcinoma in-situ (DCIS).



(a) Video Image, (b) OCT Intensity, (c) Histology, and (d) Micro-Elastogram of Adipose (A) and Tumorous (T) Tissue



A schematic showing an optical palpation setup. The actuator applies a force to the compliant layer and sample, and the strain of the compliant layer is measured using an OCT scan. The known stress-strain relationship of the compliant layer allows the stress across the surface of the sample to be calculated.

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

PUBLICATIONS

1) S. Es'haghian, K.M. Kennedy, P. Gong, Q. Li, L. Chin, P. Wijesinghe, D.D. Sampson, R.A. McLaughlin, B.F. Kennedy, Biomed. Opt. Express, **8** (5), 2458, 2017
2) M.S. Hepburn, P. Wijesinghe, L. Chin, B.F. Kennedy, Biomed. Opt. Express, **10** (3), 1496, 2019
3) D. Düwel, C. Otte, K. Schulz, T. Saatho, A. Schlaefer, Current Directions in Biomedical Engineering, **1**, 215, 2015
4) W.M. Allen, K.M. Kennedy, Q. Fang, L. Chin, A. Curatolo, L. Watts, R. Zilkens, S.L. Chin, B.F. Dessauvagie, B. Latham, C.M. Saunders, B.F. Kennedy, Biomed. Opt. Express, **9** (3), 1082, 2018
5) S. Nebelung, N. Brill, F. Müller, M. Tingart, T. Pufe, D. Merhof, R. Schmitt, H. Jahr, D. Truhn, J. Mech. Behav. Biomed. Mater., **56**, 106, 2016
6) B. Krajancich, A. Curatolo, Q. Fang, R. Zilkens, B.F. Dessauvagie, C.M. Saunders, B.F. Kennedy, Biomed. Opt. Express, **10** (1), 226, 2019
7) W.M Allen, P. Wijesinghe, B.F. Dessauvagie, B. Latham, C.M. Saunders, B.F. Kennedy, J. Biophotonics, **12** (1), e201800180, 2019
8) R.W. Sanderson, A. Curatolo, P. Wijesinghe, L. Chin, B.F. Kennedy, Biomed. Opt. Express, **10** (4), 1760, 2019

Images provided by Brendan Kennedy from The University of Western Australia and the Harry Perkins Institute of Medical Research