SOLEIL SYNCHROTRON

FOR **BIOLOGISTS**

ANATOMIX

beamline

X-ray tomography

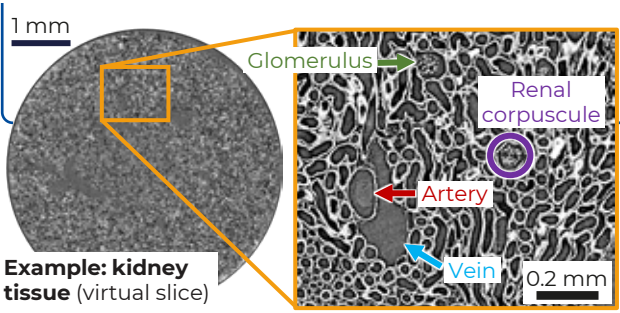
- **ORGANISMS**
- **TISSUES**
- **CELLS**
- ORGANELLES
- COMPLEXES
- PROTEINS
- ATOMS

SAMPLES

TYPES

Example: lizard
(3D rendering)

- Biological tissues (soft or calcified)
- Entire organisms (e.g., small animals)
- Plants, seeds
- Biomaterials and biocompatible materials
- Environmental (soils, rocks)
- Engineering materials, man-made systems



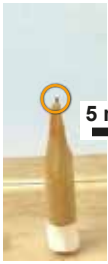
Example: kidney tissue (virtual slice)

SAMPLE PREPARATION & ENVIRONMENT

- Free-standing or embedded samples (in air)
- Samples in liquid environments (plastic container)
- Prepared with or without X-ray staining agents
- Size: from less than 1 mm to several cm, depending on the resolution needed
- User-built sample environments possible (controlled conditions and/or in-situ tests: temperature, humidity, pressure, mechanical loading etc.)

Mouse brain

Pancreas in paraffin

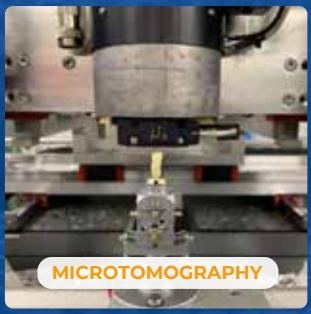


Seed

Coral

TECHNIQUE

ANATOMIX is a beamline for **X-ray tomography on the micro- and nanoscale,** in **absorption** and **phase contrast**. Operating in the energy range **from 5 keV to more than 50 keV**, it allows users to obtain two and three-dimensional radiographic images of bulk volume samples of macroscopic size.


MICROTOMOGRAPHY


TXM NANOTOMOGRAPHY

Parallel-beam microtomography

- Resolution (pixel size): from 0.13 to 20 µm
- Typical size of one volume scan: 2000 × 2000 × 2000 voxels
- Typical time for one volume scan: a few minutes
- Fast measurements down to below 1 s per microtomography scan where needed
- In-situ sample environments possible: mechanical loading, temperature etc.

Transmission X-ray microscope (TXM): nanotomography

- Resolution (pixel size): from 20 to 100 nm
- Typical size of one volume scan: 1000 × 1000 × 1000 voxels, limited to ≈ 40 µm FOV
- Typical time for one volume scan: tens of minutes

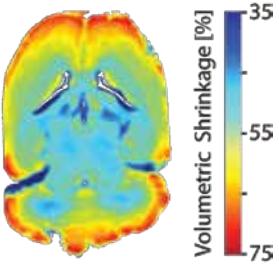
HIGHLIGHTS

Microscopic imaging of the brain to identify diseases traditionally relies on histology: tissue embedded into paraffin wax and thinly sliced for optical microscopy.

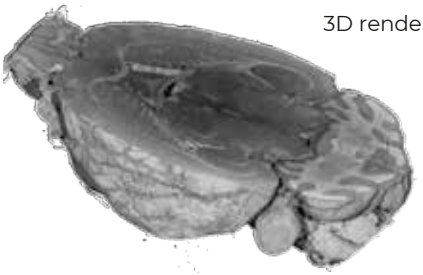
But this conventional method only provides 2D information and induces non-uniform shrinkage. Using 3D microtomography on ANATOMIX, distortions were identified, and the optimum preparation for obtaining contrast-rich 3D X-ray images of brain tissue was determined.

Left: phase-contrast tomography virtual slice of a mouse brain.

Below: map of distortion induced by preparation.



This is applicable in the emerging field of virtual histology, where microtomography adds a third dimension to conventional histological analysis.



3D rendering of a mouse brain from high-resolution microtomography

G. Rodgers et al., J. Neurosci. Methods 364 (2021) 109354 & 365 (2022) 109385.

REFERENCES

- **ANATOMIX beamline User Guide** (PDF), download from https://www.synchrotron-soleil.fr/en/beamlines/anatomix.
- **Microtomography on the ANATOMIX beamline at Synchrotron SOLEIL**, J. Phys. Conf. Ser. 2380 (2022) 012122.
- **Current status of hard X-ray nano-tomography on the transmission microscope at the ANATOMIX beamline**, J. Phys. Conf. Ser. 2380 (2022) 012045.

More information on ANATOMIX publications web page

COMPLEMENTARY BEAMLINES

DISCO: VUV to visible light beamline, dedicated to biochemistry, chemistry and cell biology.

NANOSCOPIUM: scanning hard X-ray nanoprobe for quantitative imaging (elemental composition, chemical speciation).

PUMA: hard X-ray fluorescence and diffraction for ancient materials.

PSICHÉ: hard X-ray diffraction and imaging for materials science; tomography at high photon energies, measurements at extreme conditions.

SMIS: infrared beamline to obtain images using IR spectro-microscopy.

SWING: small angle X-ray scattering; X-ray ptychography.

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Health & Well-Being at SOLEIL

Link to the web page

SOLEIL's Health and Well-being Scientific Section is composed of 30 scientific experts from different fields. Through collaborative and science-driven approaches, the Section offers the community a coherent portfolio of state-of-the-art techniques to serve scientific and societal health-related challenges.

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