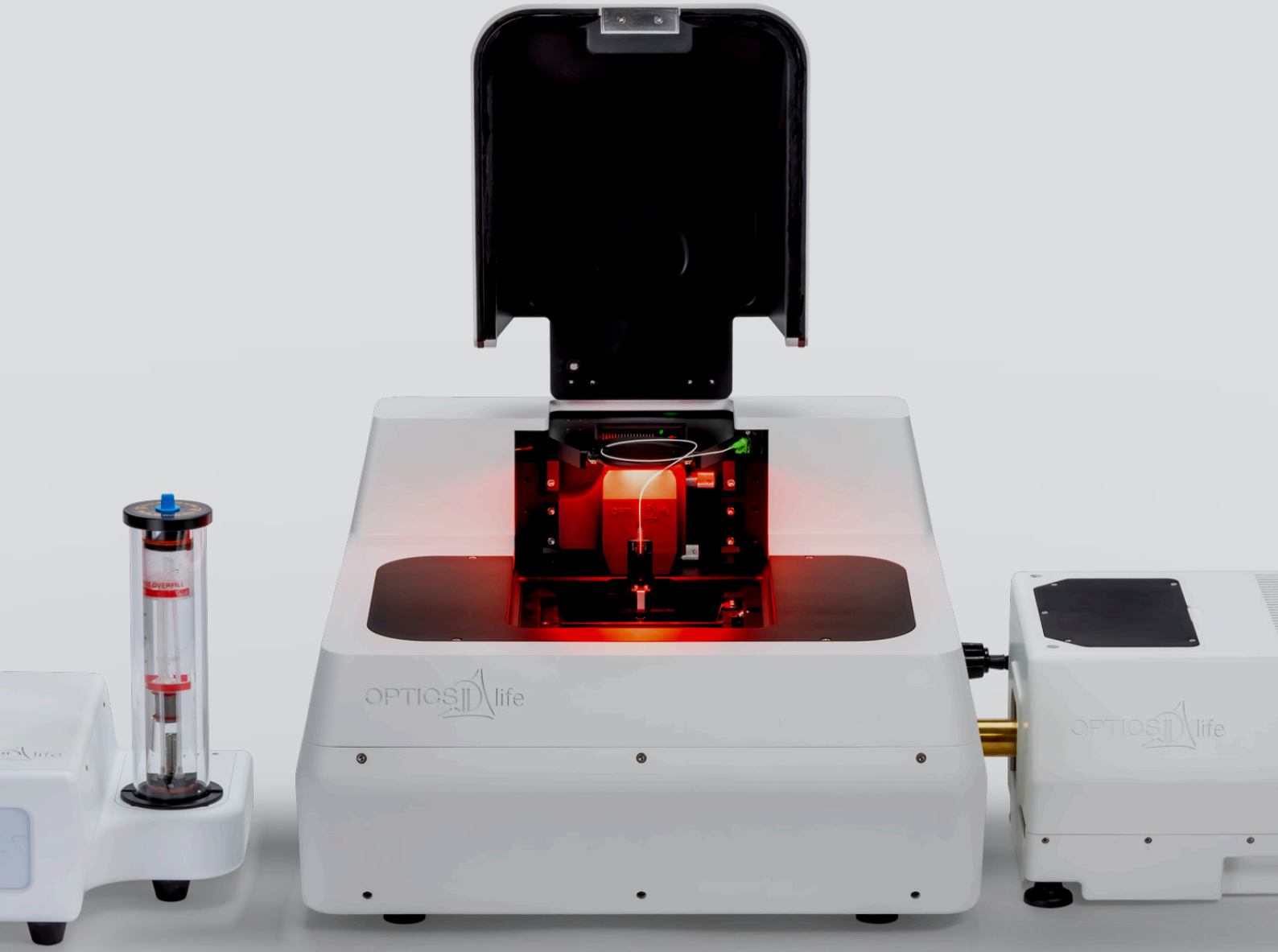
OPTICS11 life

Pavone

High-throughput nanoindentation and imaging platform.



UNLOCK THE POWER OF MECHANOBIOLOGY

Pavone offers

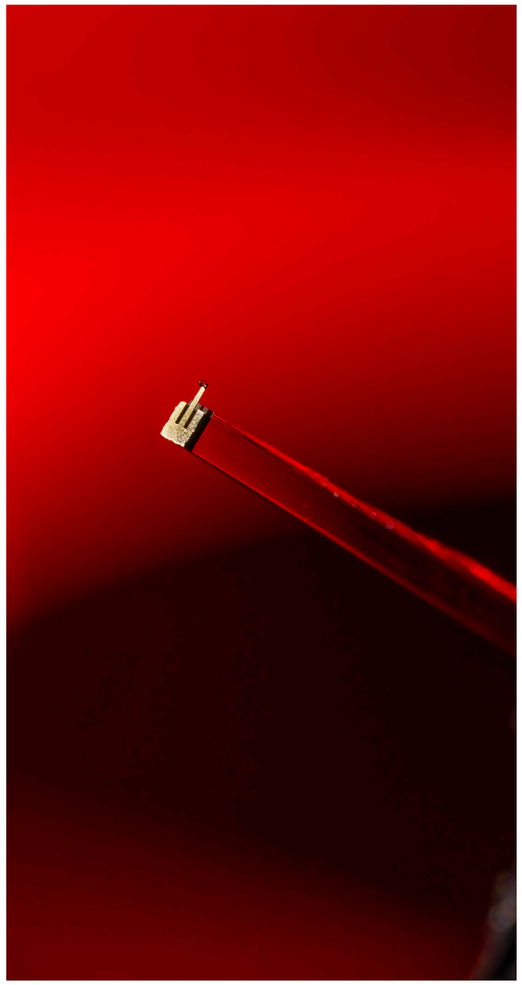
An easy-to-use, automated nanoindentation platform combining imaging and non-destructive topographical and surface mechanical measurements of soft and living samples.

- **A functional assay for diverse workflows:** map the local elastic and viscous properties of your samples, from cells to tissues, to understand how mechanical properties and forces affect biological processes in health and disease.

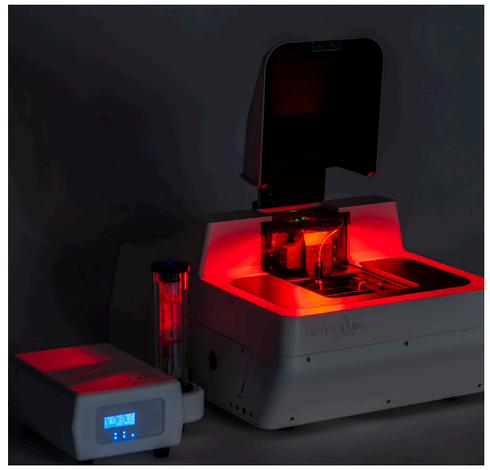
- **Automated experimental execution:** design imaging and mechanical screening routines for your samples, and let the device take care of the execution. Integrated temperature control and optional environmental control ensures sample stability during measurements.

- **High-throughput:** collect tens of thousands of data points a day, over hundreds of samples. Measure in petri dishes, conventional well-plates (up to 384 wells), glass slides, well plate inserts, microstructured plates, and more. Build strong statistical evidence for your research and explore large parameter spaces.

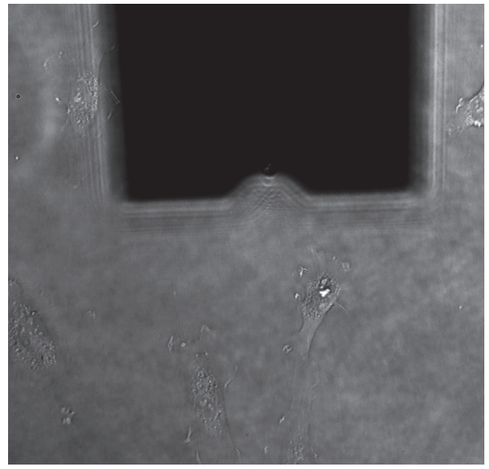
- **Multimodal data collection:** combine microscopy with nanoindentation to perform correlative analysis, targeted measurement of regions of interest, or even actuation of cells and engineered constructs.



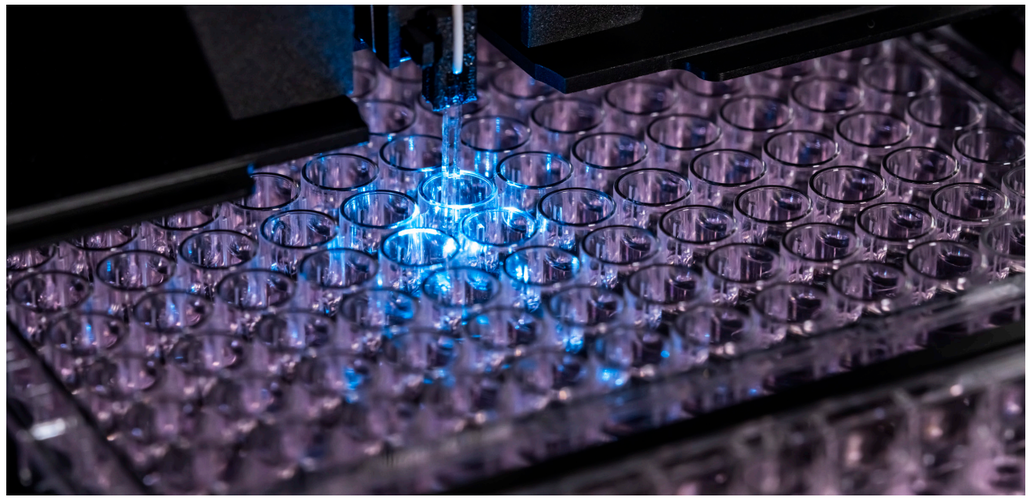
The probe used for the nanoindentation measurement.



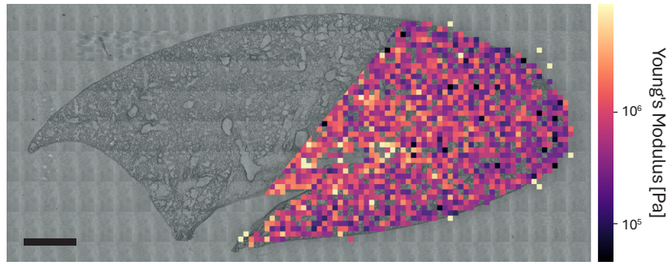
Pavone equipped with environmental control.



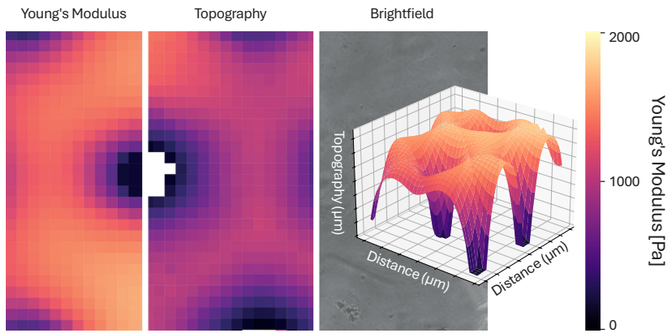
Microscope view whilst mapping single cells.



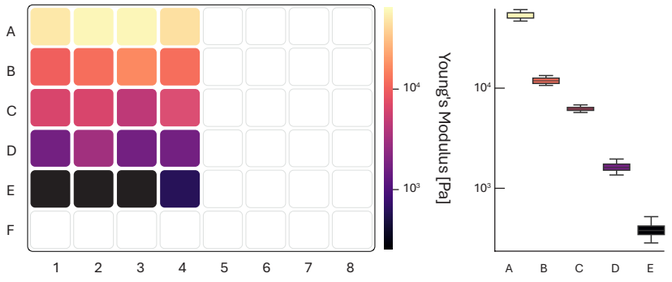
A close-up of a measurement in a well plate whilst imaging in widefield fluorescence.



Tissue section with mechanical map (Young's Modulus) overlay.
Scale bar is 100 µm.



Microstructured hydrogel niches for an in vitro cancer model. Overlay of elastic properties and topography (300x400x70 µm) on the brightfield image*.



Screening of different hydrogel formulations for tissue engineering applications. On the left, average value per well, on the right results per condition (rows A-F).

* Data courtesy of Emna Ouni, PhD - Institut Gustave Roussy

Mechanical assays for biology

Pavone is being used for many different applications. Some notable examples include:

- **Optimization of tissue engineering constructs:** verify reproducibility of your engineered systems and benchmark their properties against biopsies using the same system.
- **Quantification of cell mechanics:** map relationships between substrate viscoelasticity and cell properties. Gain insights about cytoskeletal or membrane modifications following drug administration.
- **Matrix remodeling studies:** perform functional assays that assess remodeling in complex systems such as hydrogel-cells mixtures. Understand how treatments affect cell contraction and matrix deposition and degradation.
- **Disease phenotyping:** discover new insights of disease conditions by non-destructively screening mechanical properties of tissue samples. Leverage the information for both correlative studies and to engineer better biomimetic in vitro systems, for instance in fibrosis research.

Our technology has been featured in **over 500 publications** to date. If you are curious to know more, check our resources:
www.optics11life.com/resources

Sample applications

Pavone provides great flexibility and can measure your samples of choice. Extract insights that let you optimize your tissue engineering workflow, understand mechanisms of action of new molecules or screen compounds more efficiently. Some examples include:

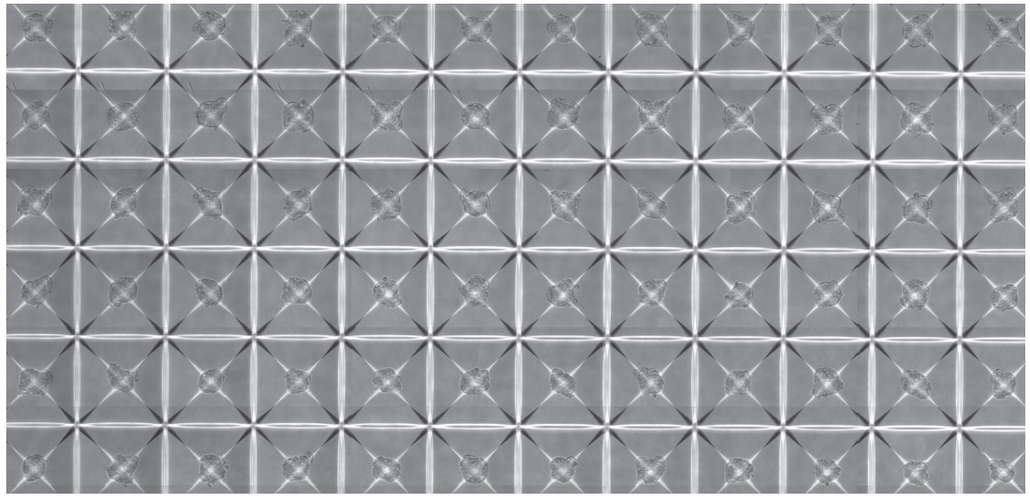
- **Hydrogels and 3D printed constructs:** validate biomimetic systems, assess stiffness, morphology and swelling or degradation properties of microstructured gels, particles or coatings.

- **Tissues:** assess the heterogeneity of cryosections, microtome and vibratome slices, as well as biopsies of most organs.

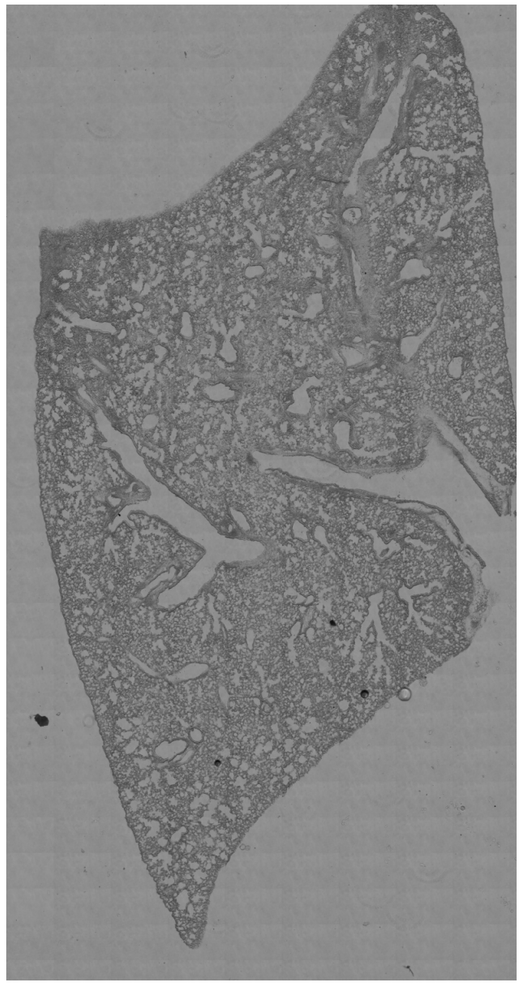
- **Single cells:** spatially characterize their mechanical phenotypes as a function of seeding conditions and treatments or use our sensor to actuate them and study their response.

- **Spheroid and organoid models:** measure the viscoelastic properties of microtissues, quantify their degree of compaction depending on initial seeding conditions or following a drug treatment.

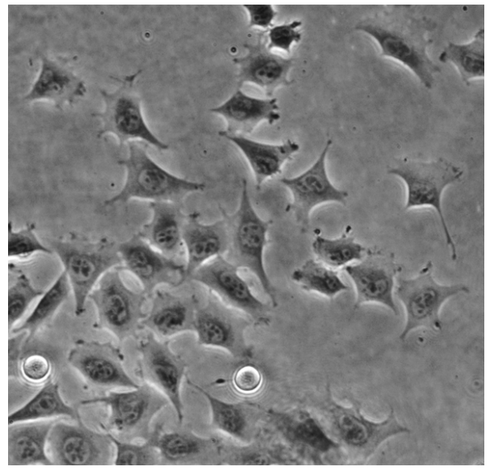
On the right, some of these samples imaged with Pavone.



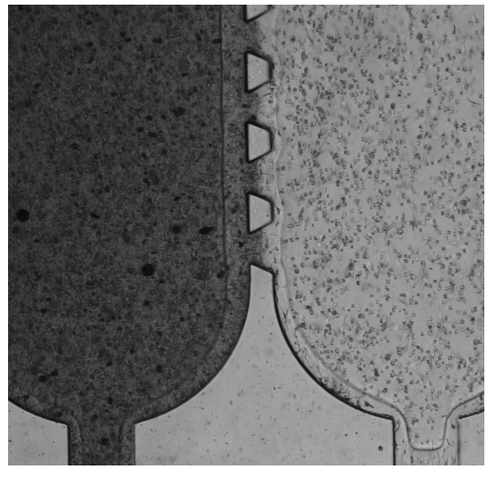
Cancer spheroid in microstructured wells.



Tissue cryosection.



Mouse embryonic fibroblasts.

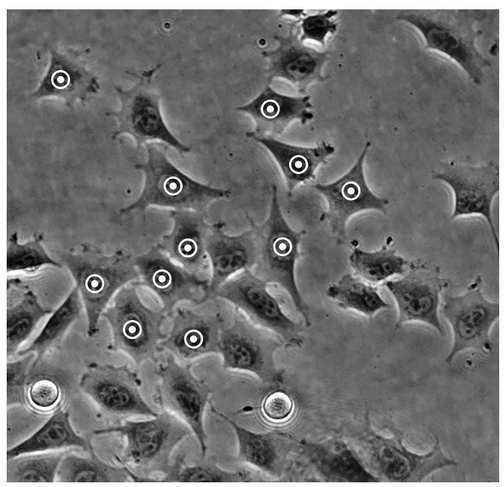


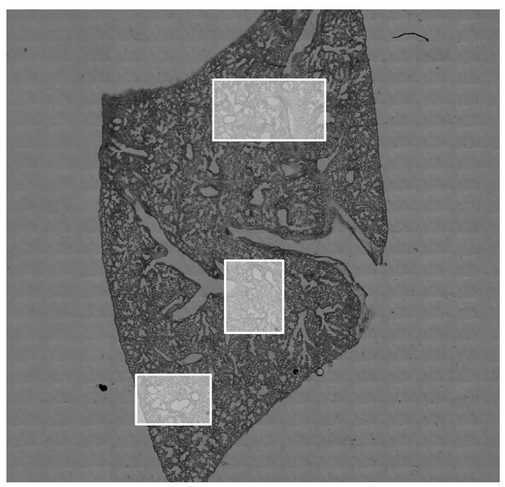
Organ-on-chip system.

System capabilities

Data acquisition

- **Target** specific objects or regions of interest via an intuitive touch interface.
- **Map mechanical properties** controlling strain rate, stress rate and peak load.
- Perform **dynamic mechanical analysis,** creep and stress relaxation.
- Acquire **images,** stitch entire well plates using brightfield, phase contrast or widefield fluorescence illumination (optional).
- **Automate** sample-to-sample and well-to-well movement, focus and imaging steps, cleaning protocols, and more.
- **Record videos** and time-lapses while performing mechanical tests.





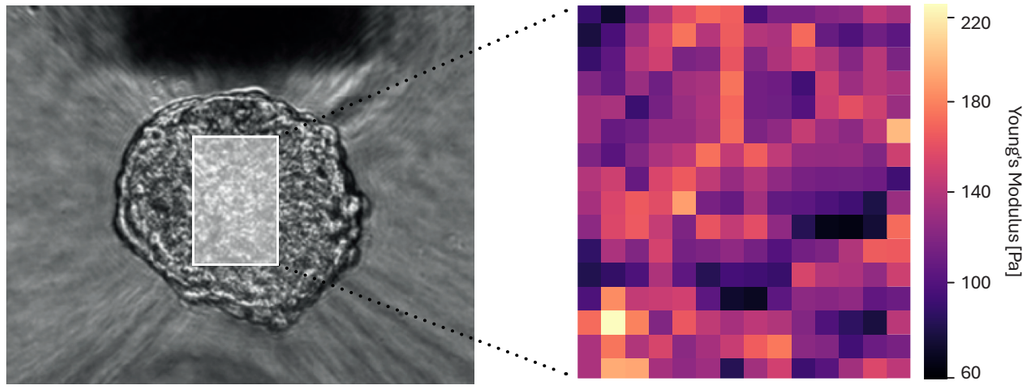
Data analysis

The data collected by Pavone allows you to:

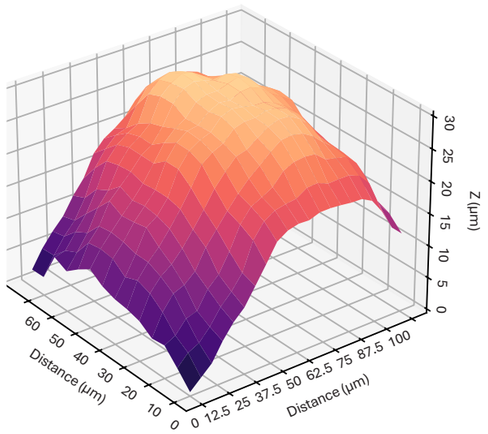
- Model **elastic properties** of your samples.
- Quantify **viscoelastic behavior.**
- Quantify tip-sample **adhesive** properties.
- Map **topography**.

This data, combined with our analysis software, makes it effortless to:

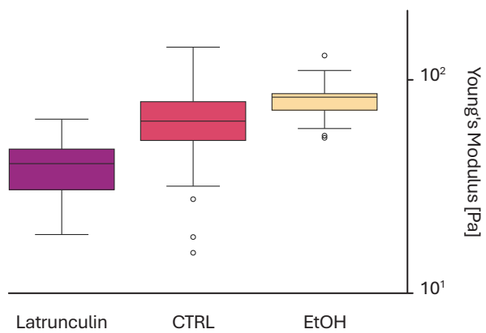
- Compare **multiple conditions.**
- Obtain **full plate overviews.**
- **Correlate** structure and stiffness.



A C4-2 spheroid with corresponding heatmap of mechanical properties.

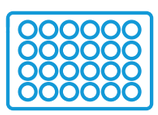


Topography reconstruction of the surface.



Stiffness variation following Latrunculin and EtOH administration.

Pavone unique features

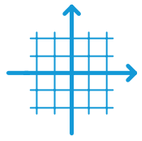


Sample compatibility

From petri dishes to chambered slides. Most well plates, up to 384 wells.

Stiffness range

Characterize samples from tens of Pa to 100s of MPa. From brain to cartilage.



Spatial mapping

XY resolution: from 1 µm. Collect maps from μm^2 to cm^2. From single cells to tissue biopsies.

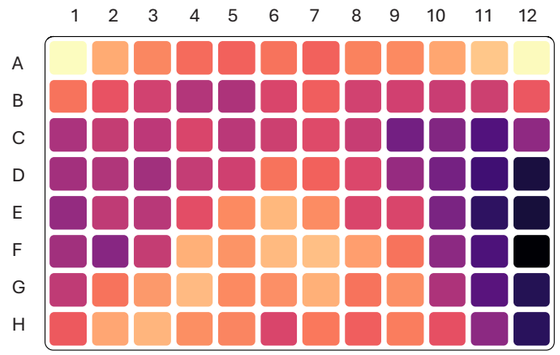
Environmental control

Maintain a near-physiological environment. Control temperature, CO_2 and humidity (optional).

Imaging capabilities

Image in brightfield and phase contrast, fluorescence (optional). Automate plate imaging/video. Motorized objective with autofocus, up to 40x.

Workflow examples



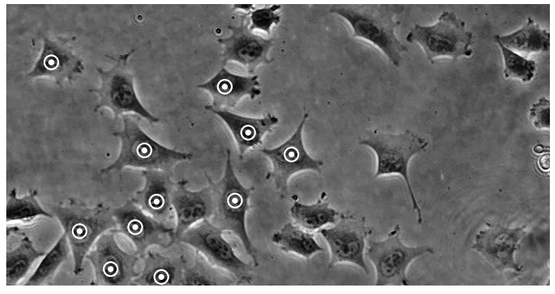
Hydrogel characterization

Data collection

~1 h

Data points

1200 over 96 wells



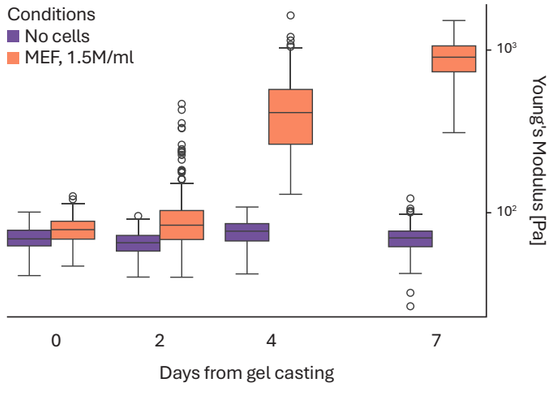
Single cell screening

Data collection

~2 h

Data points

800 cells over 10 conditions



Cells-in-gel remodeling study

Data collection

<30 min per day

Data points

450 per day

A modular platform

The modular nature of Pavone adapts to your experimental needs, making it the ideal companion in any laboratory.

Environmental control module

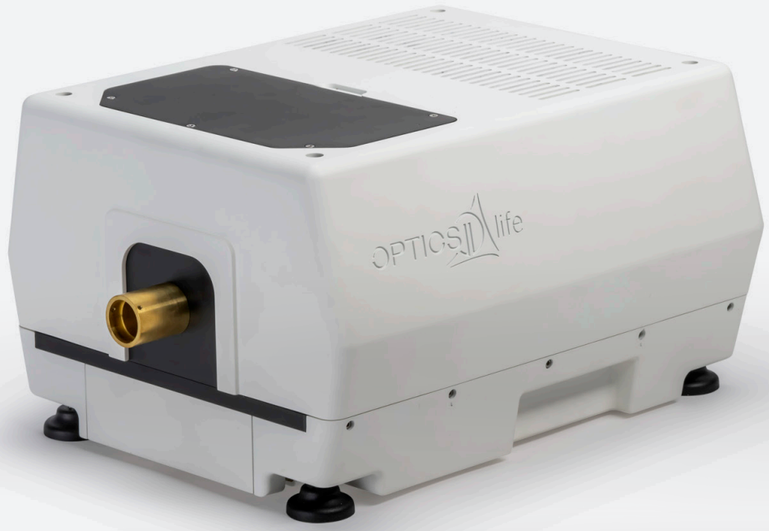
Maintain optimal environmental conditions during long-term experiments with the optional environmental control module.

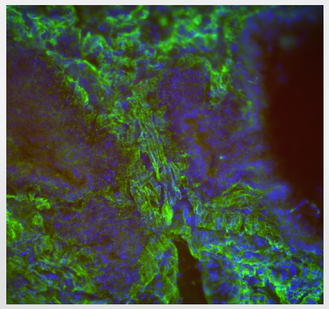
This adds CO_2 and humid air control to the default temperature control, enabling measurements in an incubator-like environment (CO_2 up to 10%, RH 95%).

Fluorescence module

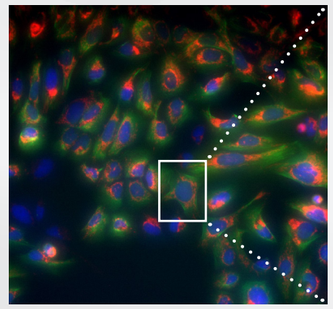
Expand your experimental capabilities by integrating a widefield fluorescence imaging option.

Equipped with up to 4 channels, this optional addition can be used to localize samples of interest for mechanical screening, record fluorescent signals following mechanical actuation, or to track the motion of fluorescent microbeads over time.

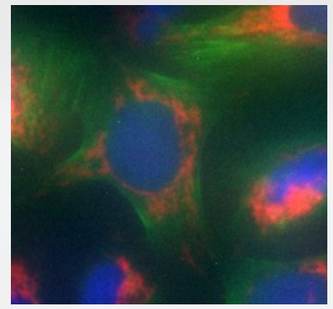




Decellularized mouse lung tissue.



U-2 OS cells with stained nuclei, actin and mitochondria.
Data courtesy of Dr. F. Canyelles, ICHB, Polish Academy of Sciences



What our users say

UNIVERSITY OF TWENTE.

Prof. Dr. Leijten

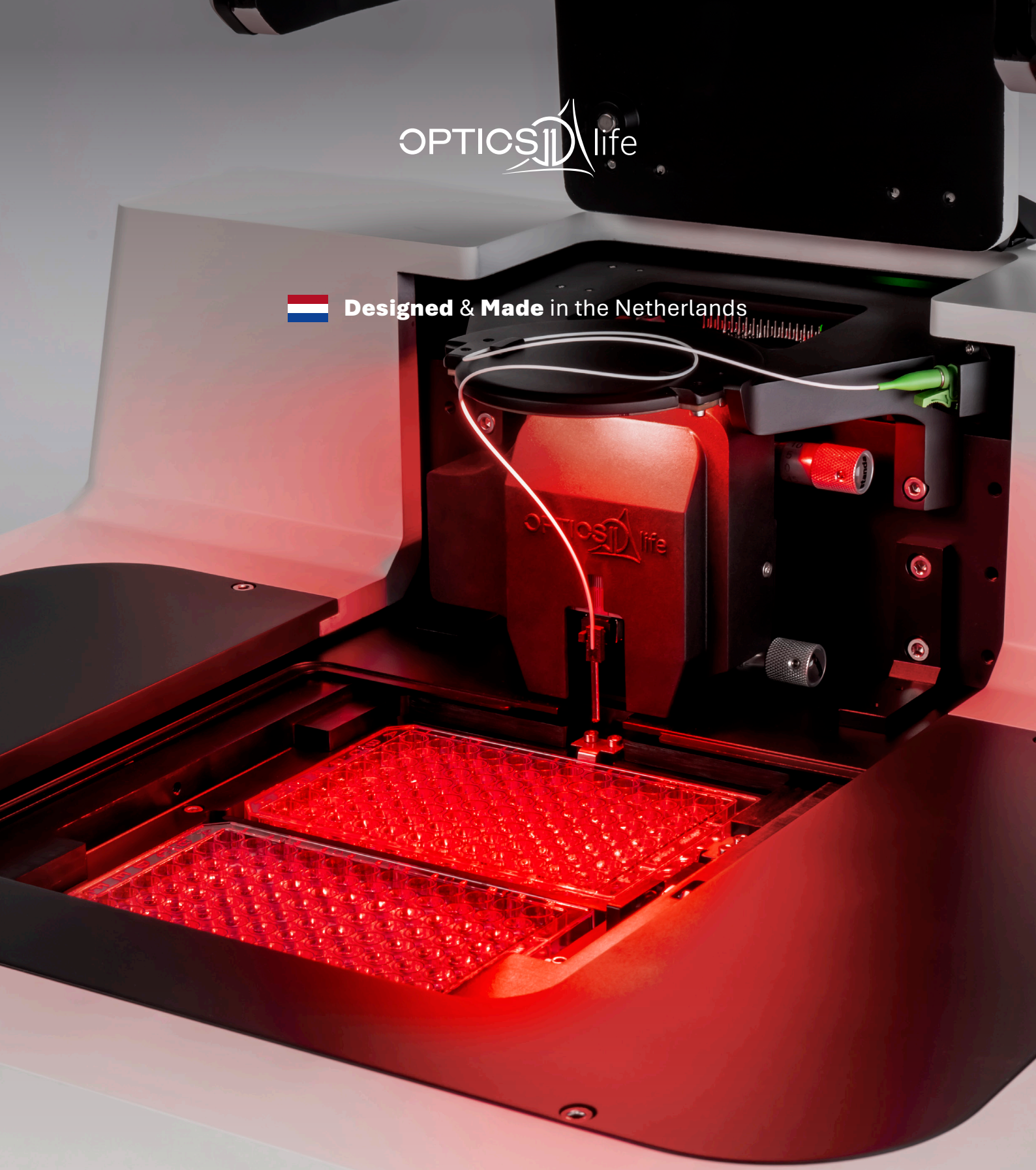
The Pavone allows us to perform accurate mechanical measurements on spherical micrometer-sized materials, which has always been true challenge with other techniques. Moreover, the Pavone allows us to obtain spatially resolved mechanical maps of complex matter such as multi-materials or human tissues in a way that is both straightforward and easy to learn.

Boehringer Ingelheim

Dr. Vincent Fiore

Pavone enables us to test different materials and get the data we wanted to get so far, with yields in the high-90% range. Calibration is very straightforward and much easier than traditional technologies (for mechanical characterization). We're able to get consistent measurements from day-to-day using the same probe. Pavone allows us to utilize mechanics in addition to transcriptional profiling to determine how the cell biology of our models compares to the cell biology within a patient.

Read our case study with Boehringer Ingelheim - scan the **QR code**:



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