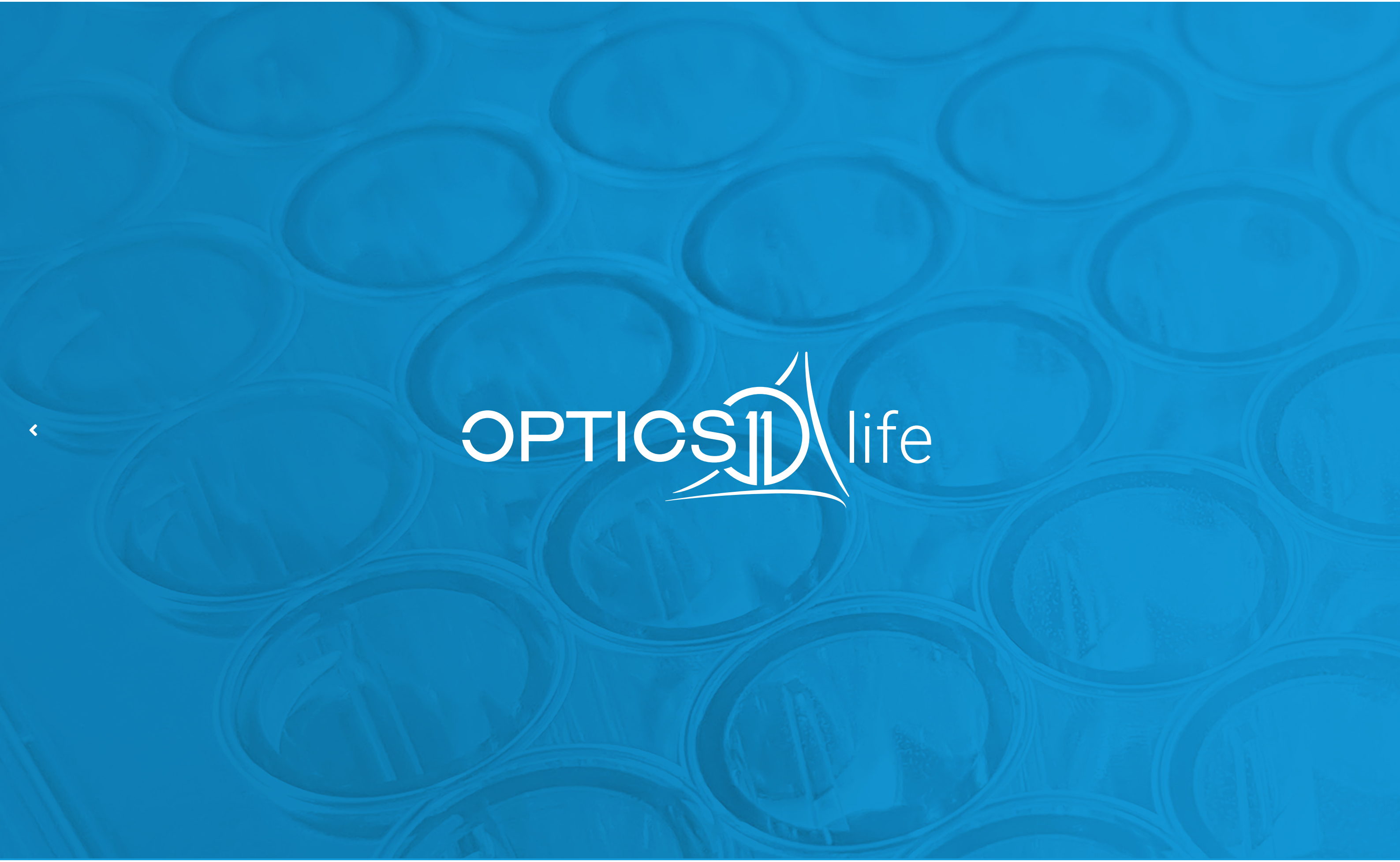
PAVONE

HIGH-THROUGHPUT **MECHANICAL SCREENING PLATFORM**


OPTICS11 life

ABOUT OPTICS 11 LIFE

Optics11 was founded in 2011 as a university spin-off. The first product was built in 2012: an extremely sensitive and easy to use measurement device for mechanical characterization of soft materials. The company now has two business units: Optics11 develops integrated fiber-optics based sensors for industrial applications while Optics11 Life focuses on Life Science applications.

Currently, Optics11 Life offers a range of Nanoindentation instruments used for various applications, from routine hydrogel testing and single-cell mechanobiology experiments to high-throughput mechanical screening of 3D tissue models.

Go the the website

PATENTED **FIBER OPTICS TECHNOLOGY**

USED IN **22 COUNTRIES** AND **5 CONTINENTS**

Amsterdam, The Netherlands

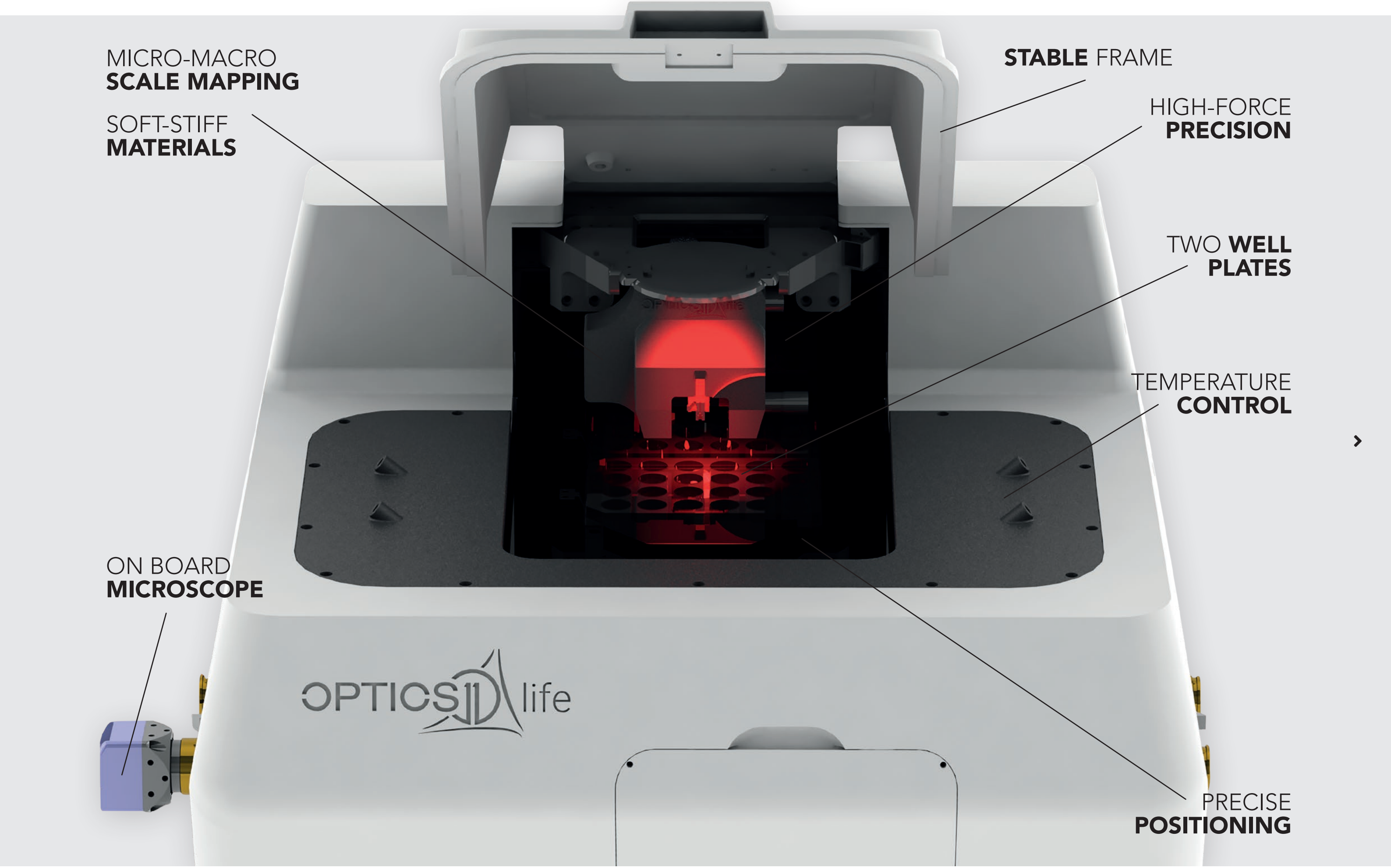
Boston, US

ABOUT PAVONE

FAST DISCOVERIES POWERED BY HIGH-THROUGPUT **MECHANICAL SCREENING**

3D tissue models are revolutionizing diagnostics, drug development, and regenerative medicine fields. New instrumentation is needed for the development, monitoring, validation, and quality control of engineered tissues. Mechanics have the potential to serve as a label-free biomarker for the assessment of structure and function of various biomaterials.

The Pavone combines state-of-the-art fiber-optics force-sensing technology with cleverly designed imaging and precision mechatronics to provide one integrated solution for any high-throughput mechanical analysis challenge. The patented fiber-optical interferometric MEMS technology makes it possible to measure even the softest materials in controlled environmental conditions with high force resolution and in a non-destructive way. Synchronized imaging and stage control enable the automatization of mechanical testing workflow in microplates. Modular design allows to add the modules in the future to expand the functionality and ensure that demands for future instrumentation are met.


MICRO-MACRO **SCALE MAPPING**
SOFT-STIFF **MATERIALS**
ON BOARD **MICROSCOPE**
STABLE FRAME
HIGH-FORCE **PRECISION**
TWO **WELL PLATES**
TEMPERATURE **CONTROL**
PRECISE **POSITIONING**
OPTICS11 life

KEY FEATURES

MICRO-RHEOLOGY

Implemented feedback loop enables **quasi-static, stress relaxation/creep and dynamic indentation measurements** with high accuracy in sensing and control of force and indentation-depth which is needed for capturing complex mechanical properties such as nonlinearity, adhesion, viscoelasticity and poroelasticity.

HIGH-THROUGHPUT AUTOMATION

Precise stage-control and surface finding of the sample enable implementation of automated experimental workflows in micro-plates without the need for user supervision. The whole 96 microplate can be measured under 2 hours.

INTEGRATED: 3 IN 1

Integration of mechanical testing, microscopy and environmental control into one device enables synchronized operation and control. Indentation locations can be overlapped with the images of the sample for **structure-stiffness correlation** analysis. Control of environmental conditions ensures viability of the sample and can be changed as part of study.

EASY TO USE

The simplicity in the use of the instrument is the key focus of software design. Operation does not require to be an expert in mechanical testing and, thus, allows one to start the experiment with the **minimal training**.

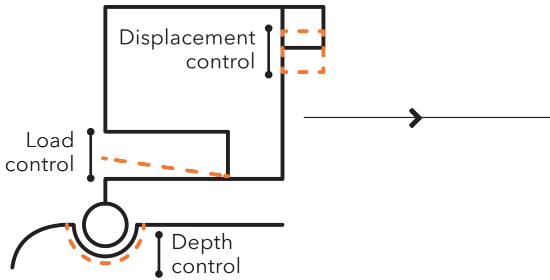
MECHANICAL CHARACTERIZATION

Pavone can measure stiffness range of 10Pa - 1GPa which corresponds to applied load of 0.2nN – 1.5mN. Indentation speed can be varied from 0.01 to 100 μm/s and oscillatory frequency from 0.01 Hz to 75 Hz (open loop). The scale of deformation can be changed between sub-μm to 100 μm.

QUASI-STATIC

1 Operate

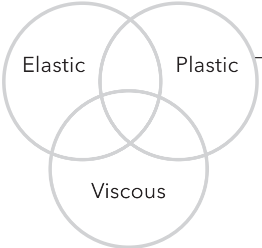
Combine any mode of operation



CONTROL MODES

3 Measure

Measure the mechanical properties



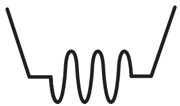
RHEOLOGY (DMA)

2 Indent

With any identation profile

Quasi-static profile

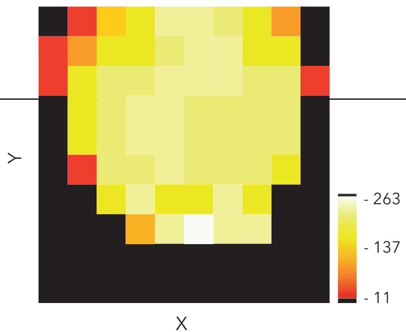
Dynamic oscillatory profile

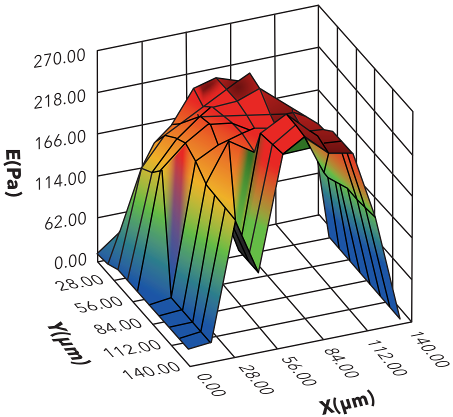


MAPPING

Young's modules

E (Pa)

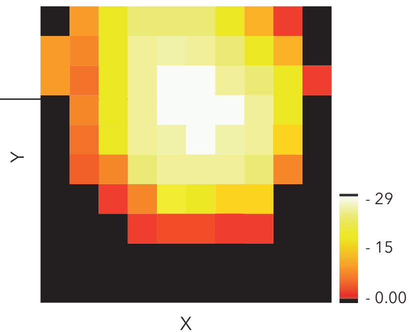


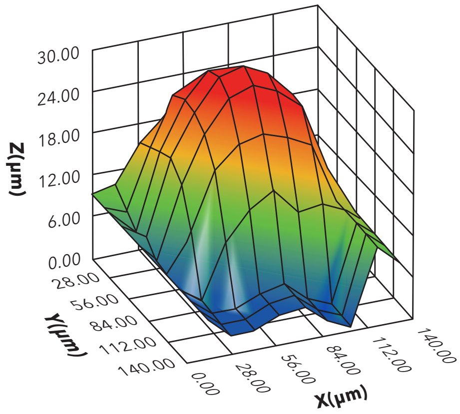


TOPOGRAPHY

Topography

Z (µm)

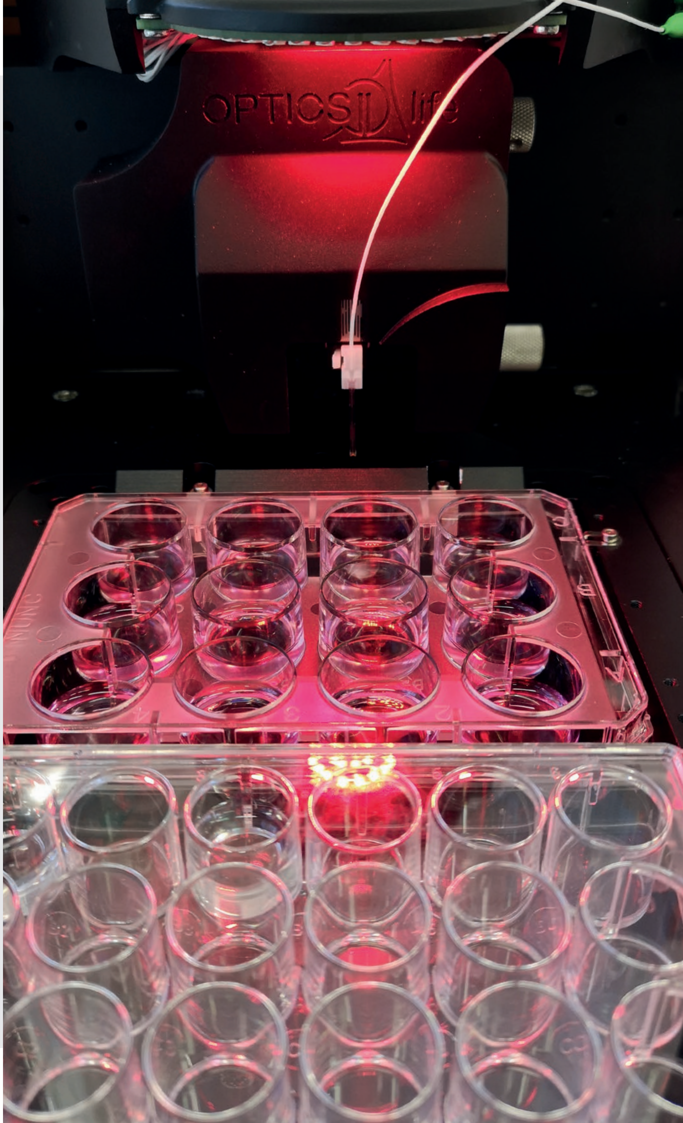




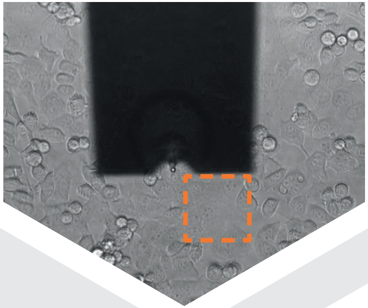
IMAGING

- **BRIGHT-FIELD**
- **PHASE-CONTRAST**
- **FLUORESCENCE**

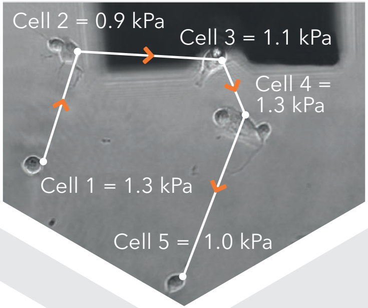
Indentation and imaging are synchronized, enabling simultaneous recordings of mechanical deformation and e.g., fluorescent signals. The probe location is calibrated within the camera view, allowing the user to simply select the region of interest for mechanical mapping or indent multiple individual objects by touch-and-go interface.



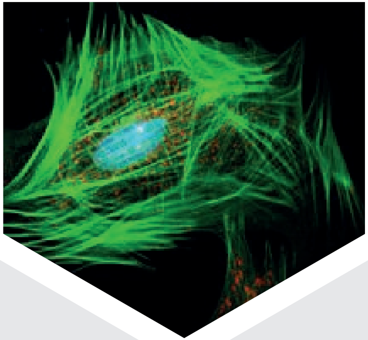
Select regions of interest

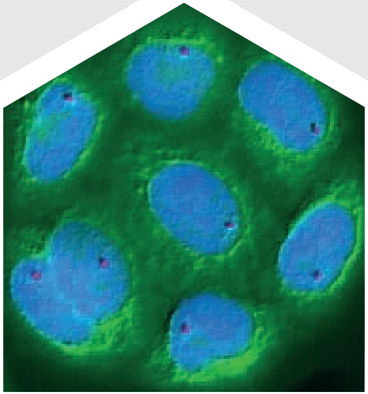


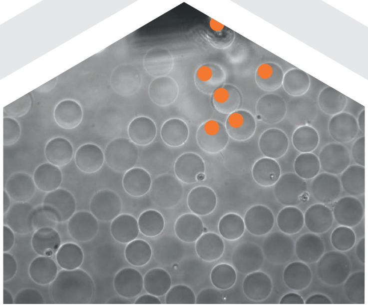
Indent and image



Fluorescence

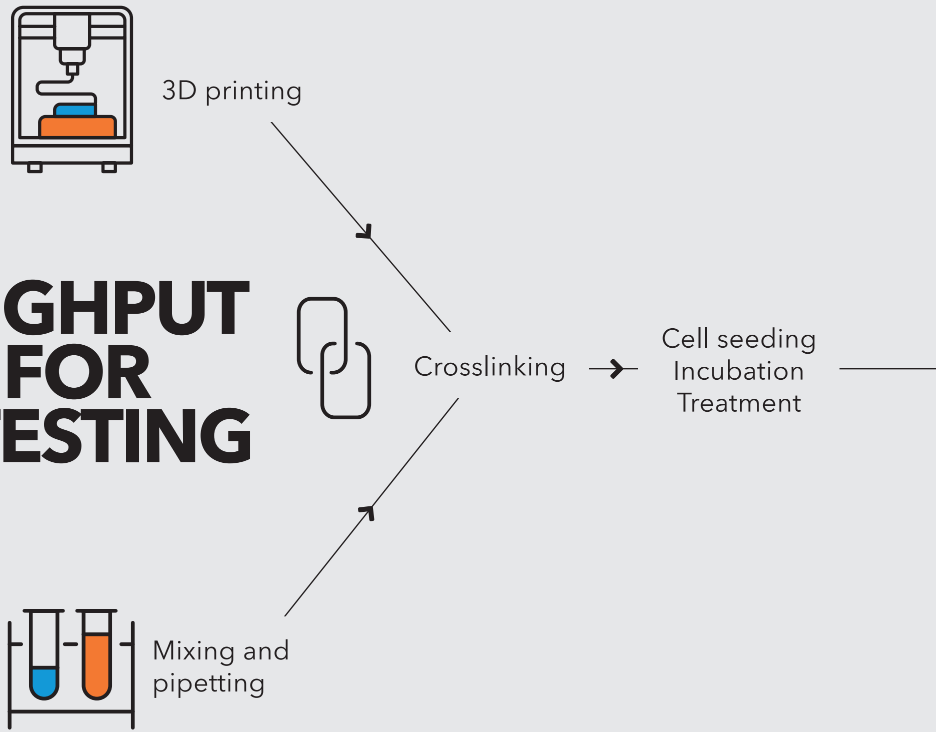


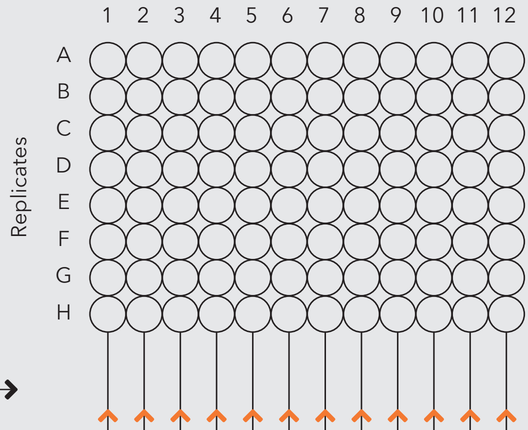




Select individual objects

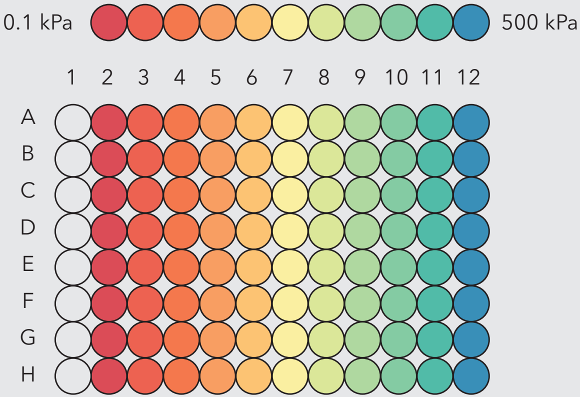
HIGH-THROUGHPUT WORKFLOW FOR HYDROGEL TESTING



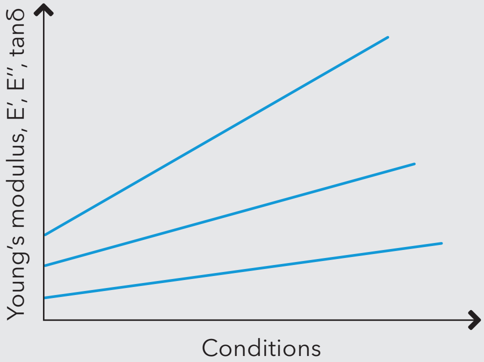


CONDITIONS

- Scaffold composition, density porosity
- Time: crosslinking, maturation, degradation
- Temperature, gas composition
- Growth factors
- Drug dosage
- Cell viability, type



Results of mechanical testing and correlations with conditions.



HIGH-THROUGHPUT WORKFLOW FOR
CELL OR SPHEROID TESTING

Microplate coating

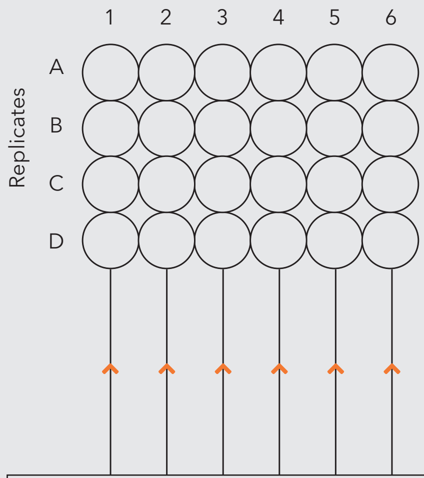
Cell seeding

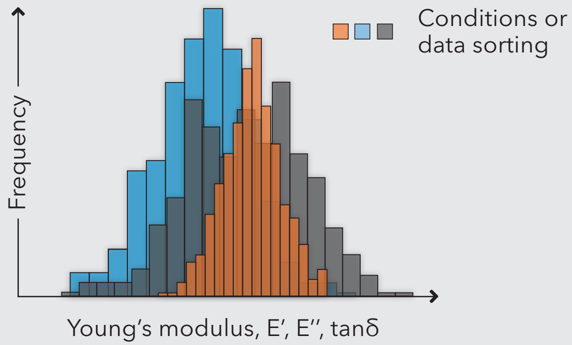
Incubation

Mechanical testing and imaging

Other bioassays and omics

Data analysis and correlations





CONDITIONS

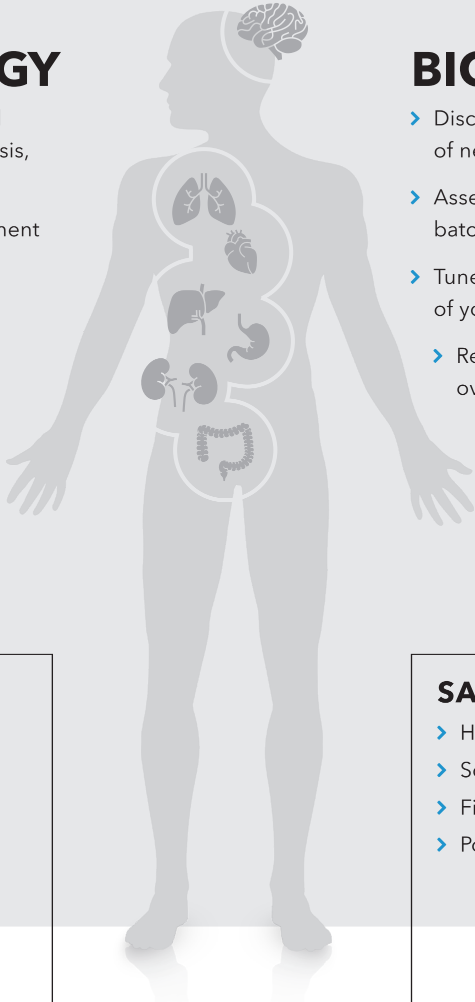
- Substrate: protein coating, gel
- Cell seeding density
- Time: proliferation, maturation, differentiation
- Growth factors
- Drug dosage

DATA SORTING BASED ON IMAGES

- Cell morphology/shape/size
- Cell density: single or monolayer
- Cell type: based on staining
- Indentation location: nucleus or cytoplasm

MECHANOBIOLOGY

- Engineer disease models with abnormal mechanical microenvironment e.g. fibrosis, cancer, inflammation.
- Mimic in vivo mechanical microenvironment (compare with native tissues).
- Assess mechanical phenotype of your cell culture.
- Mechanically characterized pathological tissues.
- Study effects of drugs to mechanical integrity of cells and tissue constructs.



BIOFABRICATION

- Discover mechanical implications of new biofabrication procedures.
- Assess reproducibility of your batch processing.
- Tune mechanical properties of your biomaterials.
- Report mechanical degradation over time.
- Characterize swelling behavior.
- Build mechanically relevant modular tissues.

SAMPLES:

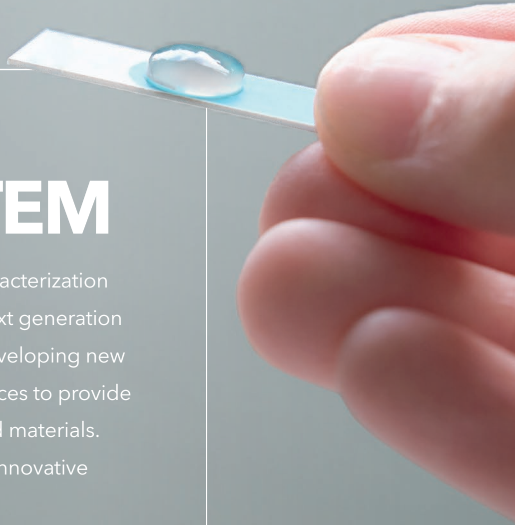
- Single cells and monolayers
- Spheroids and organoids
- Ex vivo tissues
- 3D cell culture models
- Embryos

SAMPLES:

- Hydrogels, gels, microgels
- Scaffolds, ECM
- Films, coatings
- Polymers

INVEST IN THE FUTURE:
MODULAR SYSTEM

Optics11Life is committed into delivering mechanical characterization instruments needed for development and validation of next generation 3D biomaterials. Therefore, our roadmap is focused on developing new modules to be combined with Pavone or stand-alone devices to provide control, sensing and monitoring solutions of biofabricated materials. Get in contact if you would like to collaborate in bringing innovative tools for bioengineering applications.



TECHNICAL SPECIFICATIONS

Imaging capabilities

Objective	Up to 60X, air, interchangeable
Focus	Motorized Z-travel 17 mm @ 5nm resolution
Compatibility	Bright-field and phase-contrast with digital switch and LED light source (standard)
CMOS camera	Fluorescence (optional)*
	Confocal (optional)*
	47 frames/s

Environmental control

Temperature control (standard)	Stage frame heating with T sensors (0.1 °C accuracy)
	Range: ambient from RT to 50 °C +/- 0.5 °C
	Humidity sensor
Incubation (optional, in development)	CO_2 control
	Humidity control
	Laminar flow hood compatible (70x70x70cm footprint)

Indentation capabilities

Probe force range	200 pN – 2 mN
Stiffness range	10 Pa – 1 GPa
Indentation stroke	Up to 100 μm @ 0.5 nm resolution
Tip size and geometry	3 μm – 250 μm, spherical
Contact size diameter	1 μm – 100 μm
Coarse X-Y stage travel	120 x 190 mm @ 50nm resolution (2 well plates)
Coarse Z stage travel	29 mm @ 2.5 nm resolution
Compatible formats	All common dishes/glass slide/well plates (up to 384 wells)
Minimum sample volume	>0.4 μL for 96-well plate (thickness 3 μm)
Indentation speed	Automated change between wells
	Automated mapping
	~2.5 hr per 96-well plate (~960 static indentations)
Single indentations	Click-and-go interface
	Coordinate list
Modes of interrogation	Quasi-static indentation (*E*, *G*)
	Step-response (Creep / Stress-Relaxation)
	Dynamic/oscillatory (DMA: *E′*, *E″*, *G′*, *G″*)
	Adhesion mode
Frequency range	0.01 – 20 Hz
Control modes	Load, depth, piezo-displacement, peak force
Test environments	Air or liquid (water, culture medium)

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