OPTICS11 life

Cuore

Measure strength in absolute numbers.

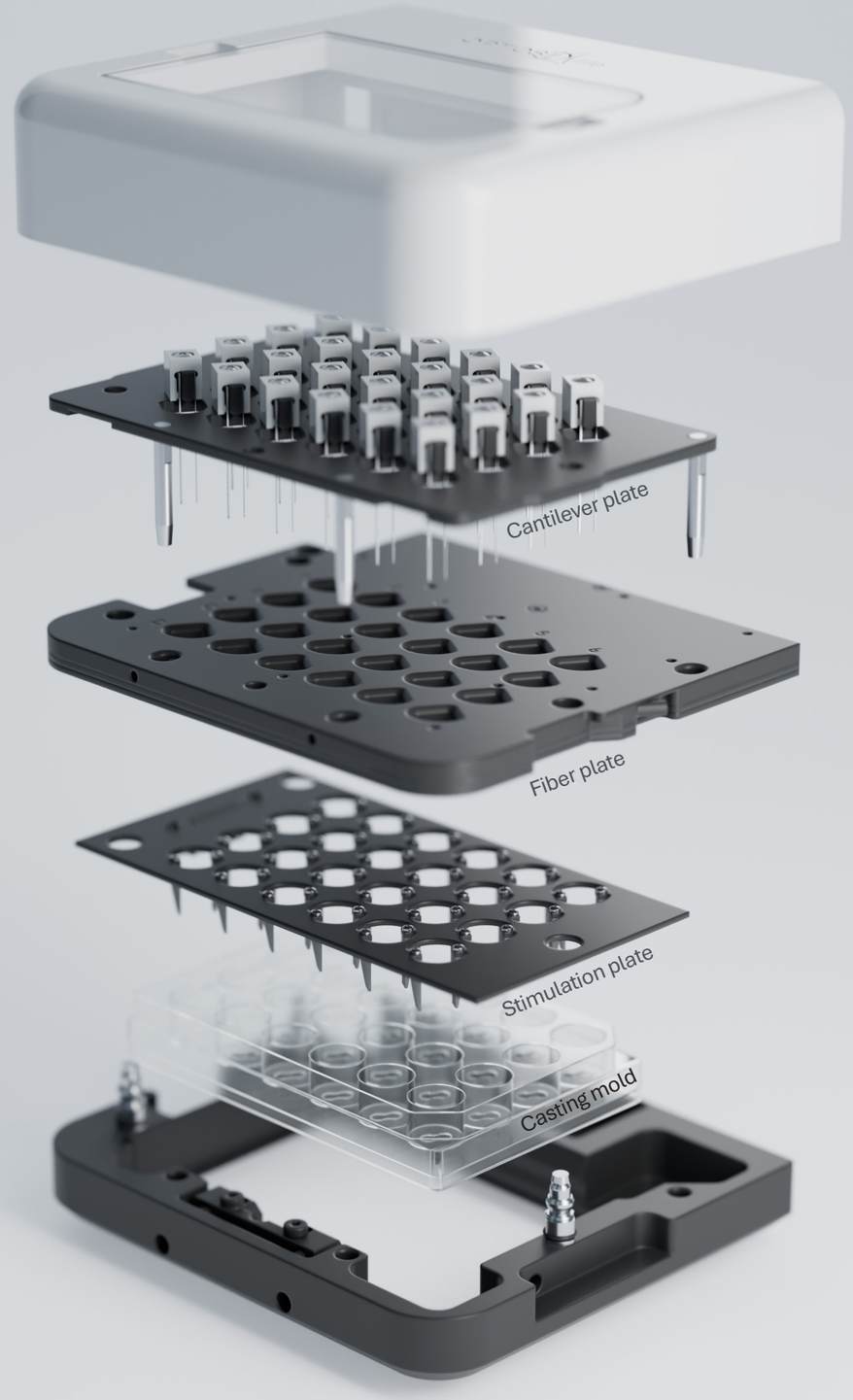


SCALABLE FUNCTIONAL DATA ON
HUMAN-RELEVANT 3D ENGINEERED MUSCLE TISSUE

Cuore offers

Cuore is an all-in-one platform for measuring muscle force with customizable electrical stimulation, providing valuable biological insights based on contraction dynamics. It stands out by providing:

- **High-sensitivity force detection:** optical interferometry enables fast, precise measurements of subtle changes in the force and contraction kinetics across all tissues.
- **Scalable platform:** the system supports expansion up to 4 culture devices (the smart lids), each able to hold 24 individual engineered muscle tissues.
- **Integrated electrical stimulation:** simultaneous pacing of up to 96 samples, for synchronized protocols tailored to your needs.
- **Validated and biology-ready:** validated protocols for the generation of engineered tissues with publicly available cell lines provide a shortcut to quickly kickstart your experiment.
- **Fully autoclavable:** all parts of the smart lids are cleanable and autoclavable for long-term experiments. High-quality consumables are re-usable up to 5 experimental cycles.
- **Incubator-compatible:** measurements and electrical stimulation are performed inside the incubator environment for physiologically relevant insights.



*Cantilever plate, stimulation plate, and casting mold are part of the consumable package.

At the heart of Cuore

Reliable and translatable models are essential to develop therapies for cardiovascular and skeletal muscle diseases. 3D cardiac, smooth, and skeletal tissue models **replicate the structure, architecture, and cellular interactions of human tissue**, and have the potential to **represent human physiology better than traditional 2D or animal models**[1].

Cuore's 3D in vitro model combines physiological complexity with ease of execution, enabling **translatable results** while maintaining **throughput and cost efficiency**.

The system's steel cantilevers provide high intrinsic mechanical load and prevent the shortcomings of PDMS pillar-based designs, such as slipping tissues or drug absorption.

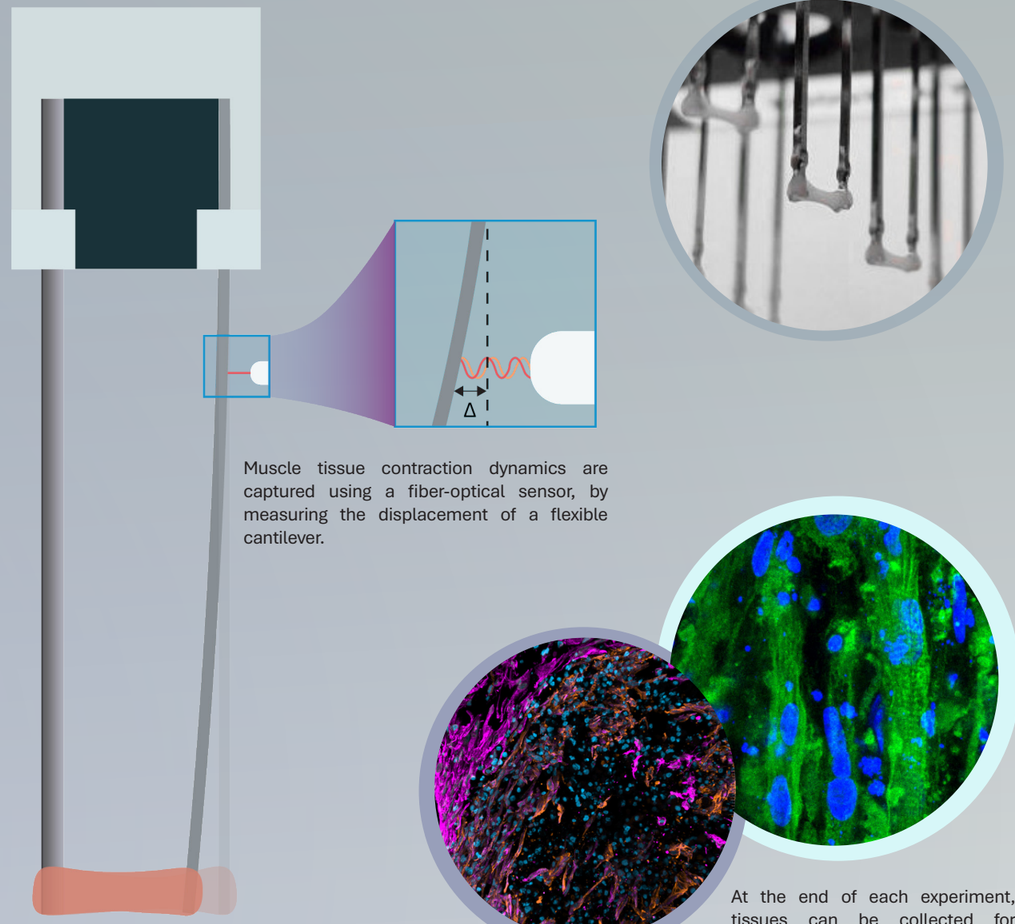
By enabling detailed insights into muscle contractility, Cuore's 3D models support a deeper understanding of disease mechanisms, enhance drug testing accuracy, facilitate biomarker discovery, reduce reliance on animal models, and advance personalized medicine.

[1] Cao & Warren, 2025, doi:10.3390/cells14120882



Our proprietary casting mold facilitates reproducible tissue formation.

Cell-gel mixture compacts around a pair of cantilevers, forming an engineered muscle tissue.



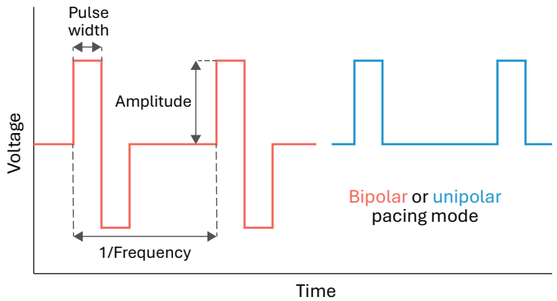
Muscle tissue contraction dynamics are captured using a fiber-optical sensor, by measuring the displacement of a flexible cantilever.

At the end of each experiment, tissues can be collected for downstream biochemical analysis.

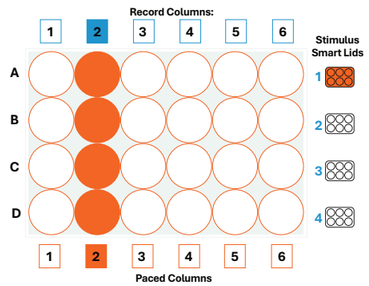
System capabilities

Tailored and automated measaments

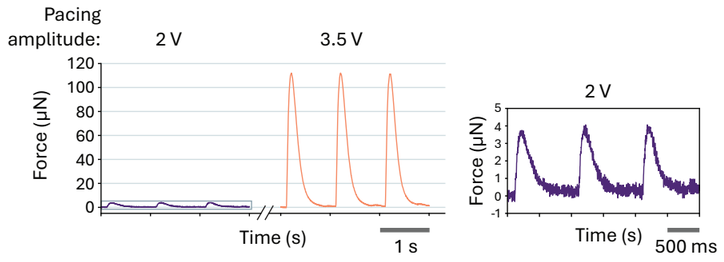
Cuore’s intuitive instrument control software provides real-time monitoring of muscle contractility for extended periods, without the need for hands-on intervention. Design and configure automated experiments, with or without electrical stimulation, and re-use protocols with ease, to quantify muscle function longitudinally in a reproducible manner.



Customize stimulation protocols: define voltage, pulse width and frequency, number of pulses, and total stimulation duration.

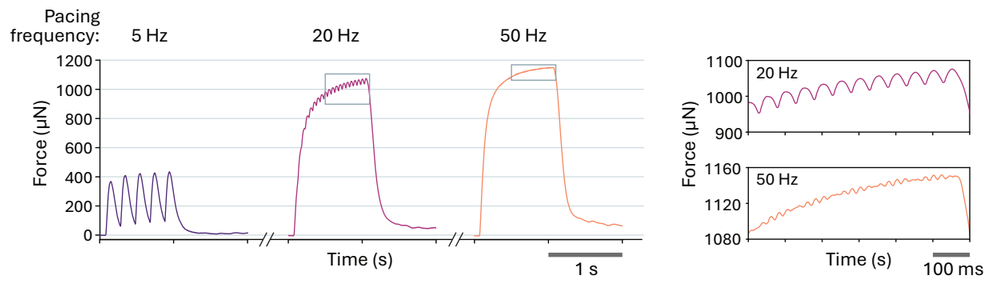


Record 4 wells and stimulate up to 96 wells simultaneously.



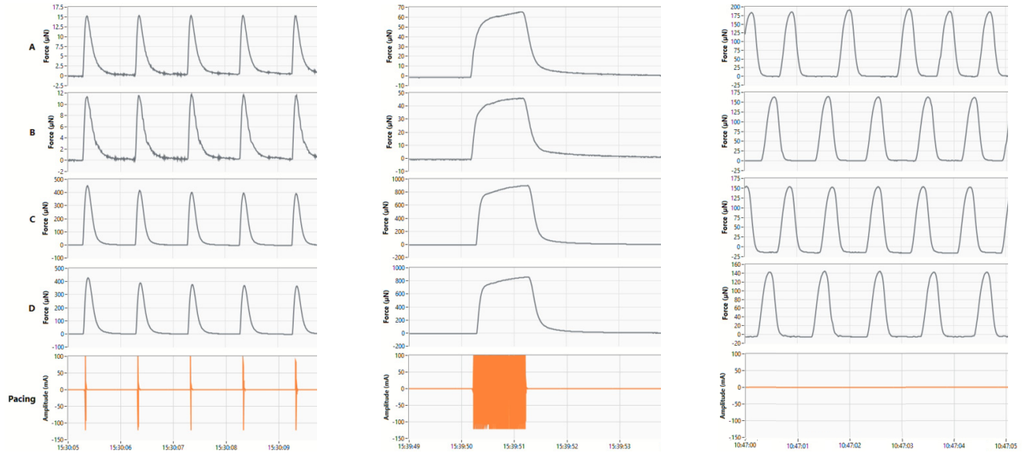
Stimulation parameters can be tuned to achieve optimal contractility response.

Cuore's high sentivity enables high-fidelity measurements already at low forces.



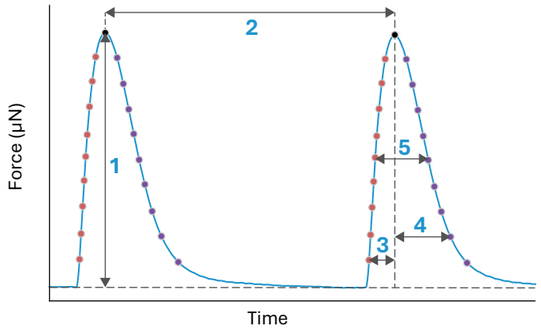
High sampling rate allows resolving minute force oscullations, for example, distinguishing summation from fused tetanus.

Direct and relevant insights



Instument control software allows real-time monitoring of tissues contraction. From left to right: electrically stimulated twitch and tetanic contractions of skeletal engineered muscle tisses; spontaneous contractions of cardiac muscle tissues.

Prova, our **data analysis** suite, enables seamless processing, visualization, and export of key insights. Your data is stored on-premise, and can be freely exported to Excel or CSV formats for further analysis.



Extracted parameters include:

1. Peak force
2. Frequency / period
3. Contraction time (at 10% force increments)
4. Relaxation time (at 10% force increments)
5. Peak widths at all phases of contraction

Prova allows for filtering on custom labels, wells, and stimulation settings, delivering detailed analysis on all contraction parameters*. Get data for individual contractions or as mean, median, and standard deviation for experimental groups.

*Basic analysis workflows are freely available. Advanced functionalities require a license.

Applications

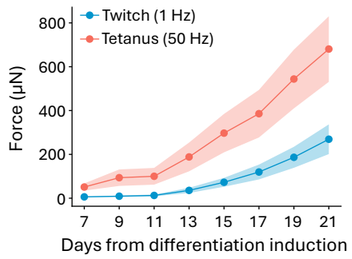
Cuore enables non-destructive monitoring of muscle contraction dynamics and has been used for skeletal, cardiac, and smooth muscle applications. Key applications include:

- **Drug development:** assess drug efficacy and safety for both acute and chronic conditions for early and better decision-making on therapeutic candidates.
- **Disease modeling:** reproduce muscle (patho)physiology using engineered muscle tissues from hiPSC-derived, immortalized, or primary muscle cells.
- **Muscle exercise:** investigate the effect of controlled stimulation on tissue maturation and compare response to exercise in healthy, diseased, and aging muscles.
- **Advanced tissue models:** increase model complexity by introducing additional cell types in the engineered muscle tissues. Add fibroblasts, endothelial, neural, or immune cells for more relevant models.

Cuore streamlines therapy development and accelerates translational research, supporting custom experimental designs for a broad range of therapeutic modalities.

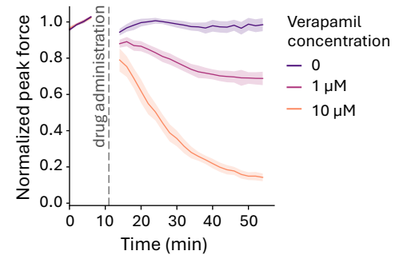
Skeletal muscle

Force evolution over time



Engineered skeletal muscle tissues respond to low- and high-frequency electrical stimulation with increasing contraction force as they mature.

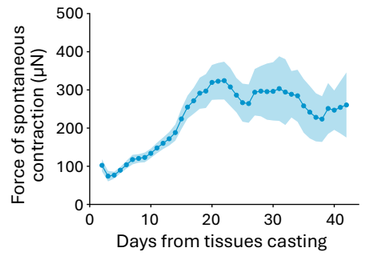
Drug effects



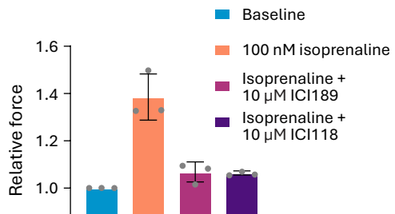
Addition of verapamil causes acute concentration-dependent decrease in contraction force.

Cells kindly provided by prof. Pijnappel at Department of Clinical Genetics, Erasmus University MC, Rotterdam.

Cardiac muscle



Engineered cardiac muscle tissues show increase in contraction force over multiple weeks.

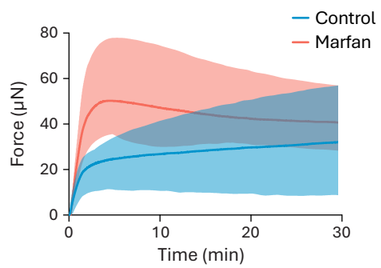


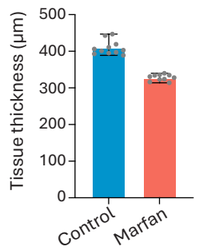
Isoprenaline-induced force increase is reverted by co-treatment with ICI189 or ICI118 (β_1- and β_2-adrenergic receptor antagonists).

Data kindly provided by the Zoccarato group at the School of Cardiovascular and Metabolic Medicine & Sciences, King's College London.

Smooth muscle

Disease modeling





Engineered smooth muscle tissues generated with cells from donors affected with Marfan syndrome show a stronger initial contraction in response to chemical stimulation but a more rapid force decline, as well as thinner morphology, compared to healthy controls.

Data kindly provided by the Schurgers group at Cardiovascular Research Institute Maastricht, Maastricht University.

Specifications

Unique fiber optics-based laser interferometry sensing

means no longer choosing between sensitivity and measurable force range.

Force range: 1 - 4200 µN

Sensitivity: 100 nN

Sampling speed: 1 - 15 kHz

High-stiffness cantilevers with optimized geometry

enable high yield of 3D muscle tissues and provide accurate force measurements with low variability.

Electrical stimulation

allows to pace and train skeletal and cardiac tissue.

Bipolar and unipolar pulses

Stimulation frequency: 0 - 100 Hz

Designed and validated for biological relevance

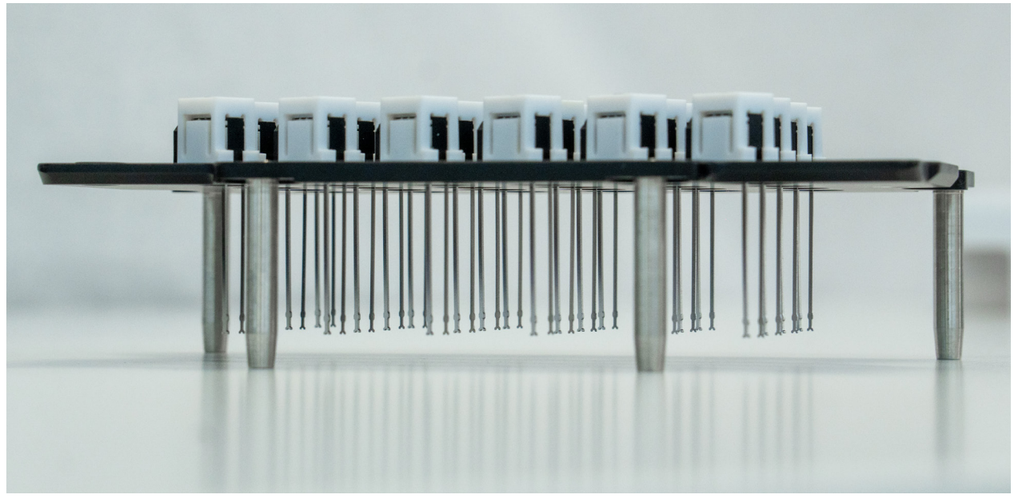
Validated protocols for engineered muscle tissues are available.

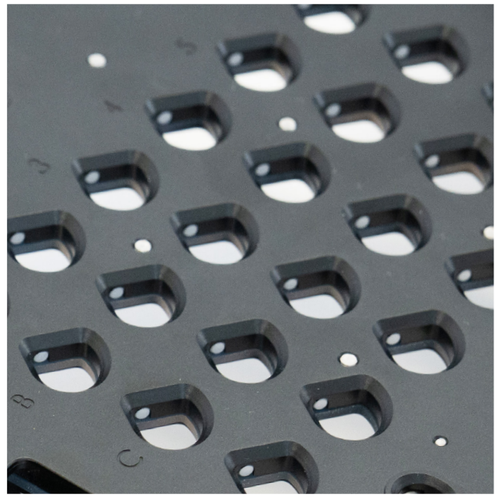
Cell amount: 500 - 750k / tissue

Fully autoclavable smart lid

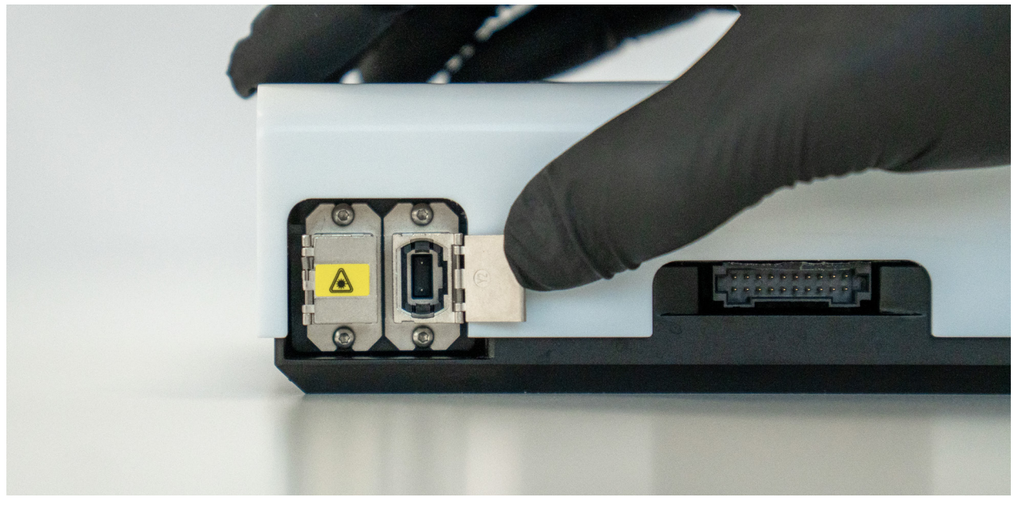
designed for long-term use inside the incubator.

Compact footprint: 17.5 x 15.3 x 5.2 cm









Platform layout

The Cuore muscle contractility platform includes the Optics11 Life's proprietary DeltaSens interferometer, a programmable electrical stimulation unit and a computer to control **up to 4 smart lids in parallel**. Each individual Cuore smart lid integrates force sensing and electrical stimulation for 24 tissues in a compact format.

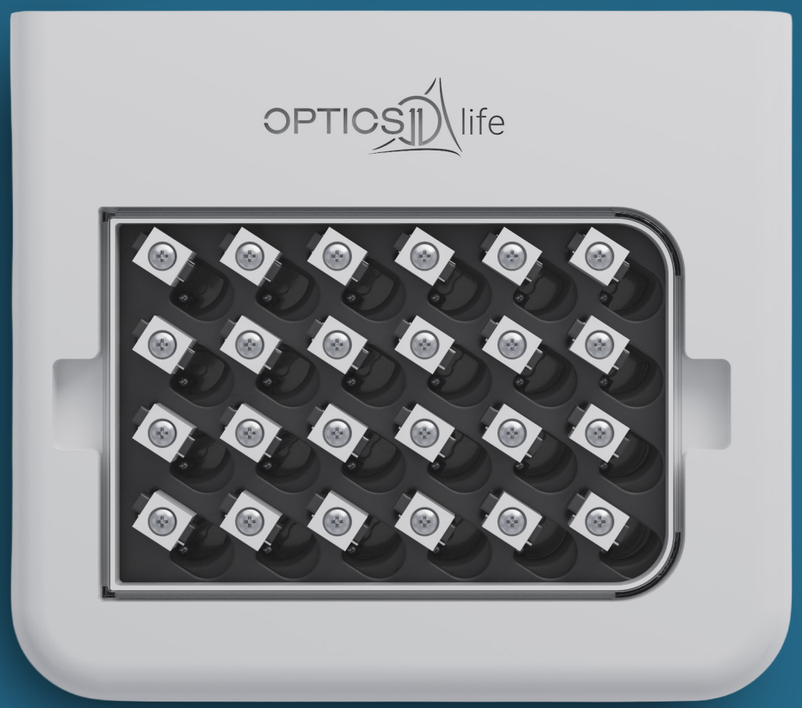
The controller software is user-friendly, allowing researchers to design experiments with live **contraction force monitoring** and customizable **electrical stimulation**.

Smart lids are **reusable** and **autoclave-compatible**. The included consumables can be used for up to 5 experimental and sterilization cycles.

Biological and technological expertise is provided during installation and trainings. The Cuore system comes with validated protocols to help researchers get started.

*Smart lids are connected via cables, not shown in illustration

What our users say



Dr. Giancarlo Forte

"My group focuses on pathological mechano-sensing and exploits advanced disease models to study it. I strongly believe Cuore might become a catalyst for new discoveries in the field. We currently use the setup to generate models of the diseased heart from hiPSCs and so far enjoyed its user friendly interface and its ability to monitor live muscle physiological parameters."

Prof. Dr. Leon Schurgers

"The Cuore serves as the foundational enabling technology within our research platform, now evolving from a cutting-edge research instrument into a clinically relevant system for high-fidelity functional vascular phenotyping. The Cuore consistently delivers robust, quantitative, and non-invasive contractile measurements in which we aim to closely mirror the clinical presentation, positioning it as a transformative tool for translational cardiovascular medicine."

Prof. Dr. Pim Pijnappel

"The optical fiber-based technology that Optics11 Life is applying for contractile force sensing of skeletal muscle-on-a-chip opens an entire next level at which basic, applied and clinical research will be performed."

Dr. Ludovico Buti

"While 3D tissue systems have made significant progress, functional assessment, especially contractile force measurement, remains a major bottleneck in both academic research and industrial drug development. Cuore directly addresses this gap by enabling non-invasive, real-time monitoring of contractile force. Their platform is compatible with long-term experiments and pharmacological testing. In our experience, it offers a level of functional insight that is complementary to other readouts to assess in vitro efficacy and safety of compounds."

Prof. Dr. Jolanda van der Velden

"Cuore is a wonderful, easy to use system to make stem cell-derived engineered heart preparations and continuously monitor contractility. I anticipate that we will be able to use Cuore for future high throughput studies testing effectiveness of compounds and metabolic stressors. As such the system will be key to better understand cellular pathomechanisms involved in heart disease".

Designed & **Made** in the Netherlands



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