Readily3D

Tomolite

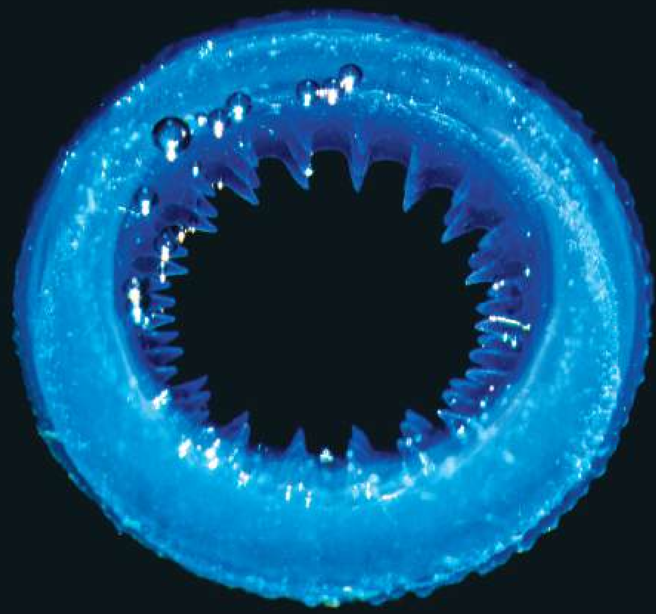
For rapid, contactless, high-viability tomographic bioprinting

What is volumetric bioprinting?

Volumetric tomographic 3D printing rapidly solidifies photosensitive inks in three dimensions, using shaped light beams from multiple angles. As the entire build volume is illuminated simultaneously, centimeter-scale biological systems are produced in just tens of seconds. After printing, the object is simply separated from the uncured ink and collected.

Our printing method is light-based, so it does not induce any shear stress on the printed cells. The remarkably low photoinitiator content (eg 1mg/mL LAP) and low light dose (<600 mJ/cm^2) make tomographic bioprinting a cell-friendly technique.

Tomolite
Complex living constructs shaped by light



Swiss-made bioprinters

We are Readily3D, we developed Tomolite and Apparite to make research in biosciences quicker and more efficient. Founded in 2020, Readily3D originates from a research work started in 2017 at EPFL in Lausanne, Switzerland.

The first generation of our 3D bioprinter, the Tomolite v1, was certified and commercialized in May 2021. The second generation, a modular volumetric bioprinter, the Tomolite v2 is certified and commercialized since September 2022.

Currently in use in dozens of laboratories around the world, our volumetric bioprinters led to ground-breaking research and publications in the Life Science community.

Tomolite 2.0

Readily bioprinted
Tomolite leverages our contactless tomographic illumination technology to shape sensitive cells and biomaterials into biological systems, without impairing their viability. Volumetric printing not only preserves cells but also makes research more efficient by simplifying design iterations and statistical studies.

Modularity and continuous upgrades
The Tomolite v2.0 can be readily used in any work environment since it is a class 1 laser product, accessible radiation is safe under all conditions of normal use. It accommodates different modules such as various laser sources and build volumes. Upgrades and new modules also fit onto this modular platform.

Benefits

Fast
Shape hydrogels in 30 seconds

Cell and organoid-friendly
Low light dose, high viability (>90%)

Optical resolution
Pixel size of 28 microns

Modular
Choose between a range of build volumes and wavelengths

Contamination-free
Print through sealed, autoclavable containers

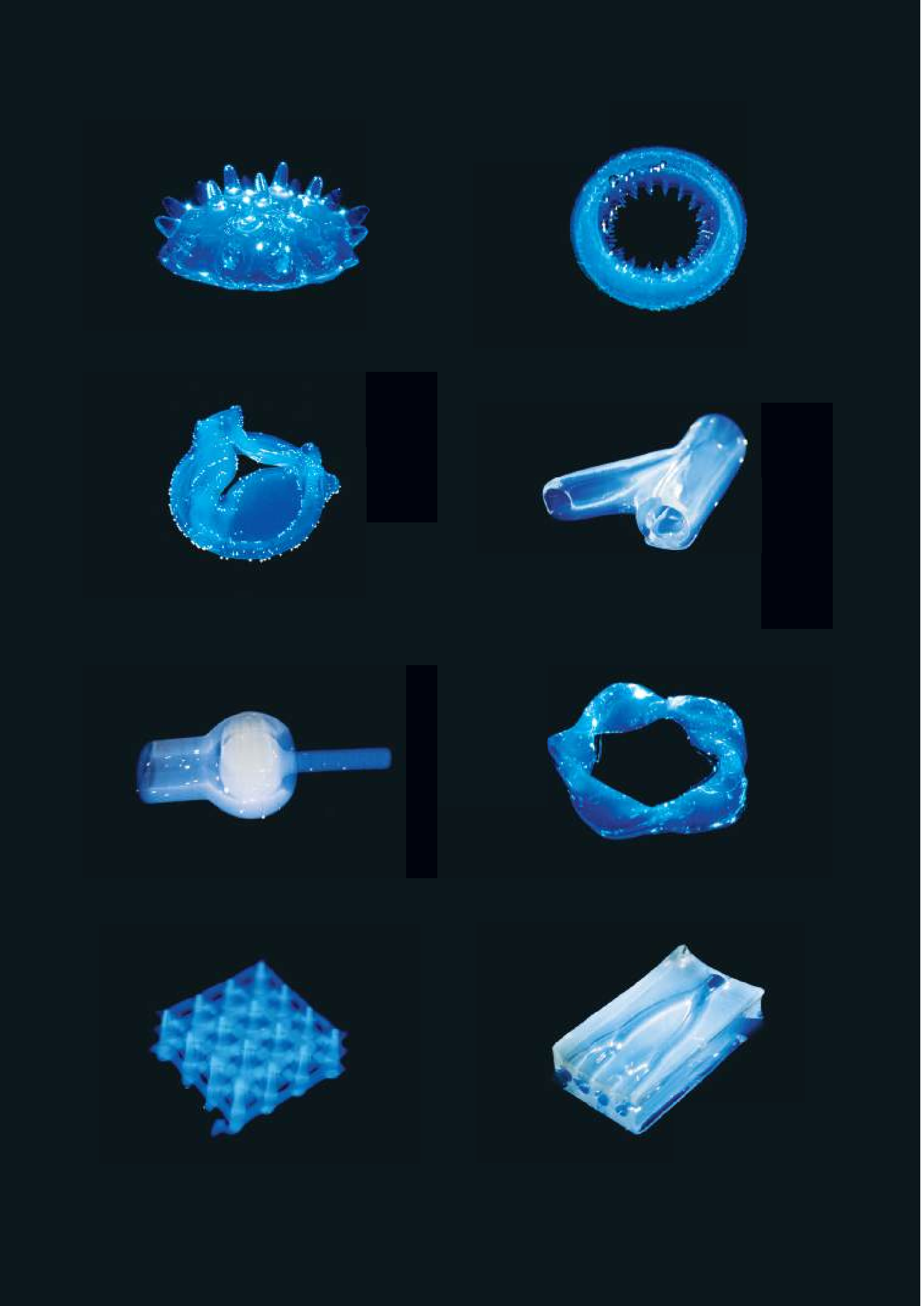
Design freedom
Easily print hollow, embedded or overhanging structures

Extrusion, DLP and Two-photon v.s. volumetric bioprinting

Extrusion	**Volumetric bioprinting**
Shear stress < 60% Viability	No shear stress Increased viability > 90%
Limited design freedom	Freeform, no support struts
Low-throughput < 0,1cm^3/min	High-throughput > 10cm^3/min

DLP	**Volumetric bioprinting**
Slow (< 0,5cm^3/min), large dose light Low viability	30s to 60s to print High viability > 90%
Limited design freedom, supports struts	Organic shapes with tunable porosity and vasculatures
Limited viscosity	Can process gels

Two-photon	**Volumetric bioprinting**
Limited depth (500µm), 2.5D	True 3D
Low-throughput < $10^{-7}cm^3$/min	High-throughput > 10cm^3/min



Tomolite v2.0

Specifications & models	Standard	Performance
Pixel size	14µm	28µm
Build diameter	up to 6.3mm	up to 12.5mm
Build height	≥ 12.5mm	≥ 25mm
Container diameter range	5mm - 10mm	5mm - 20mm
Wavelength*	405nm ± 5 nm	400nm ± 1 nm
Light intensity	1 to 60mW/cm^2 (average at container) ≥ 100mW/cm^2 (maximum peak intensity)	1 to 20mW/cm^2 (average at container) ≥ 45mW/cm^2 (maximum peak intensity)
Indicative print time	20s – 120s (depends on material)	
Container materials	Autoclavable and reusable glass vials	
Max. rotation speed	≥ 60°/s	
Compatible materials	hydrogels, acrylics and silicones	
External footprint	27cm x 30cm x 67cm	
Initial accessories kit	Precision chuck adaptor for vials Vial extraction tool	
Laser class	Class 1 laser product: accessible laser radiation is safe under all conditions of normal use. (IEC/EN 60825:1-2014 certifi ed)	

* other wavelengths available upon request

An organoid and cell-friendly bioprinter

Examples of organoid and cell types printed to date

	Type	Concentration	Viability	Construct size	Print time
1	Human hepatic organoids	5.10^6 cells/ml	> 95% after 10 days	Ø 6 mm × h 17 mm	15.5s
2	Human embryonic kidney cells (HEK 293)	4.10^6 cells/ml	—	Ø 8.1 mm × h 9 mm	36s
3	Mouse myoblasts (C2C12)	10^6 cells/ml	> 90% after 7 days	Ø 7 mm × h 15 mm	10 – 11s
4	Normal human dermal fibroblasts (NHDF)	10^6 cells/ml	> 90% after 7 days	13 mm × 6.0 mm × 2.6 mm	11.4s
5	Equine mesenchymal stromal cells (MSCs)	10^6 cells/ml	—	Ø 8.5 mm × h 9.3 mm	12.5s
6	Equine articular chondroprogenitor cells (ACPCs)	10^7 cells/ml	> 85% after 7 days	Ø 5.0 mm × h 1.0 mm	—

Publications

1 Bernal et al. "Volumetric Bioprinting of Organoids and Optically Tuned Hydrogels to Build Liver-Like Metabolic Biofactories", Advanced Materials (2022)

2 Madrid-Wolff et al., "Controlling Light in Scattering Materials for Volumetric Additive Manufacturing", Advanced Science (2022)

3,4 Rizzo et al., "Optimized Photoclick (Bio)Resins for Fast Volumetric Bioprinting", Advanced Materials (2021)

5,6 Bernal et al., "Volumetric Bioprinting of Complex Living-Tissue Constructs within Seconds", Advanced Materials (2019)

Publications

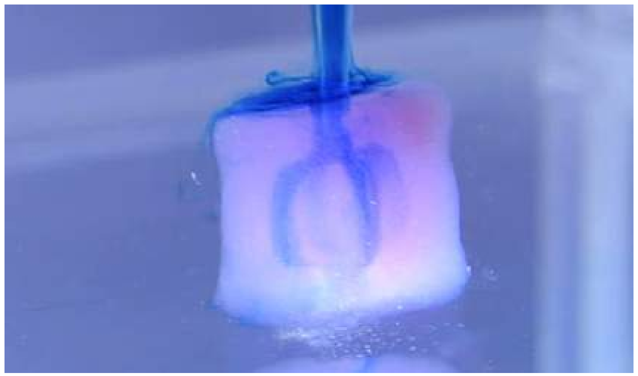
Volumetric Bioprinting of Organoids and Optically Tuned Hydrogels to Build Liver-Like Metabolic Biofactories
Bernal, P. et al., 2022
DOI: 10.1002/adma.202110054

Tomographic volumetric bioprinting of heterocellular bone-like tissues in seconds
Gehlen, J. et al., 2022
DOI: 10.1016/j.actbio.2022.06.020

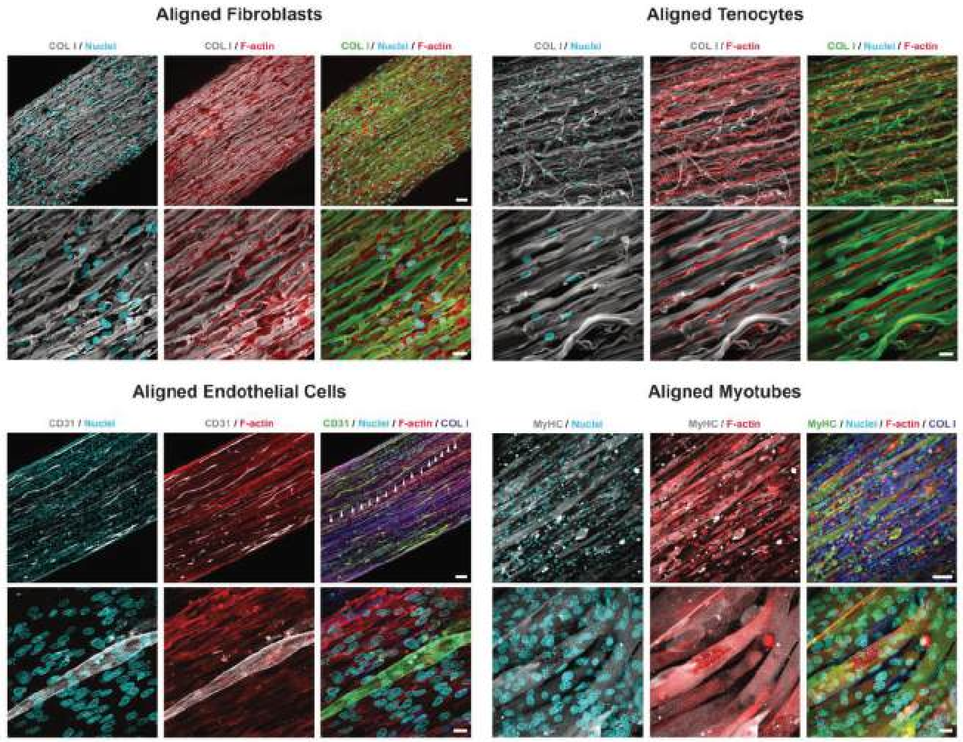
Optimized Photoclick (Bio)Resins for Fast Volumetric Bioprinting
Rizzo, R. et al., 2021
DOI: 10.1002/adma.202102900

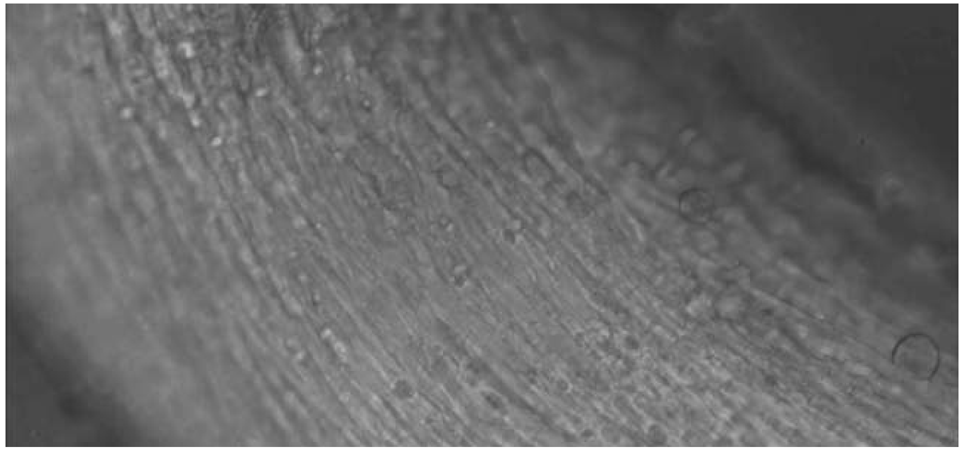
Filamented Light (FLight) biofabrication of highly aligned tissue-engineered constructs
Liu, H. et al, 2022
DOI: 10.1002/adma.202204301

Volumetric Bioprinting of Complex Living-Tissue Constructs within Seconds
Bernal, P. et al., 2019
DOI: 10.1002/adma.201904209



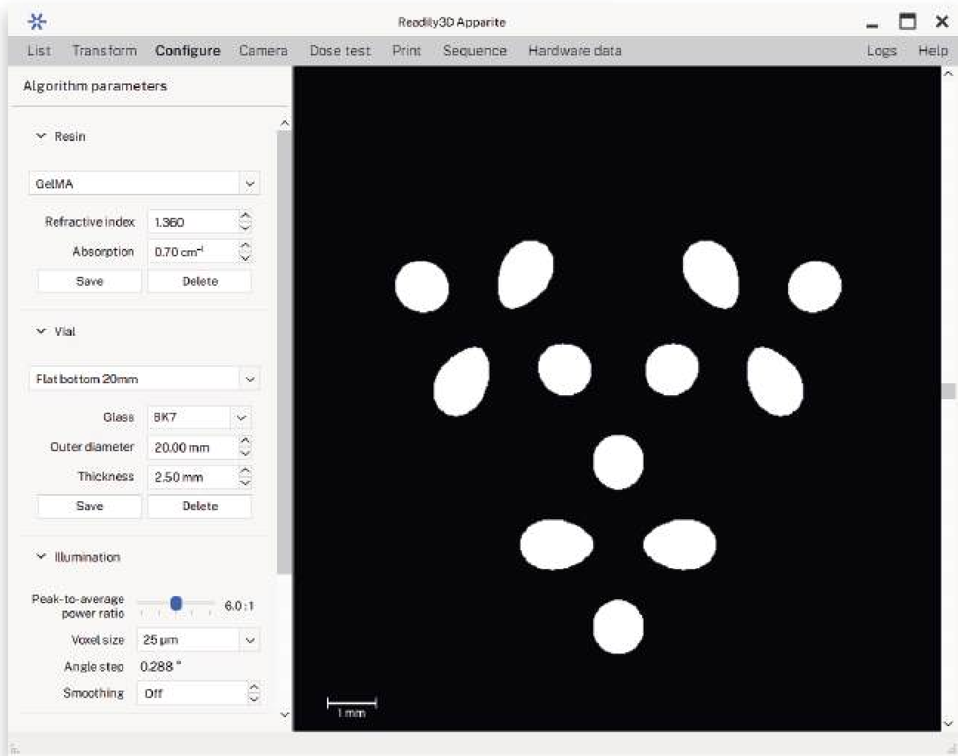
Adapted from Madrid-Wolff et al., Controlling Light in Scattering Materials for Volumetric Additive Manufacturing, Adv. Sci., 2022, License: CC BY 4.0 DEED -https://creativecommons.org/licenses/by/4.0





Adapted from Liu et al., Filamented Light (FLight) Biofabrication of Highly Aligned Tissue-Engineered Constructs, Adv. Mat., 2022, License: CC BY 4.0 DEED -https://creativecommons.org/licenses/by/4.0

Apparite
Rapidly configure and launch your 3D bioprint

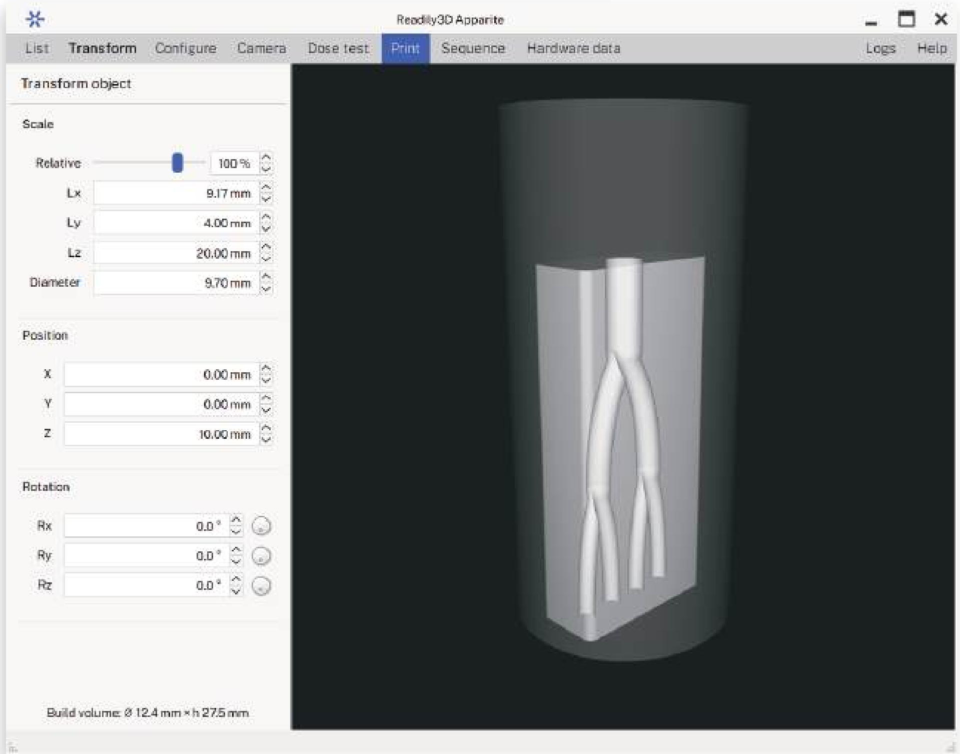


Load, Preview, Print.

Apparite facilitates the preparation of a print while giving users full control over the process parameters. In a few clicks, import the STL geometry of your constructs, configure the material properties and preview the computed light dose distribution.

Specifications

3D object format	STL
Multi-object printing	Supported
Transformations	Position Rotation Scaling
Beam computation time	Approximately 30s-90s (cloud-accelerated)
Print parameters	Dose Intensity Exposure time Print speed Number of rotations Projection rate
Computation parameters	Voxel size Angular step Dose contrast Resin compensation
Build volume monitoring	Live camera feed
Print log	Automatic
Dose estimation	Preview of dose distribution before printing Dose test procedure (with small volume of ink)
Supported operating system	Windows 10 and 11



Contact us
Let’s work together

Learn more
www.readily3d.com

Email
contact@readily3d.com

Contact address
Readily3D SA
EPFL Innovation Park
CH–1015 Lausanne

CRN
CHE-261.606.782