Vital 3D Technologies

3D Bioprinting: challenges of the technology

What needs to be done to print full size kidney?

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Topics discussed:

1. Intro into company and vision
2. Technological challenge in bio-printing
3. FemtoBrush technology as a solution
4. Partnerships

Company

Mission: technology for 3D printing of human organs (kidney)

Founded: November 30, 2021

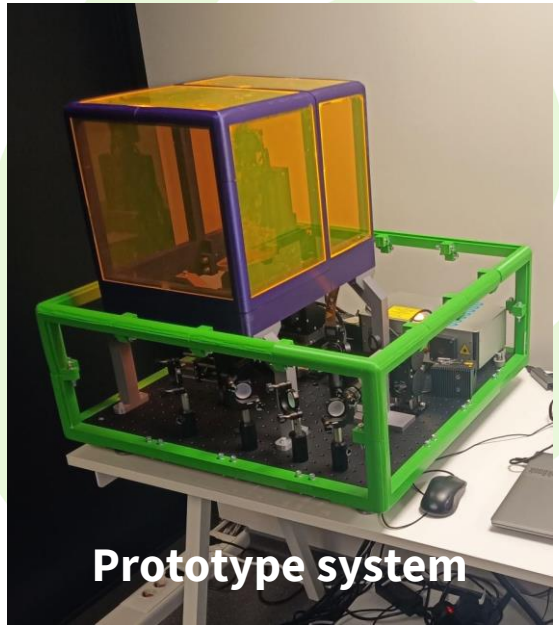
Number of employes: 8

Investment raised: 2 MEUR

Patents: 3 pending

Products: worlds fastest bioprinter Vital Light 3D

Services: R&D of medical devices (stents, micro-fluidics, lab-on-chips, organoids)

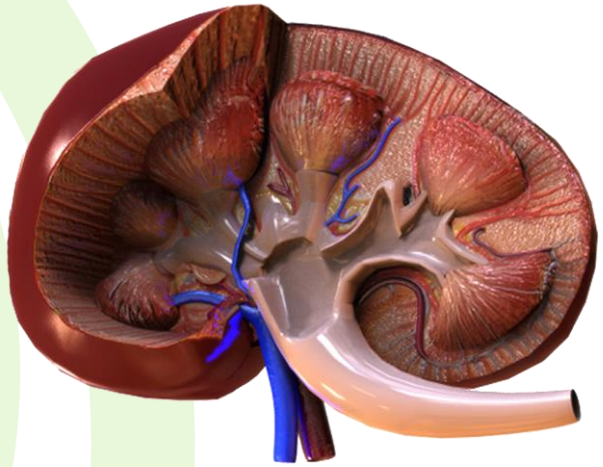

Prototype system

Commercial system

Vision

To be **3D bio-printing** technology leader in personalized medicine providing services and tools for **personalized patient therapies**, including printing natural size vital **human organs** with a **complex vascular system.**

Developing world's **fastest** technology to enable printing full size **kidney in 24 hours**.

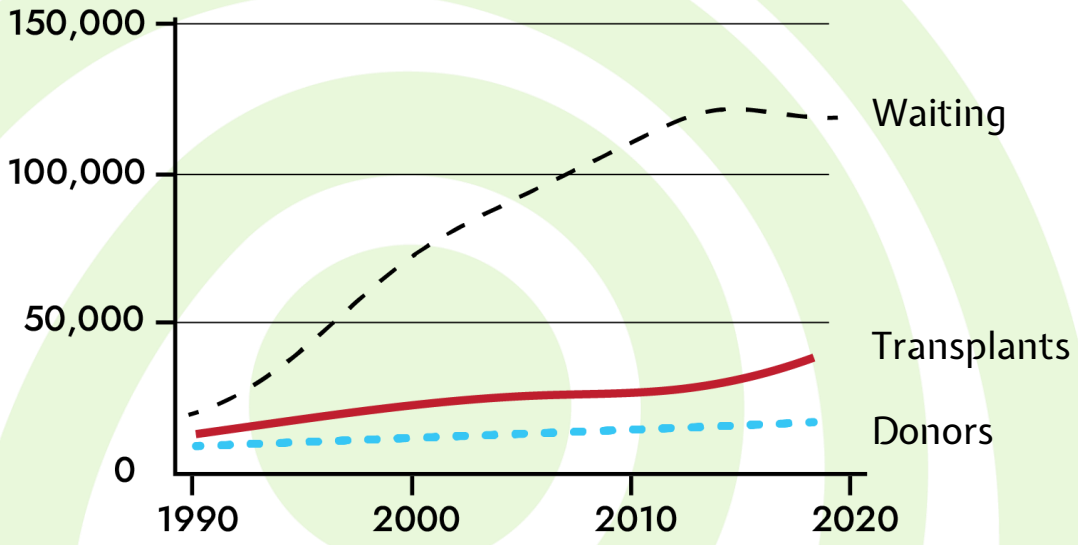


Cooperating with world leading institutions to create **advanced dense tissue 3D printing** processes.

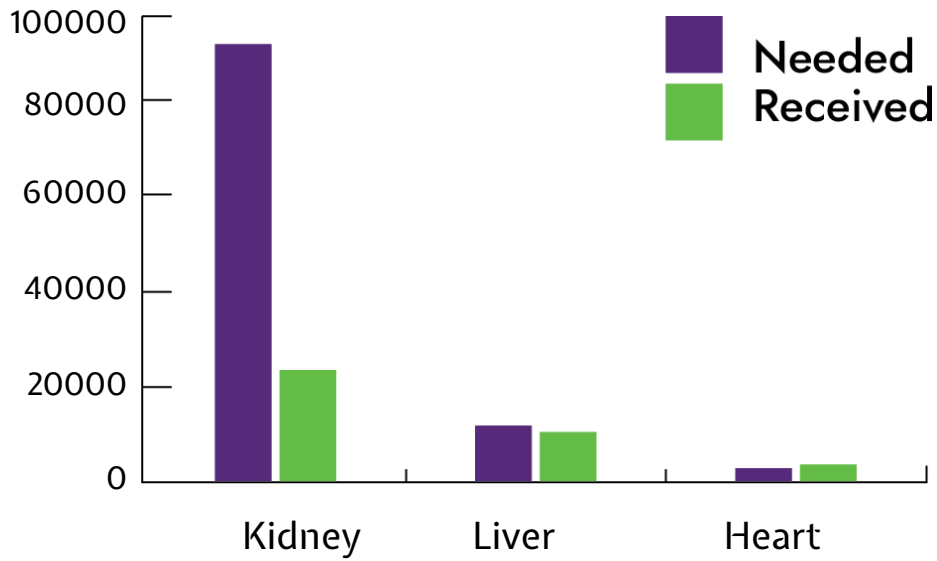
Enable wider usage of **personalized medicine** by introducing 3D printing technology to the hospitals.

Problem

The growing shortage of organs (USA)



Yearly demand for transplantations (USA)



- China's transplantation list contains 1.5 million names;
- 20 people die each day awaiting a transplant in USA;
- 10 000 operations a year, WHO estimate of black market for illegal transplants.

Bio-printing: a promising solution

1989 — Concept of bio-printing demonstrated.

1999 — First artificial organ printed with scaffold.

2002 — Miniature, fully functional kidney printed.

2004 — Demonstration of printing live human cells.

2009 — First biodegradable blood vessel without a scaffold.

2019 — First promising rabbit-sized printed heart.

Key market drivers:

1. **Organ transplantation shortage** leads to long waiting lists and significant mortality rates;
2. Rise of **personalized medicine** has the potential to revolutionize medical treatments by tailoring therapies to specific patients;
3. **Ethical concerns about animal testing** leads to use of bioprinting for alternative to animal testing;
4. Increasing **prevalence of chronic diseases**, such as diabetes and cardiovascular diseases, has created a higher demand for tissue and organ replacements.

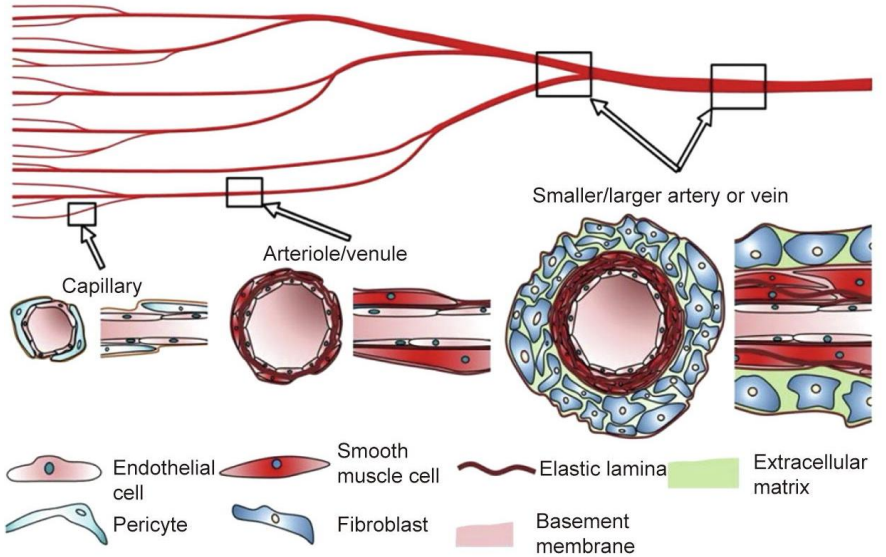
Technological challenge

To print **full sized** human organ (like kidney) printing technology combining **fine precision** and **high printing speed** is needed.

The total length of the blood vessels in the human kidney is estimated to be around **100 to 150 kilometers in length**. This is a substantial length, which highlights the extensive vascularization required to support the kidney's vital functions in filtering blood and producing urine.

State of the art bio-printing technologies currently are **either fast or precise**. To print full-size kidney **both** properties are needed.

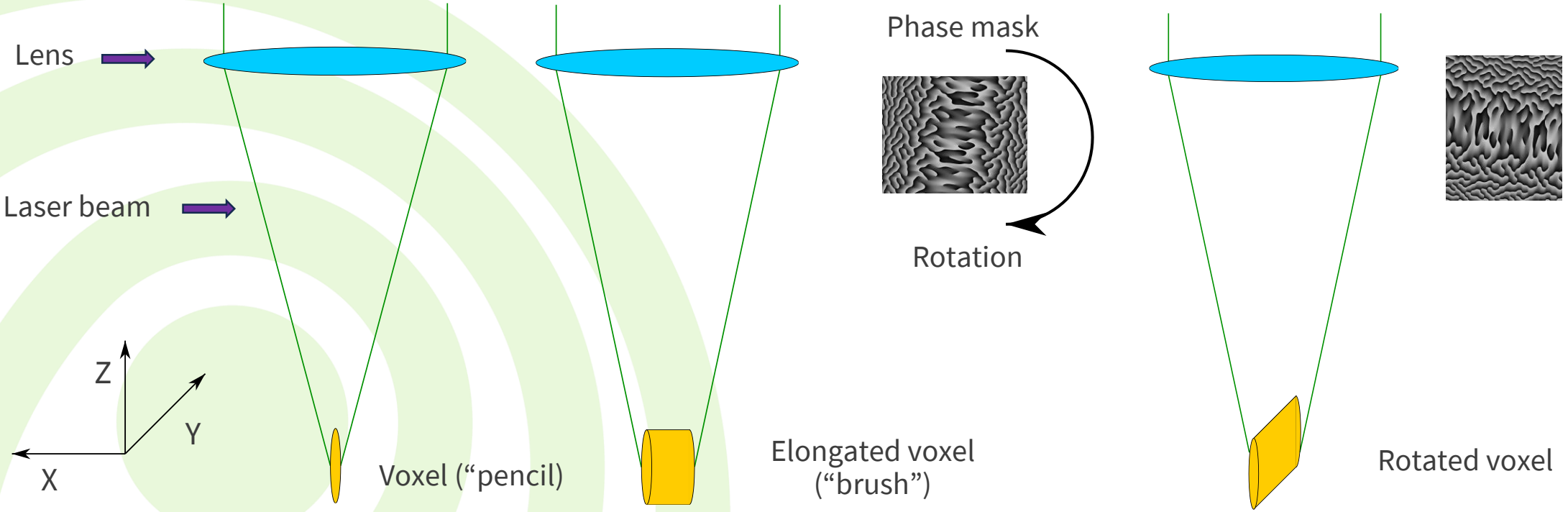
Smallest blood vessels of human organs require printing precision of **1 micron.**



	Diameter	Wall thickness
Artery	0.1–10.0 mm	1.0 mm
Arteriole	10–100 µm	6.0 µm
Capillary	4–10 µm	0.5 µm
Venule	10–100 µm	1.0 µm
Vein	0.1–100.0 mm	0.5 mm

Bioprinting Vasculature: Materials, Cells and Emergent Techniques, https://doi.org/10.3390/ma12172701

Our solution - FemtoBrush

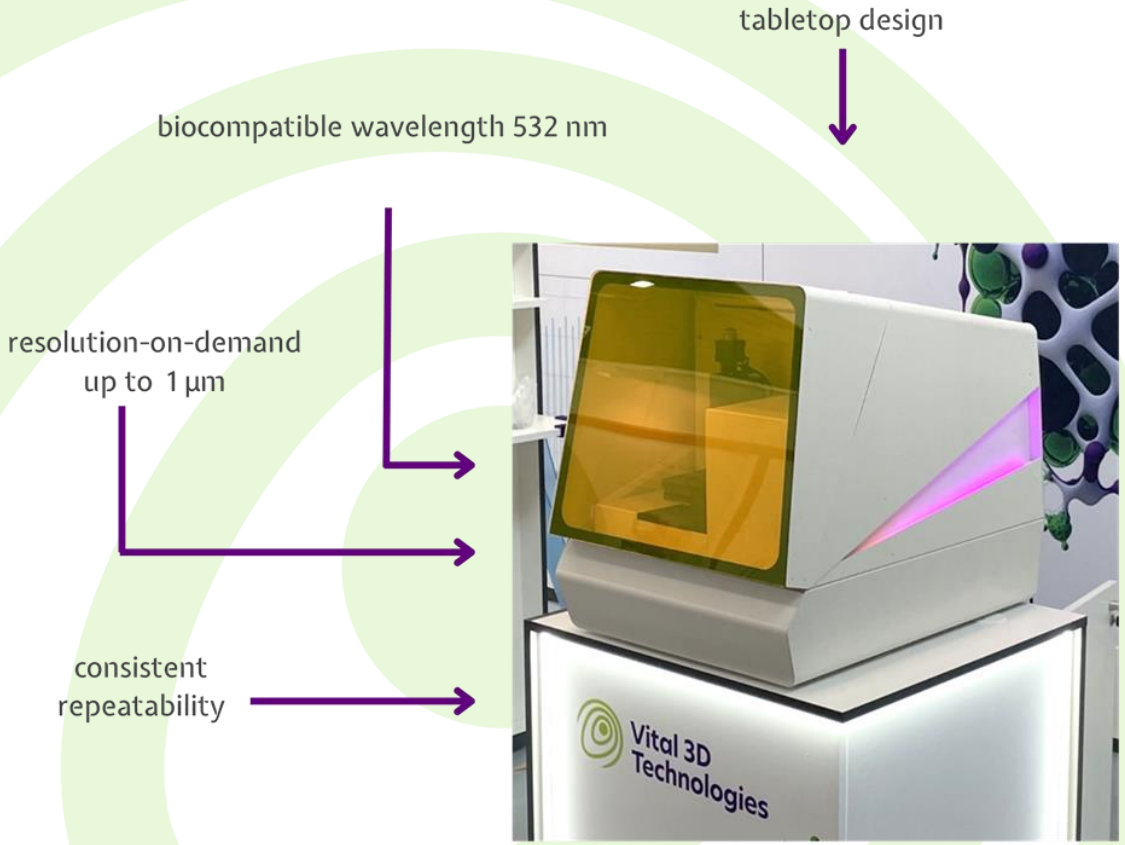


- **FemtoBrush -** 3D printing with dynamically adjusted laser beam shape.
- Spatial Light Modulator works to **reshape and rotate voxel in 3D in real time**.
- Printing with a “brush” or “pencil” on-demand achieving **high printing speeds with 1µ precision**.

Vital Light 3D

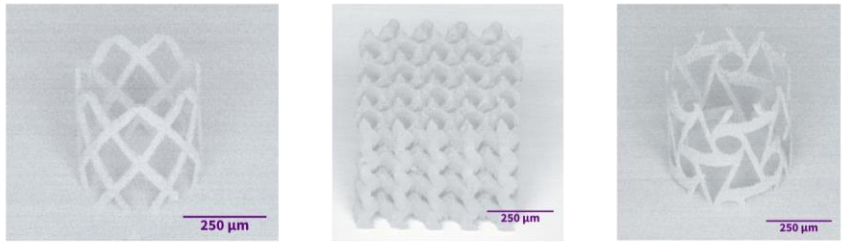
Vital Light 3D bio-printer is based on unique 3D printing technology **FemtoBrush**.

There are **3 patents pending** for this technology.



Wavelength	532 nm
Size	Tabletop, 60 x 60 x 70 cm
Build volume	50 mm x 50 mm x 100 mm
Type of technology	Two Photon Polymerization (2PP) Stereolithography
Feature size	XY - ~1 µm, Z - ~5 µm

Technology stands out due to its extraordinary printing efficiency thanks to **resolution-on-demand** capability. This makes Vital Light 3D **the fastest bio-printer** in the market with printable feature size down to ~1 µm.



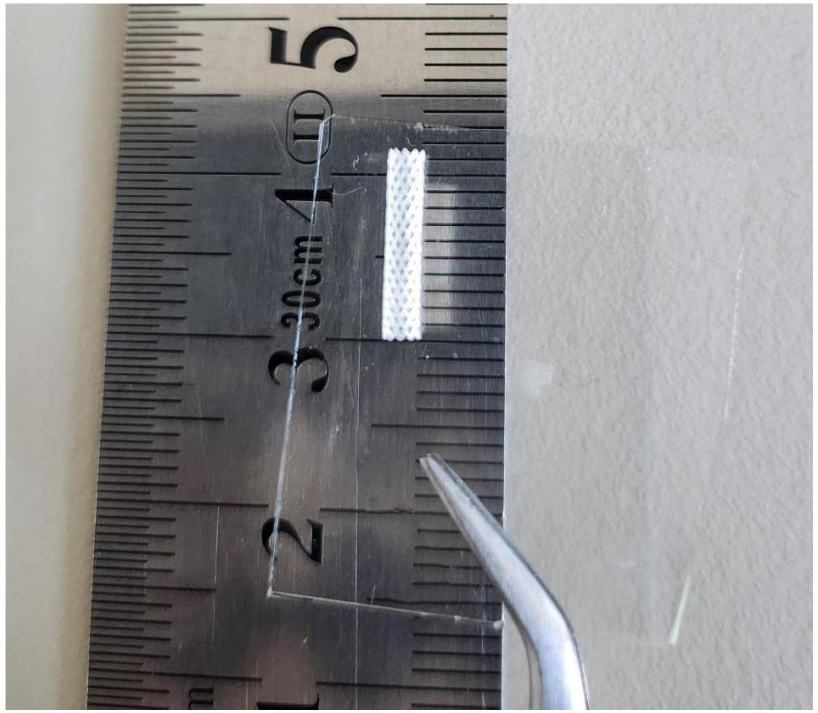
Looking for partnerships

1. Joint development of improved **artificial kidney/dialysis machines filtering technology**.

2. Joint development of **thick tissue models** incorporating **dense vascular systems**.

3. Joint development of **photosensitive printing materials** for advanced bio-printing techniques.

4. Joint development of **micro-medical devices with advanced capabilities** – stents with integrated sensors, 3D micro-fluidic chips, Organ-On-Chip.



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Let's build personalized medicine together!