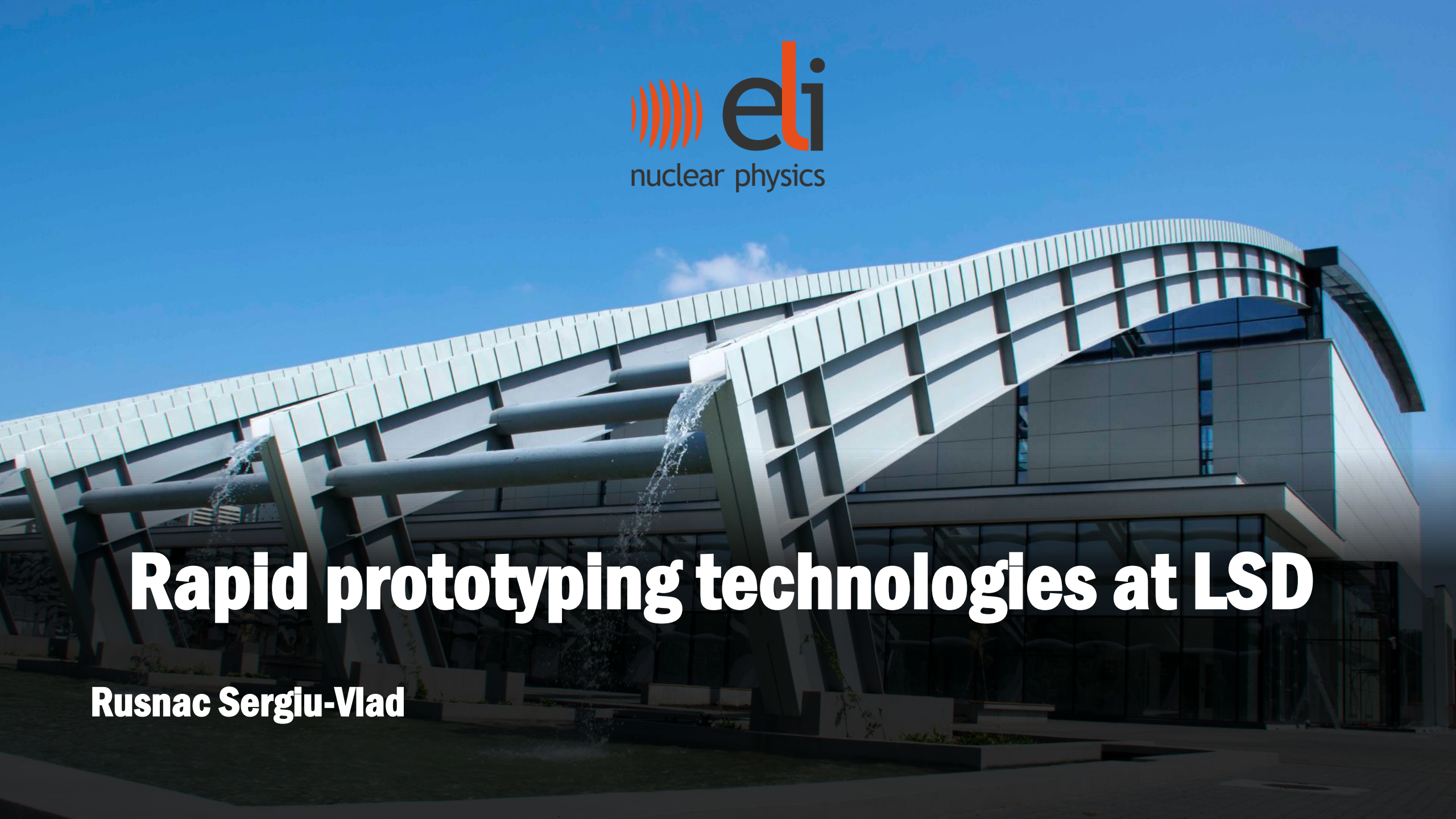


Rapid prototyping technologies at LSD

Rusnac Sergiu-Vlad

Why do we need

Accelerated Development Timeline

Customized and Complex Components

Cost-Effective Testing

Flexibility and Adaptability

In-House Prototyping Capability

Innovation and Exploration

Vacuum compatible materials

Design Iteration and Optimization

Iterative Experimentation

Types of rapid prototyping available

Fused Deposition Modeling (FDM) – Markforged Mark Two

FDM is an additive manufacturing process that involves the layer-by-layer deposition of thermoplastic material.

A filament of thermoplastic material is heated and extruded through a nozzle. The material is then deposited layer by layer to create the final object.

FDM supports a variety of thermoplastic materials, including PLA, ABS, PETG, and more.

FDM printers typically have good accuracy and resolution, but the surface finish may not be as smooth as some other technologies.

Types of rapid prototyping available

Fused Deposition Modeling

PolyJet

PolyJet Technology - Objet30Pro V5

PolyJet is a 3D printing technology developed by Stratasys that uses liquid photopolymer resins.

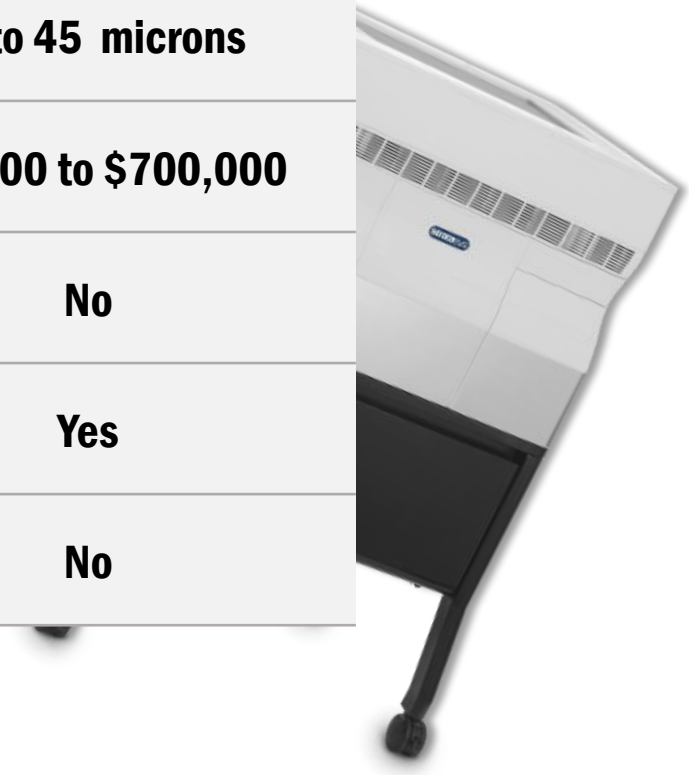
The printer jets tiny droplets of liquid material onto a build tray. These droplets are then cured using UV light, layer by layer.

PolyJet supports a wide range of materials with different properties, including rigid, flexible, transparent, and multi-material options.

PolyJet technology is known for its high level of accuracy and resolution. It can produce parts with fine details and smooth surfaces.

Key differences between FDM and PolyJet

Attribute	FDM	PolyJet
Material costs	$10/kg to $50/kg	$200/kg to $500/kg
Max print resolution	50 to 500 microns	16 to 45 microns
Capital cost	$50 to $250,000	$19,000 to $700,000
Can be easily maintained	Yes	No
Capable of printing fine details	No	Yes
Less wastage of materials	Yes	No



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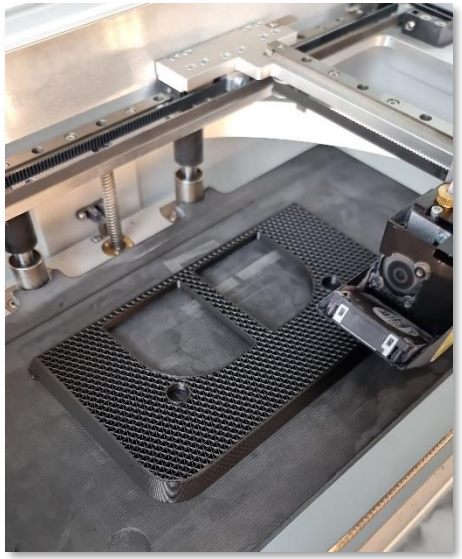
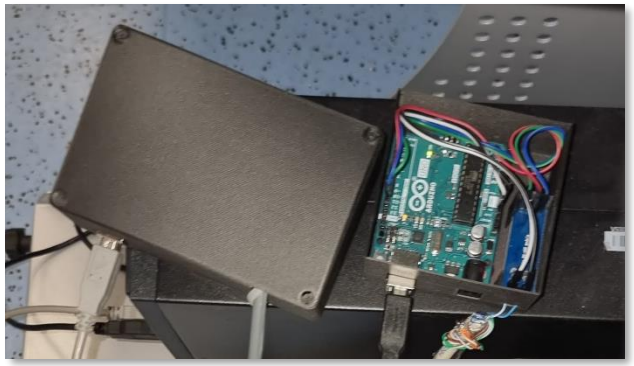
Carbon fiber composite 3D printer – Continuous Fiber Reinforcement (CFR) process

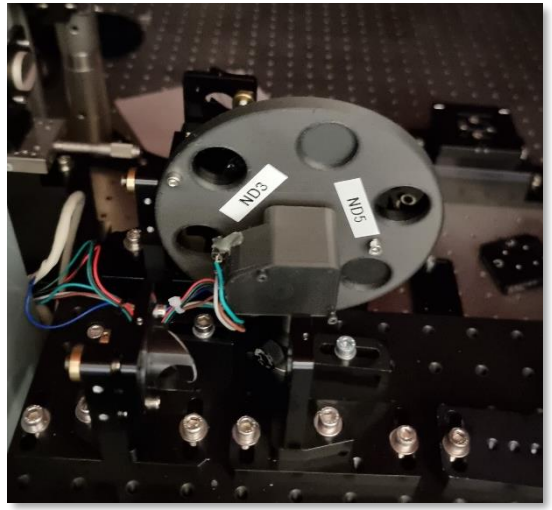
Layer Resolution – 100 µm - 200 µm

Build Volume – 320 x132 x154 mm

Compatible Materials – Onyx, Carbon fiber, Fiberglass, Nylon etc.







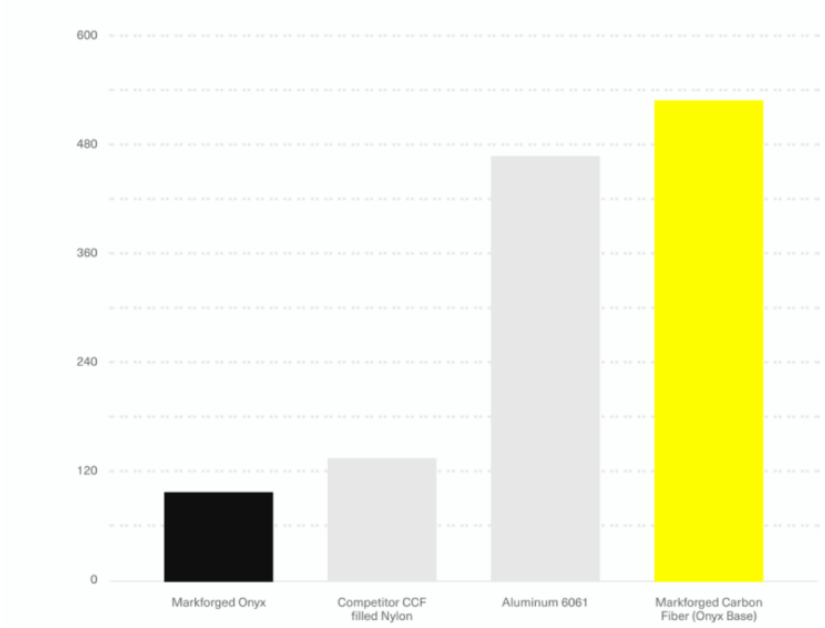
Onyx and Carbon fiber

- micro carbon fiber filled nylon
- it offers high strength, toughness, and chemical resistance
- can be reinforced with Continuous Fibers to yield aluminum-strength parts

Flexural Strength

540 MPa

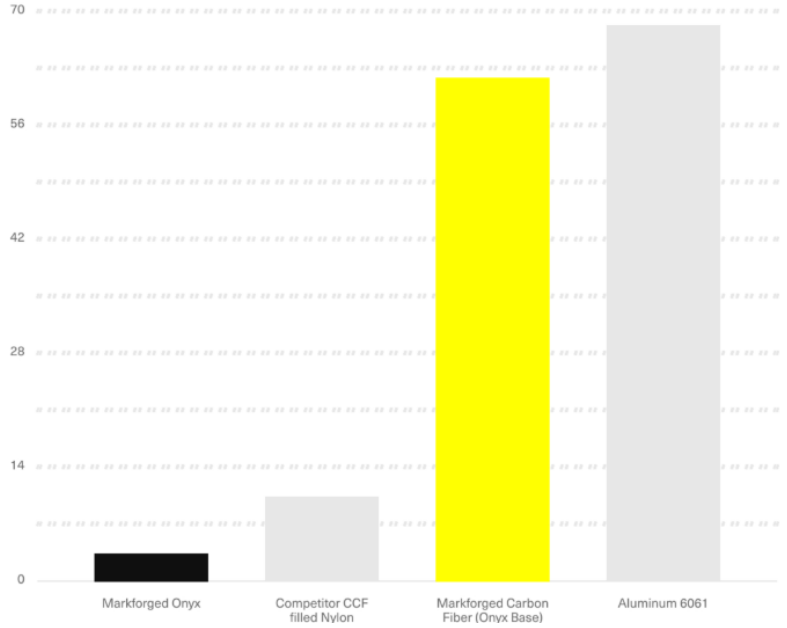
Carbon Fiber Reinforced



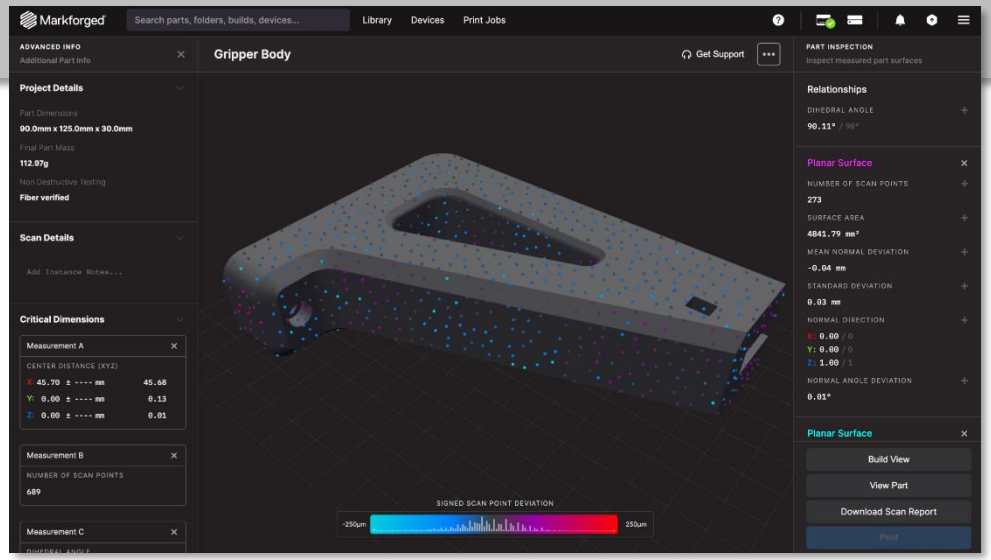
Flexural Stiffness

60 GPa

Carbon Fiber Reinforced

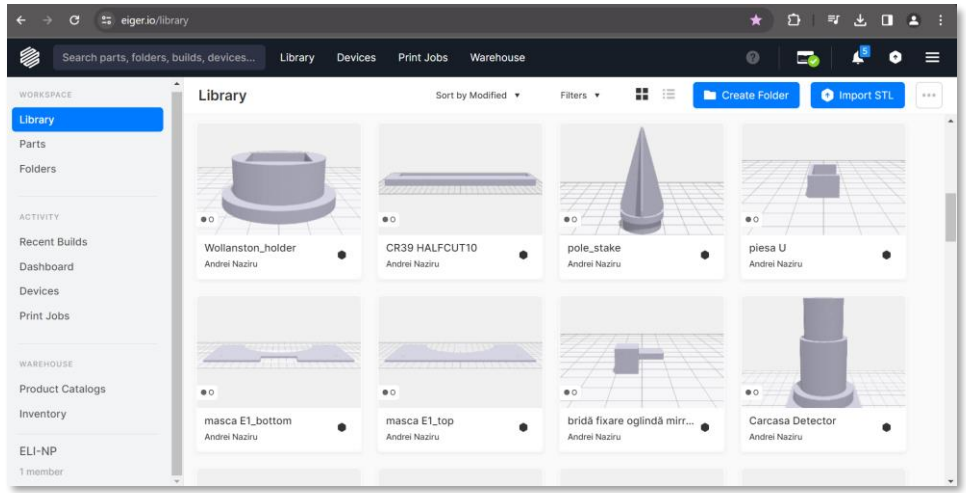


Software (Eiger)



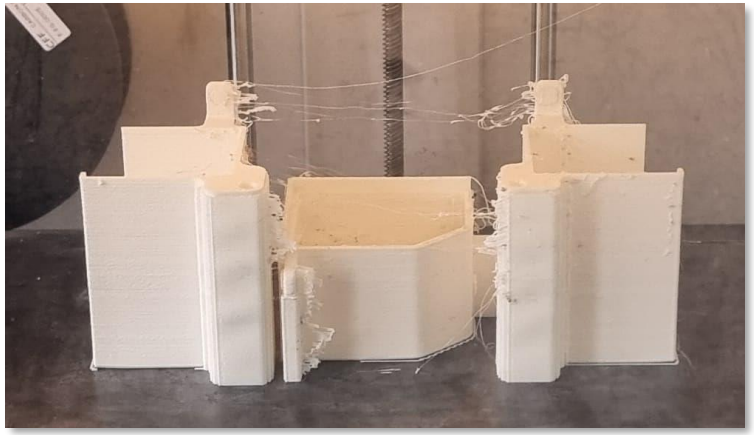
- wide variety of materials
- browser-based software
- easy to use

- capable of slicing, scaling, orientating and filling designs with fiber reinforcement.
- cloud based storage



Problems encountered

- curling/ peeling of printed bed
- stringing
- gaps between infill and outline
- layer separation and splitting
- under and over extrusion
- layer shifting



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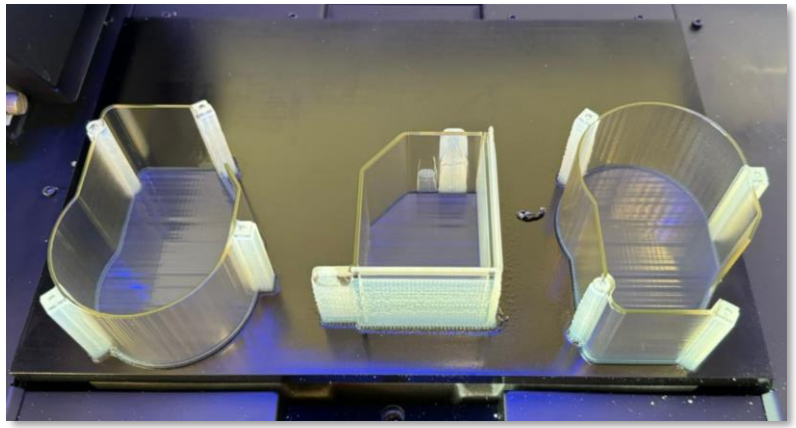
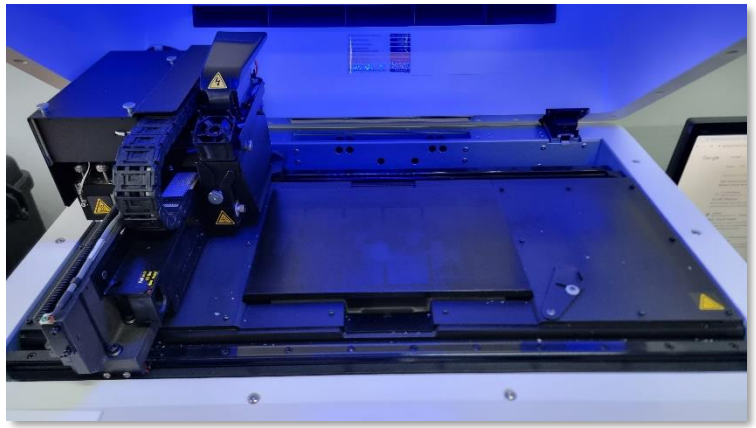
Photopolymer 3D printer – Polyjet technology

Layer Resolution – High Speed 30 µm - High quality 16 µm

Build Volume – 294 x 192 x 148.6 mm

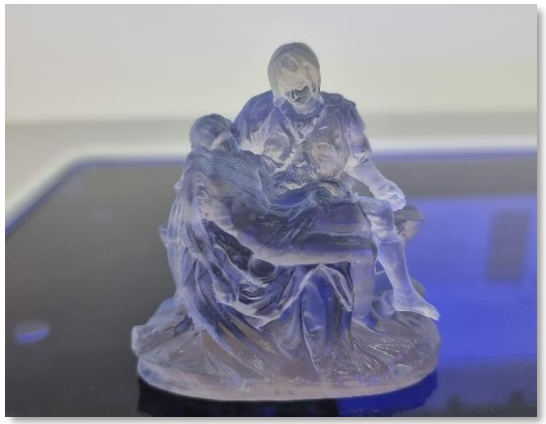
Compatible Materials – VeroClear, RGD525(High Temperature), RGD450 & RDG430(Simulated Polypropylene)





Vero Clear(RGD 810)

- **transparent, rigid material that simulates PMMA**
- **high dimensional stability and smooth surface**
- **Vacuum compatible, durable, highly water resistant**



Flexural Strength

75-110 MPa XZ axis

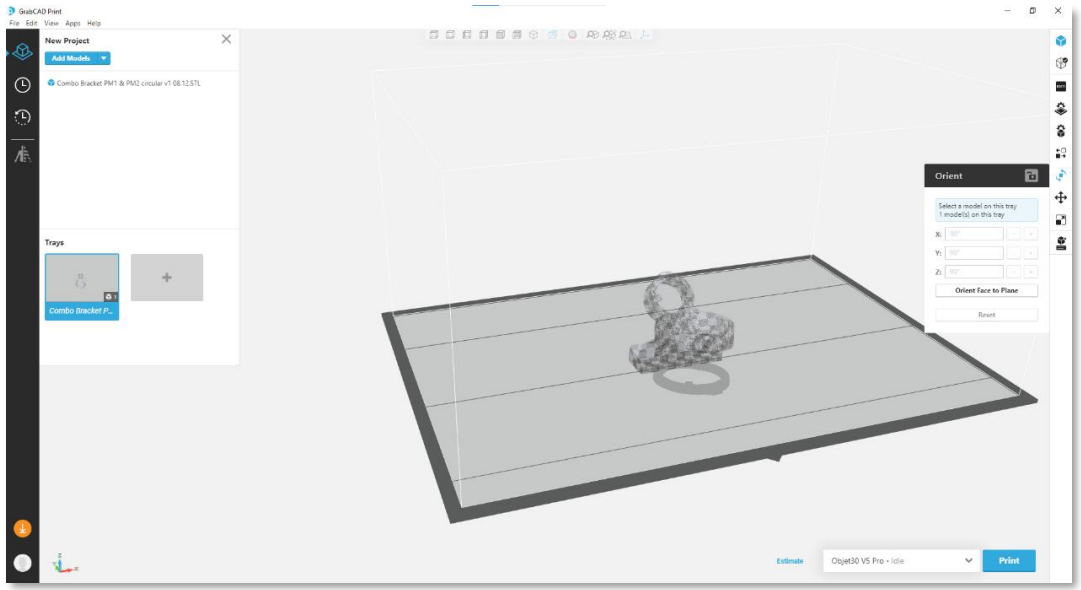
Tensile Strength

50-65 MPa XZ axis

Software(Stratasys and GrabCAD Print)

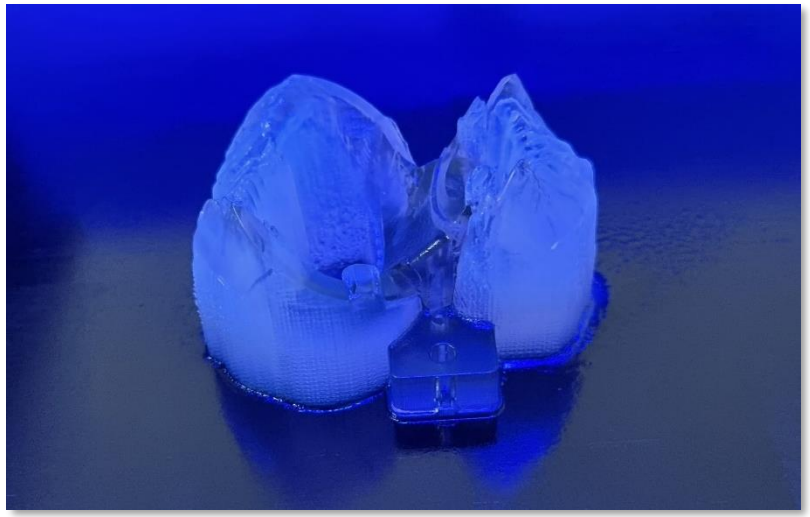
- capable of slicing, scaling and orientating designs
- intuitive and versatile
- cloud-based additive manufacturing software

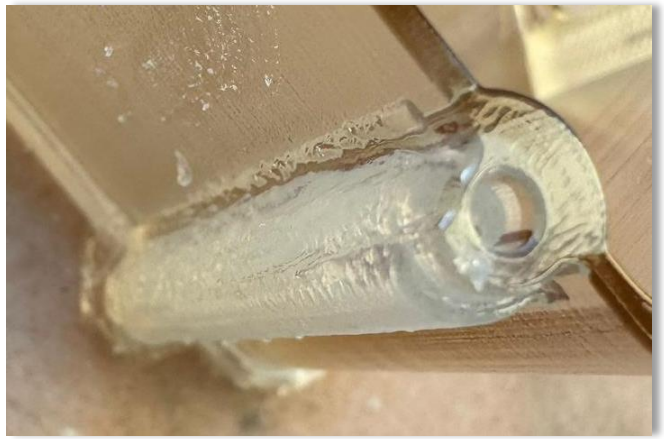
- variety of materials with physical properties for all manner of situations
- limited to a local network via ethernet cable
- maintenance wizards



Problems encountered

- model orientation and support
- calibration problems
- warpage
- clogged nozzles





Systems maintenance

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- Nozzle replacement
- Print bed alignment
- Belt tensioning
- Feed tube replacement
- Filament dehumidification

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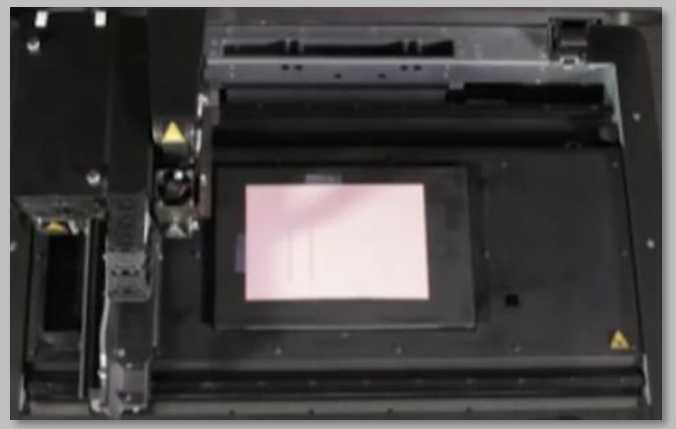
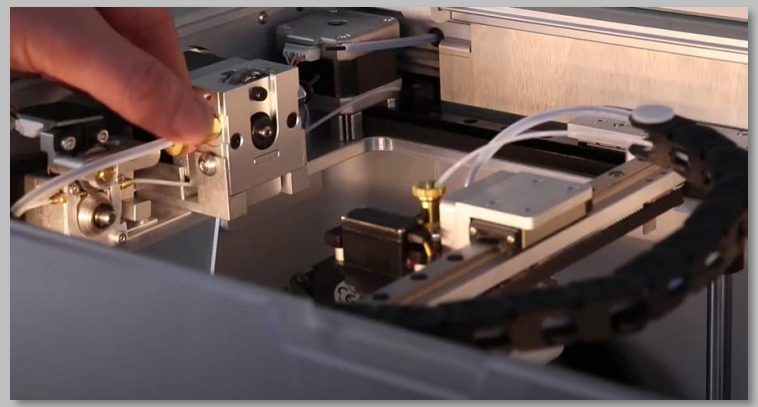
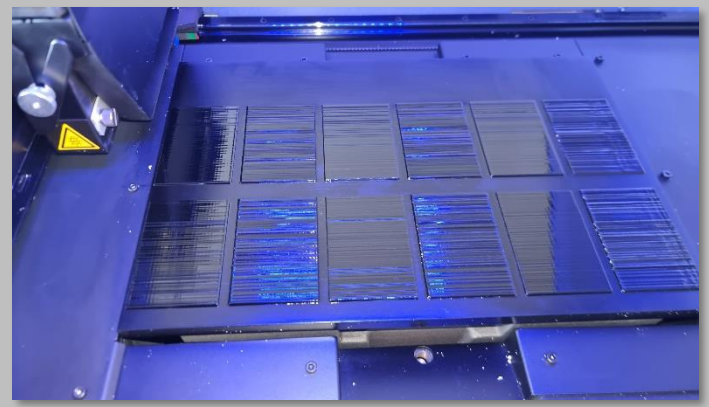
Objet30Pro V5

- Print head cleaning
- UV lamp calibration
- Print head optimization
- Wiper blade cleaning
- Print head alignment

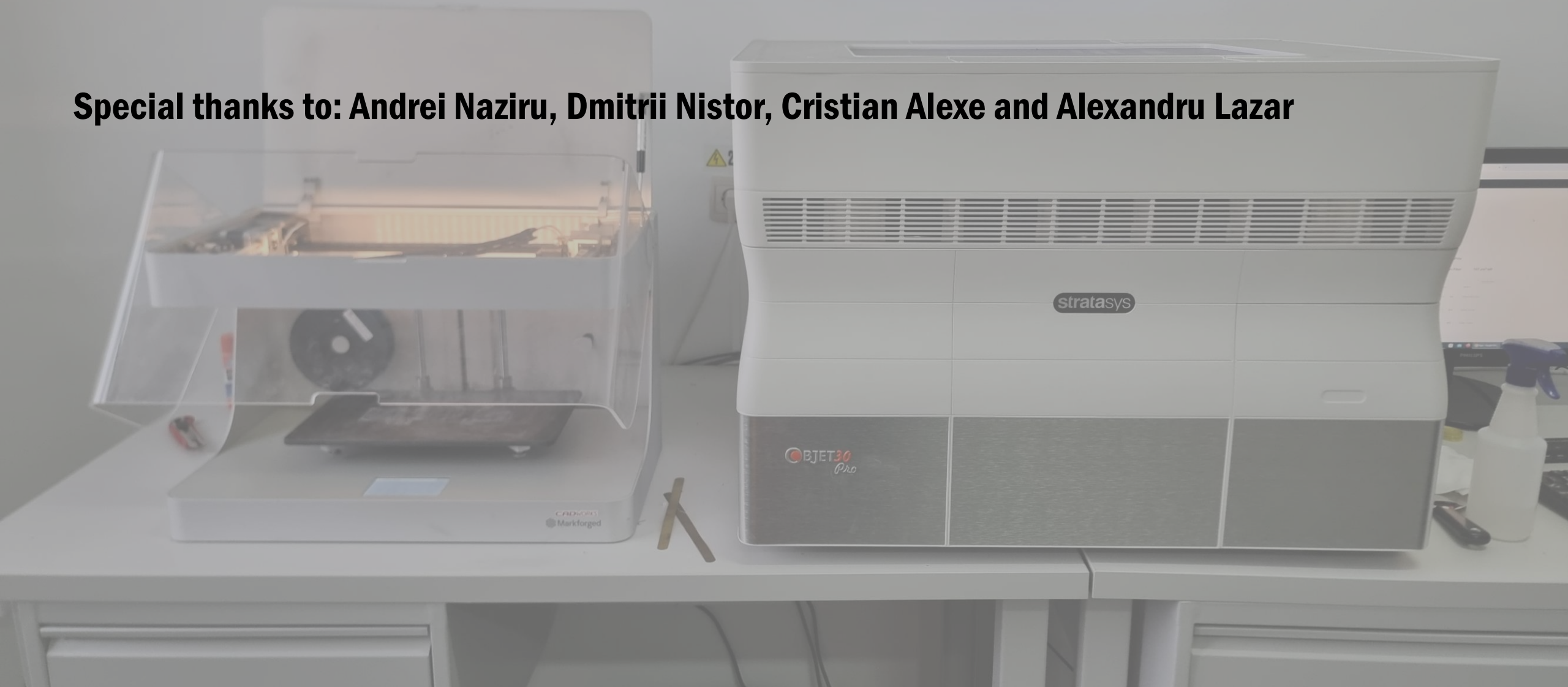






Acknowledgement

Special thanks to: Andrei Naziru, Dmitrii Nistor, Cristian Alexe and Alexandru Lazar




eli
nuclear physics
Thank you!