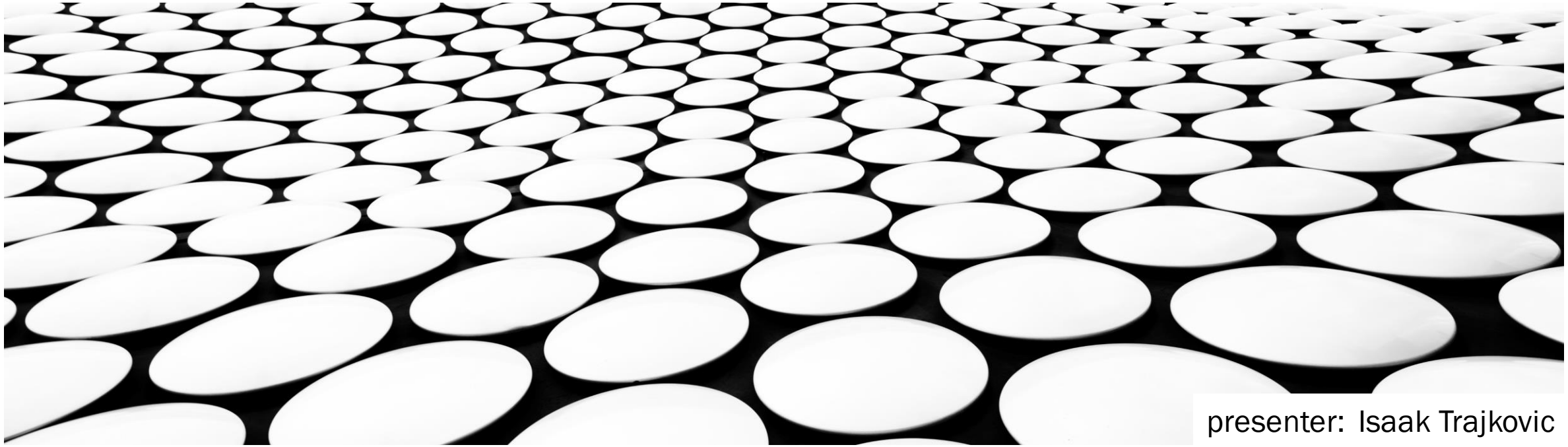
CENTER FOR OPTICAL MEASUREMENT AND RAPID PROTOTYPING

FACULTY OF MECHANICAL ENGINEERING

INNOVATION CENTER OF THE FACULTY OF MECHANICAL ENGINEERING



presenter: Isaak Trajkovic

IDEA

RAPID PROTOTYPING

* RAPID PROTOTYPING is a group of techniques used to quickly create a model of the size of a physical part or assembly by using three-dimensional computer data. The production of a part or assembly is usually done by using 3D printing or "additive layer" technology.
* Good equipment and extensive experience of Innovation Center associates are a guarantee for fast and accurate creating of highly demanding prototypes.

https://www.istockphoto.com/vector/new-start-up-business-idea-concept-vector-flat-graphic-design-cartoon-illustration-gm1173190486-325758149

IDEA

3D MODELING

RAPID PROTOTYPING

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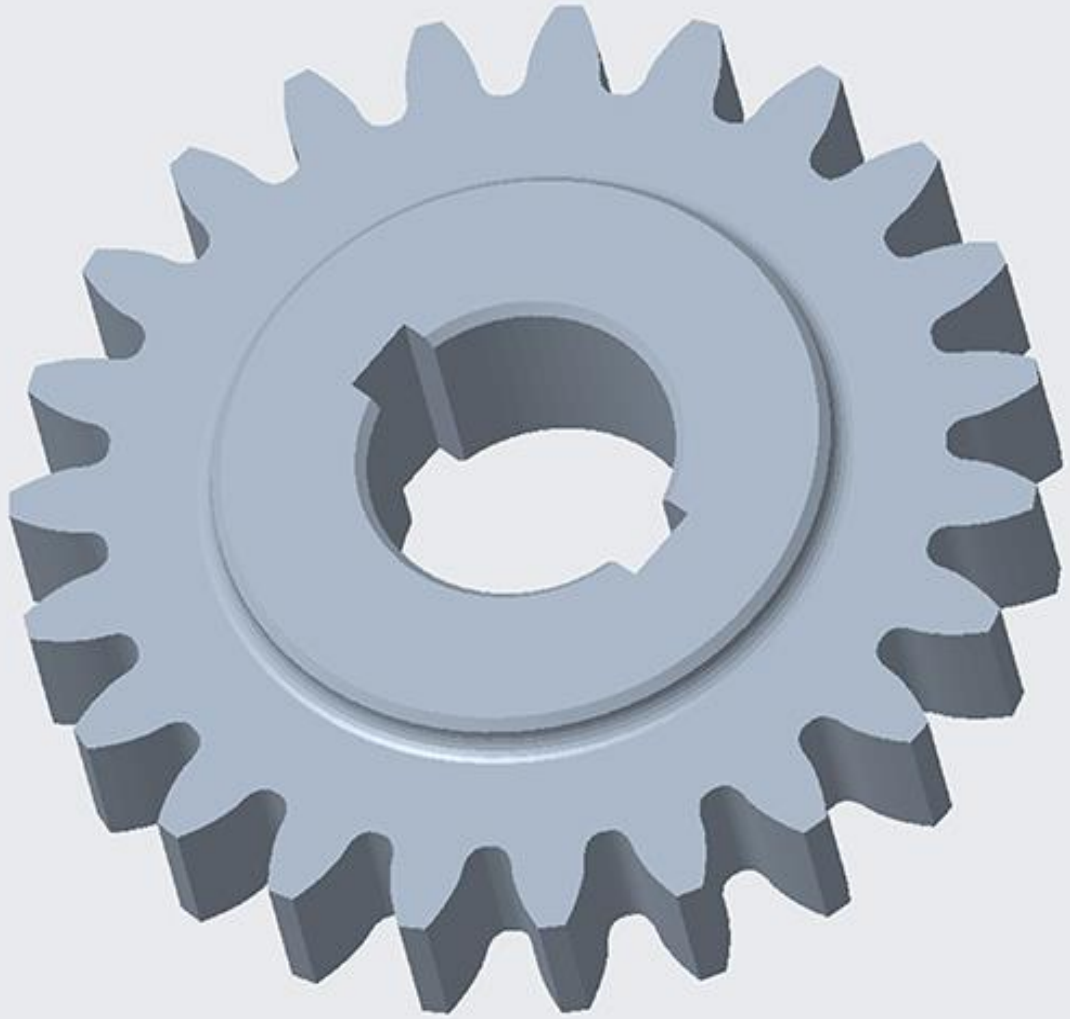
Regenerate Copy Paste Delete — Operations
User-Defined Feature Copy Geometry Shrinkwrap — Get Data
Plane Axis Point Coordinate System Sketch — Datum
Extrude Revolve Sweep Swept Blend — Shapes
Hole Draft Round Shell Chamfer Rib — Engineering
Pattern Mirror Extend Project Trim Offset Thicken Merge Intersect Solidify — Editing
Boundary Blend Fill Style Freestyle — Surfaces
Component Interface — Model Intent

Model Tree | Folder | Favorites

Model Tree

ZUPCANIK.PRT
ZUPCANIK
Facet Feature id 5

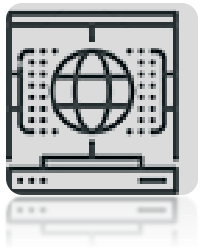


• Datum planes will not be displayed.

Geometry

IDEA

3D MODELING



3D PRINTING

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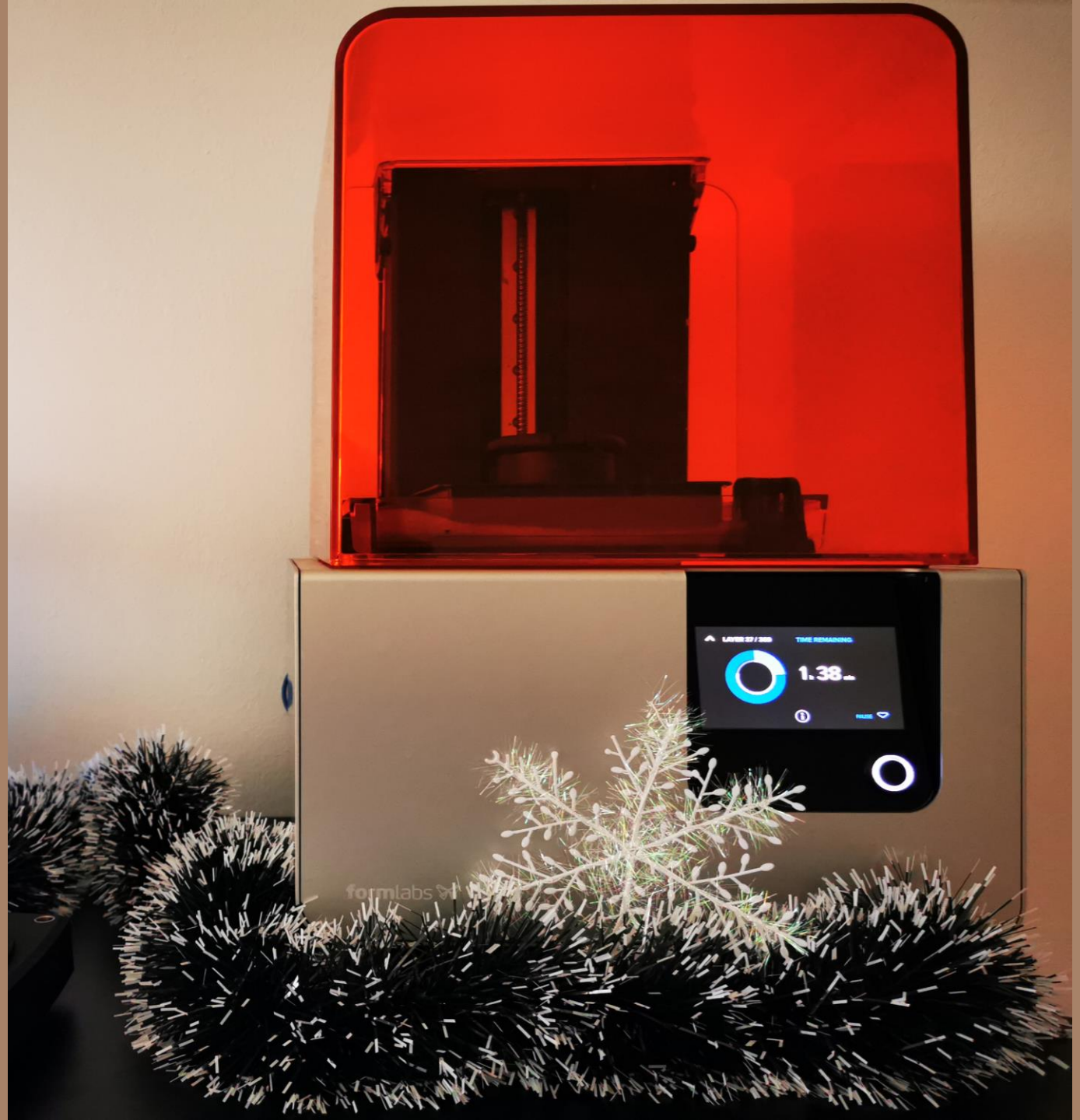
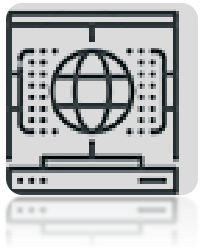

TIME REMAINING
1.38
formlabs

IDEA

3D MODELING



3D PRINTING

PROTOTYPE

RAPID PROTOTYPING

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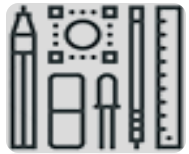
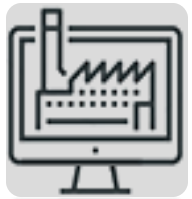
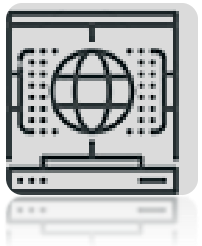
formlabs



IDEA



3D MODELING



3D PRINTING

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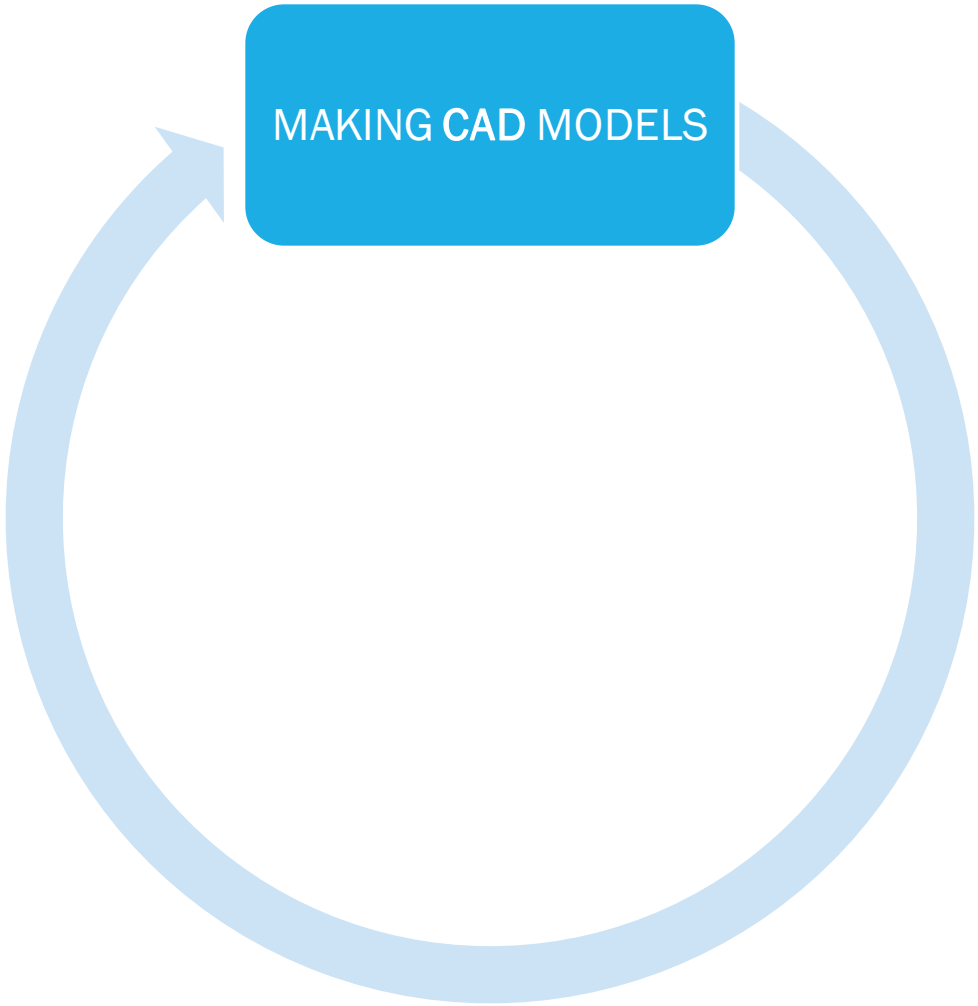
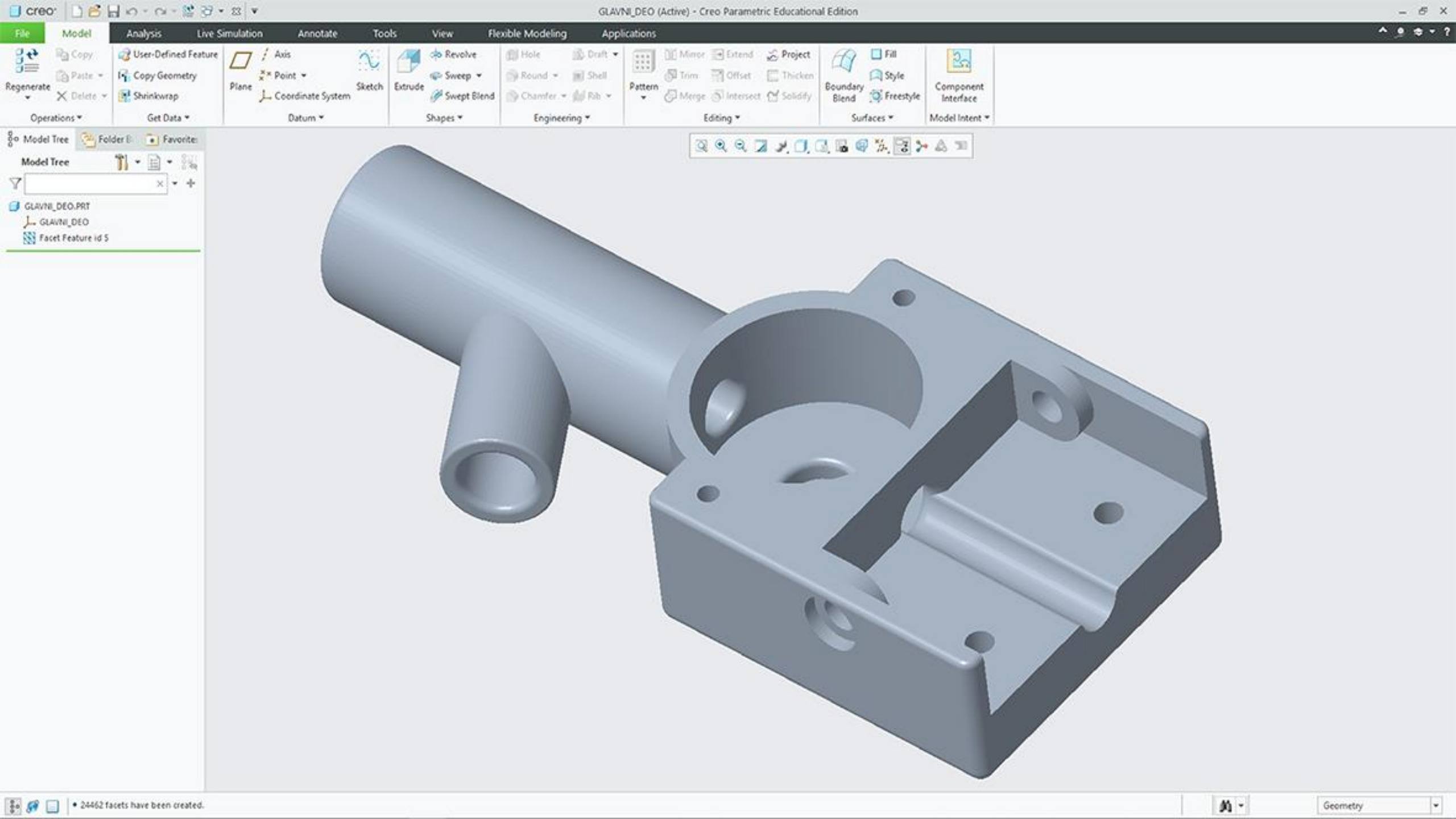
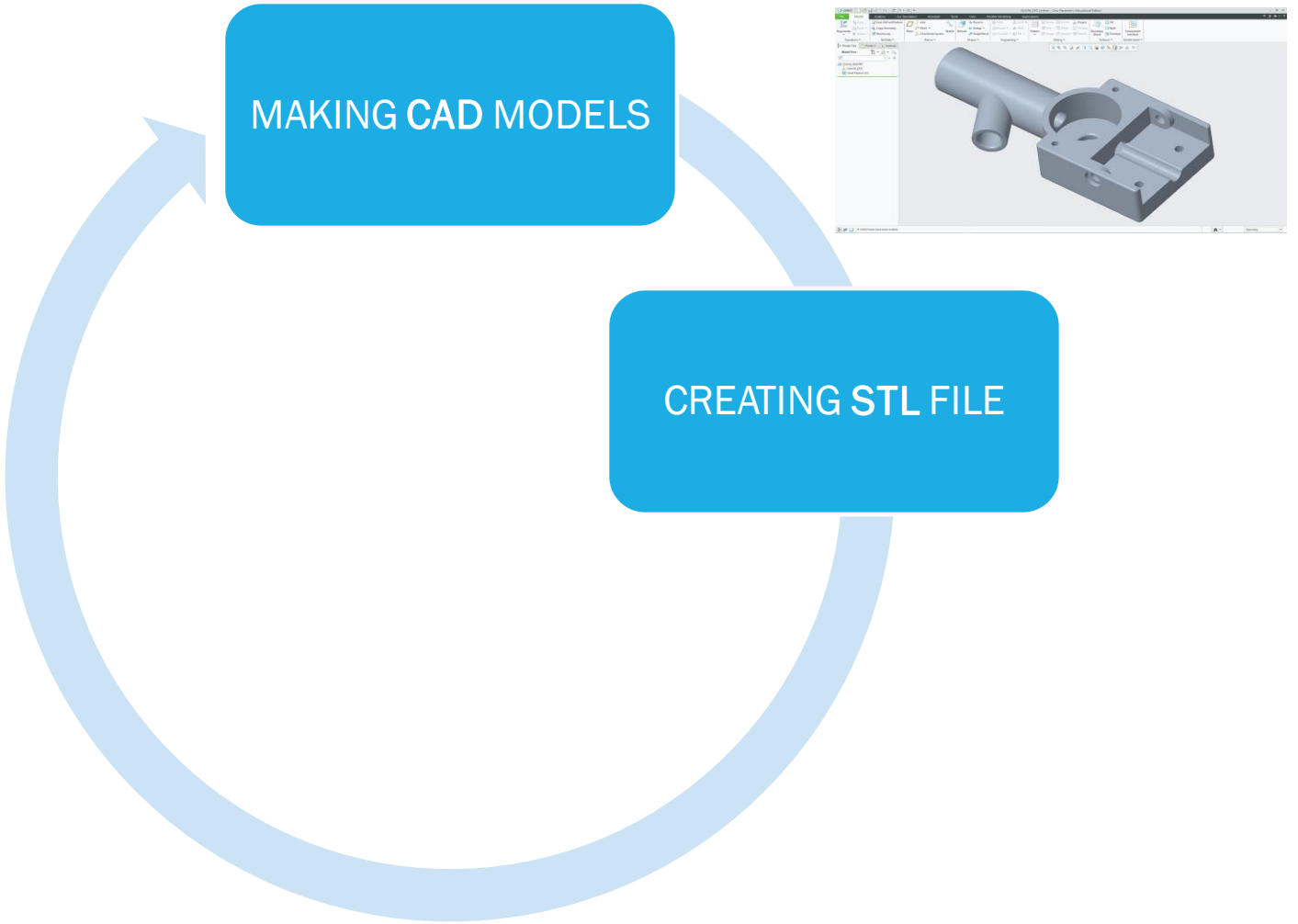
RAPID PROTOTYPING CYCLE




creo
GLAVNI_DEO (Active) - Creo Parametric Educational Edition
File
Model
Analysis
Live Simulation
Annotate
Tools
View
Flexible Modeling
Applications
Regenerate
Copy
Paste
Delete
Operations
User-Defined Feature
Copy Geometry
Shrinkwrap
Get Data
Plane
Axis
Point
Coordinate System
Sketch
Datum
Extrude
Revolve
Sweep
Swept Blend
Shapes
Hole
Draft
Round
Shell
Chamfer
Rib
Engineering
Pattern
Mirror
Extend
Project
Trim
Offset
Thicken
Merge
Intersect
Solidify
Editing
Boundary Blend
Fill
Style
Freestyle
Surfaces
Component Interface
Model Intent
Model Tree
Folder
Favorites
Model Tree
GLAVNI_DEO.PRT
GLAVNI_DEO
Facet Feature id 5
• 24462 facets have been created.
Geometry

RAPID PROTOTYPING CYCLE



Simplify3D (Licensed to Inovacioni Centar)

File Edit View Mesh Repair Tools Add-Ins Account Help

Models (double-click to edit)

glavni deo

Import Remove

Center and Arrange

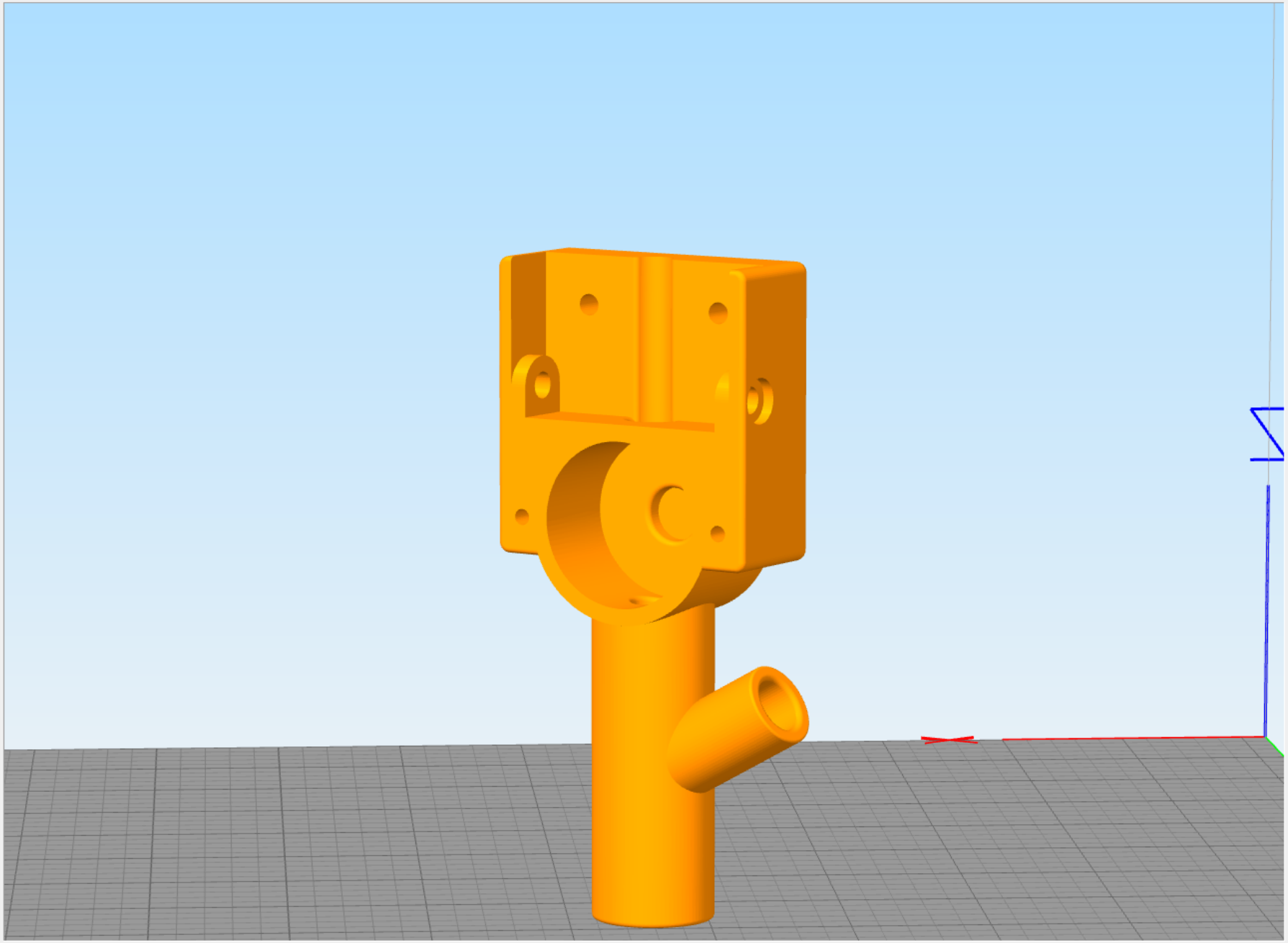
Processes (double-click to edit)

Name	Type
Process1	FFF

Add Delete

Edit Process Settings

Prepare to Print!



Model Name: glavni deo

Change Position

X Offset 138,30 mm

Y Offset 193,53 mm

Z Offset 5,00 mm

Reset Position

Change Scaling

	Size (mm)	Scale (%)
X	53,82	100,00
Y	47,66	100,00
Z	123,27	100,00

Uniform Scaling

Reset Scale

Change Rotation

X Rotation 0,00 deg

Y Rotation 0,00 deg

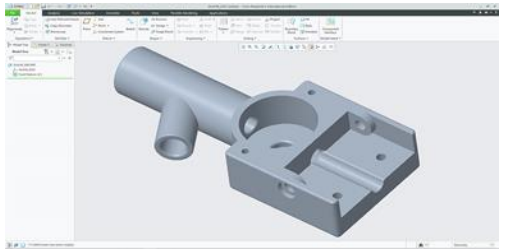
Z Rotation -233,00 deg

Reset Rotation

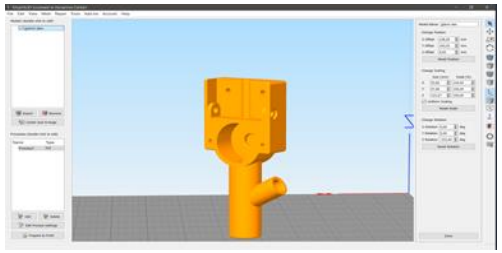
Done

RAPID PROTOTYPING CYCLE

MAKING **CAD** MODELS



CREATING **STL** FILE



SETTING DEVICE PARAMETERS AND CHECKING **STL** FILE

Simplify3D (Licensed to Inovacioni Centar)

File Edit View Mesh Repair Tools Add-Ins Account Help

Build Statistics

Build time: 3 hours 7 minutes
Filament length: 13934.6 mm
Plastic weight: 41.90 g (0.09 lb)
Material cost: 100.55

Show in Preview

Build table Travel moves
Toolhead Retractions
Coloring Movement Speed

Real-time Updates

Live preview tracking
Update interval 5,0 sec

Begin Printing over USB

Save Toolpaths to Disk

Exit Preview Mode

Speed (mm/min)
3000
2715
2430
2145
1860
1575
1290
1005
720
435
150

Preview Mode

Toolhead Position
X: 116.030
Y: 154.664
Z: 13.324

Animation

Play/Pause
Speed:

Control Options

Preview By Line
Only show 100 lines

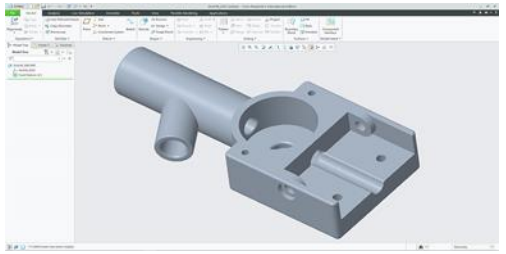
Line Range to Show

Min 1
Max 144230

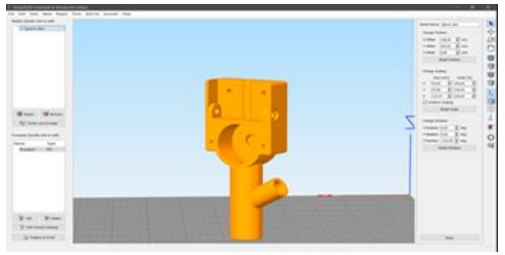
Previewing file from line 1 to 144230

RAPID PROTOTYPING CYCLE

MAKING **CAD** MODELS



CREATING **STL** FILE



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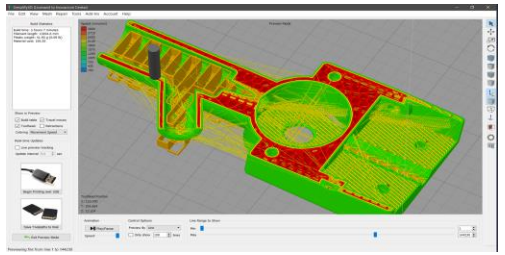
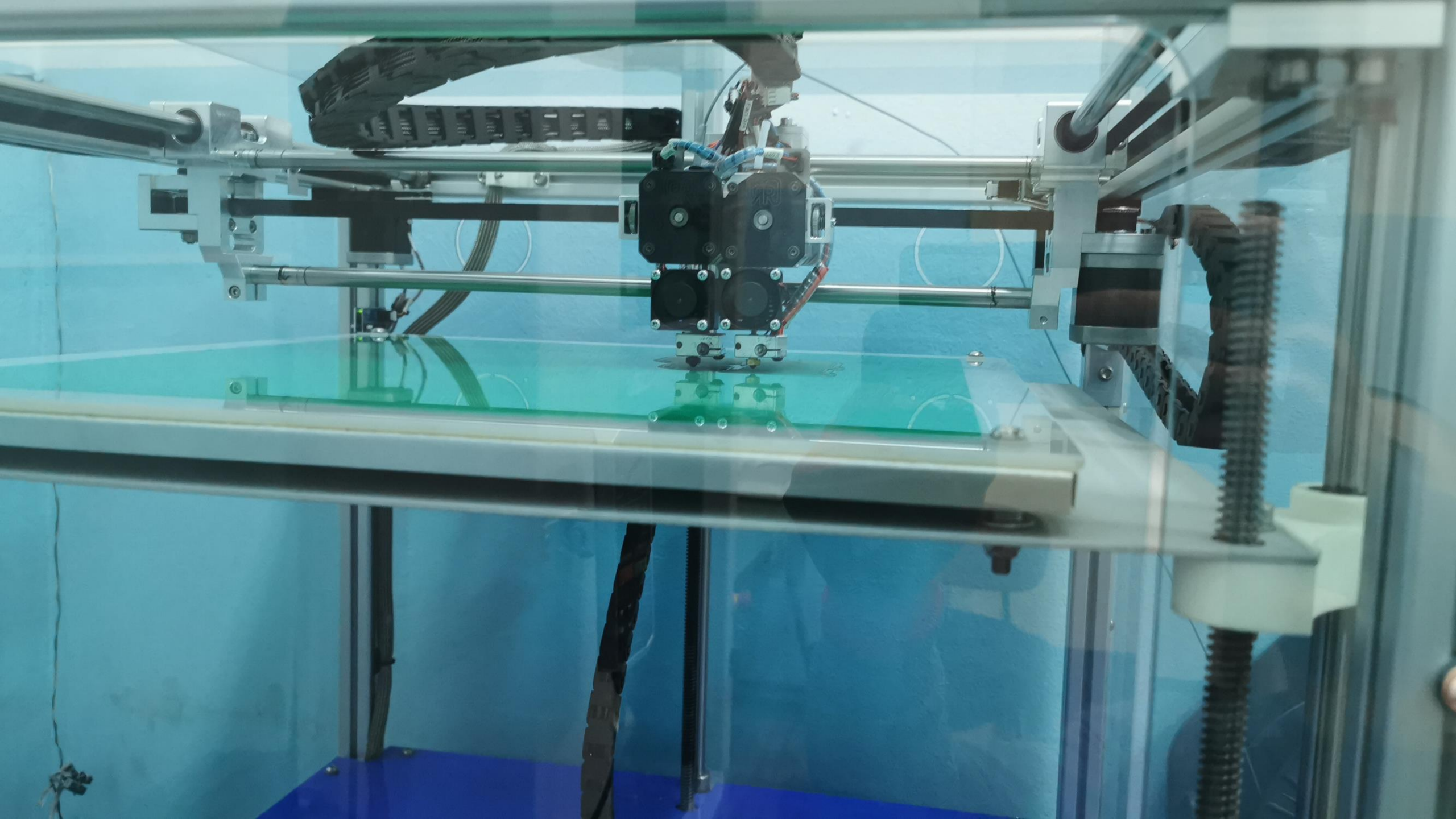
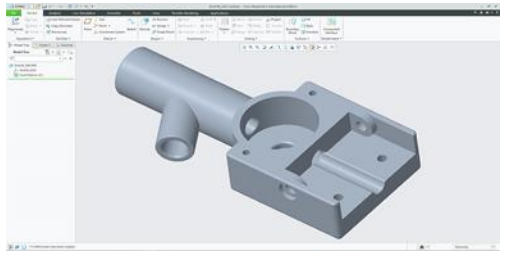


MAKING A MODEL (**3D** PRINTING MODEL)



RAPID PROTOTYPING CYCLE

MAKING **CAD** MODELS



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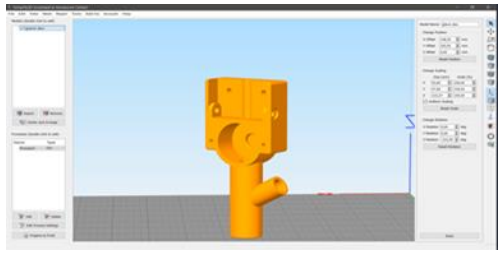

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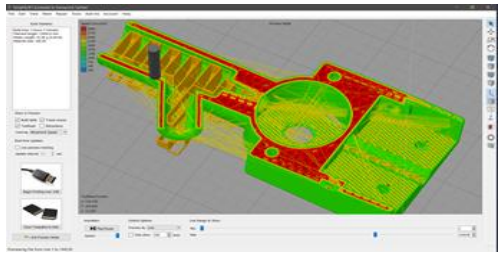
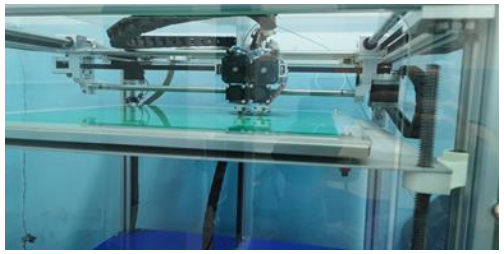
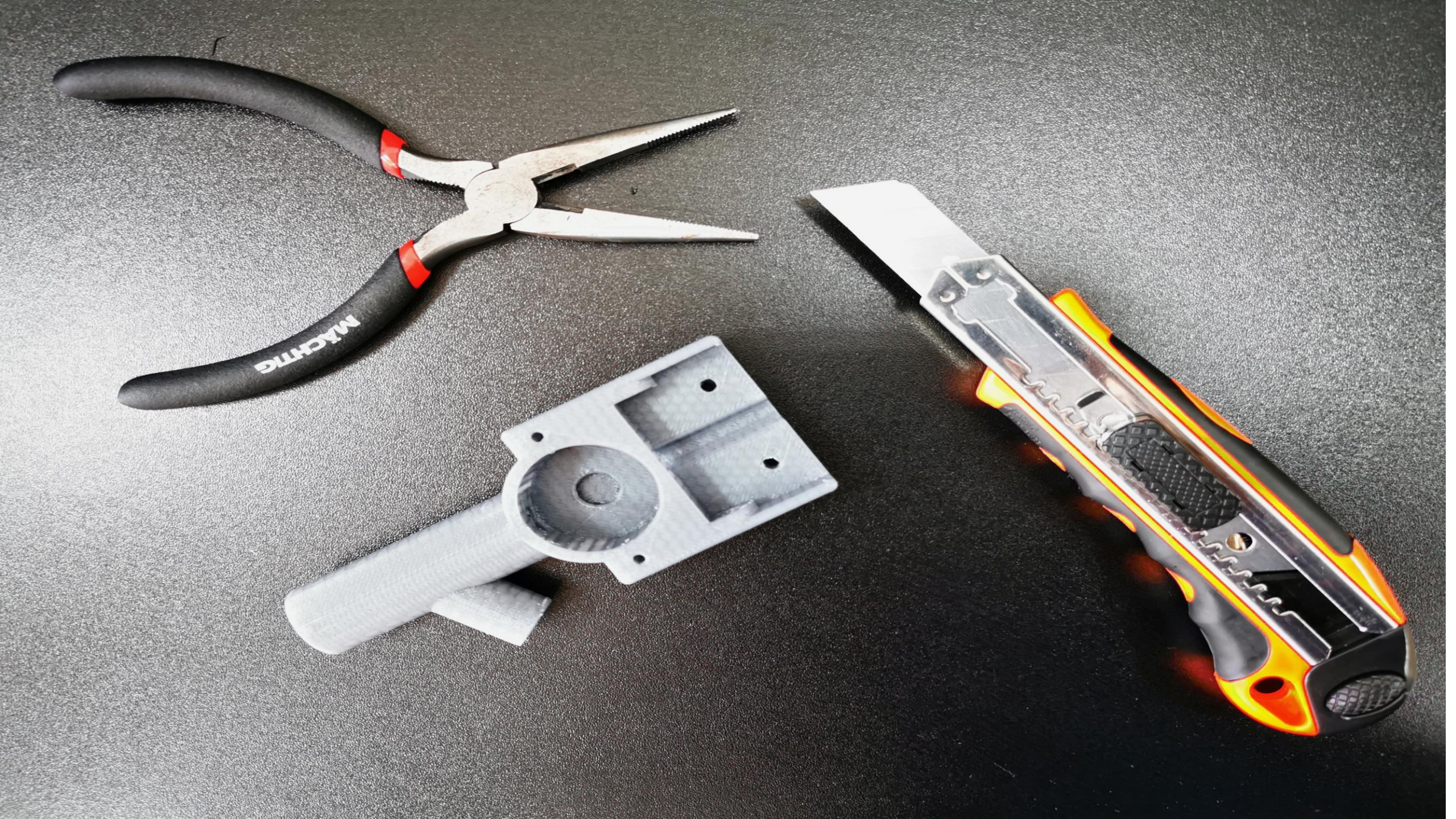


MAKING A MODEL

(**3D** PRINTING MODEL)

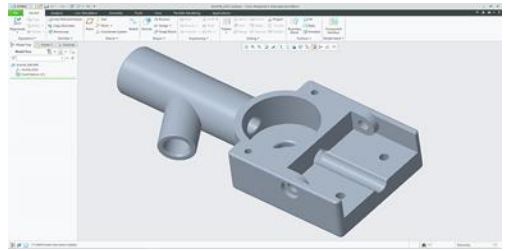


POSTPROCESSING (ADDITIONAL OPERATIONS)

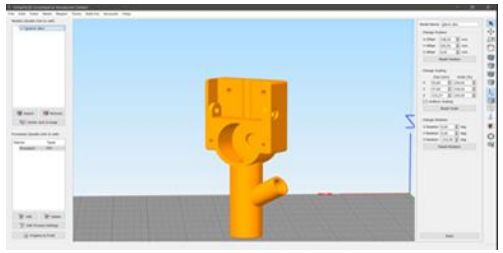

MACHTIG

RAPID PROTOTYPING CYCLE

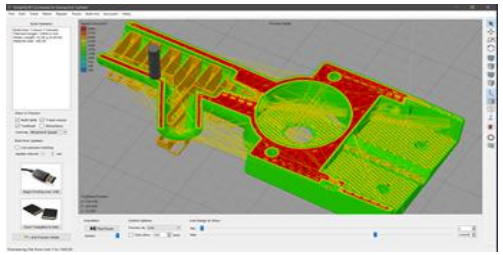
MAKING **CAD** MODELS



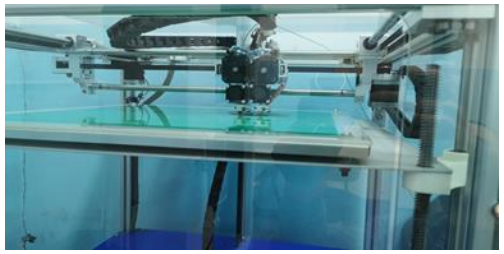
CREATING **STL** FILE



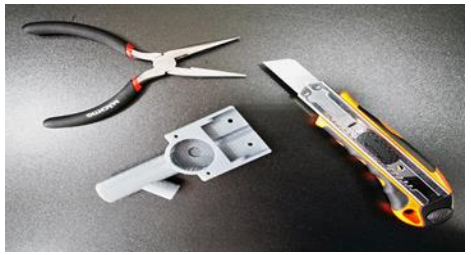
SETTING DEVICE PARAMETERS AND CHECKING **STL** FILE



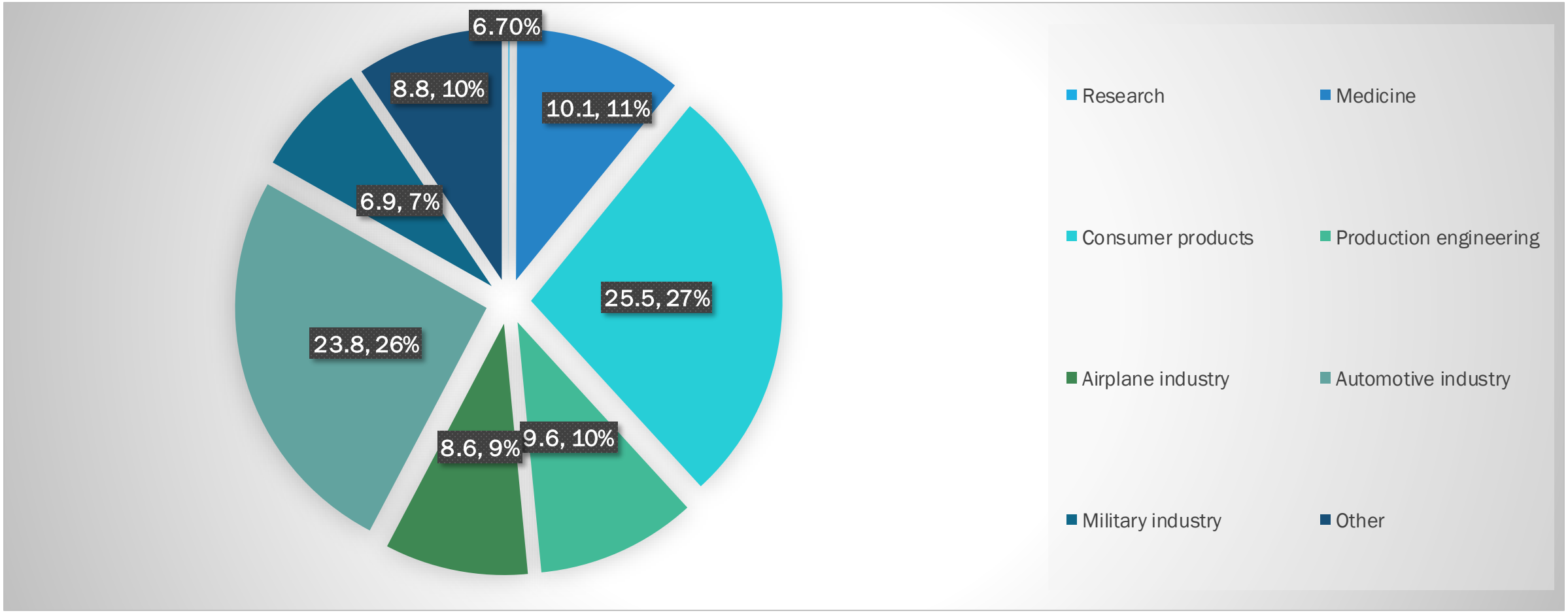
MAKING A MODEL (**3D** PRINTING MODEL)



POSTPROCESSING (ADDITIONAL OPERATIONS)



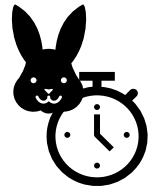
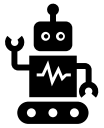
APPLICATION FIELDS OF 3D PRINT



OLD CONVENTIONAL METHODS OF PROTOTYPING (PROBLEMS IN PRACTICE)

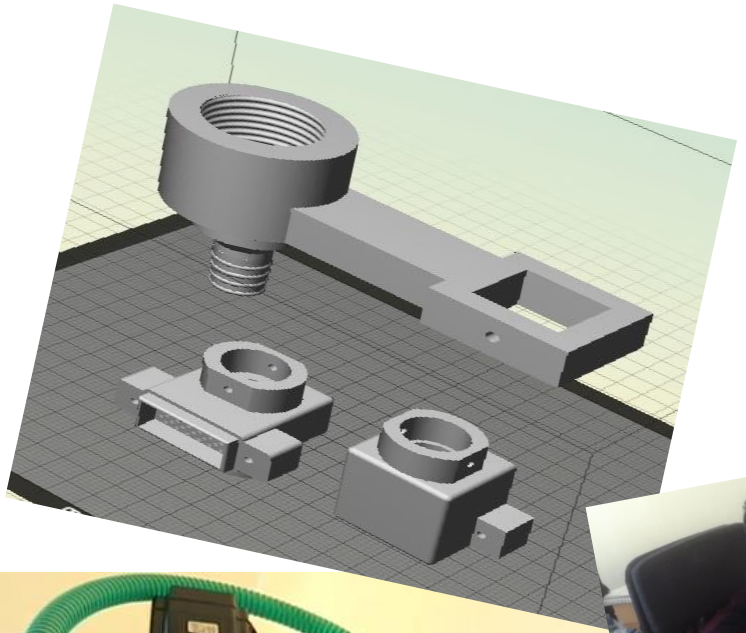
- Long time of development and create prototype 
- High product manufacturing costs 
- Accelerating production increases the possibility of manufacturing errors 
- Delocalized product development   
- Transport problems 

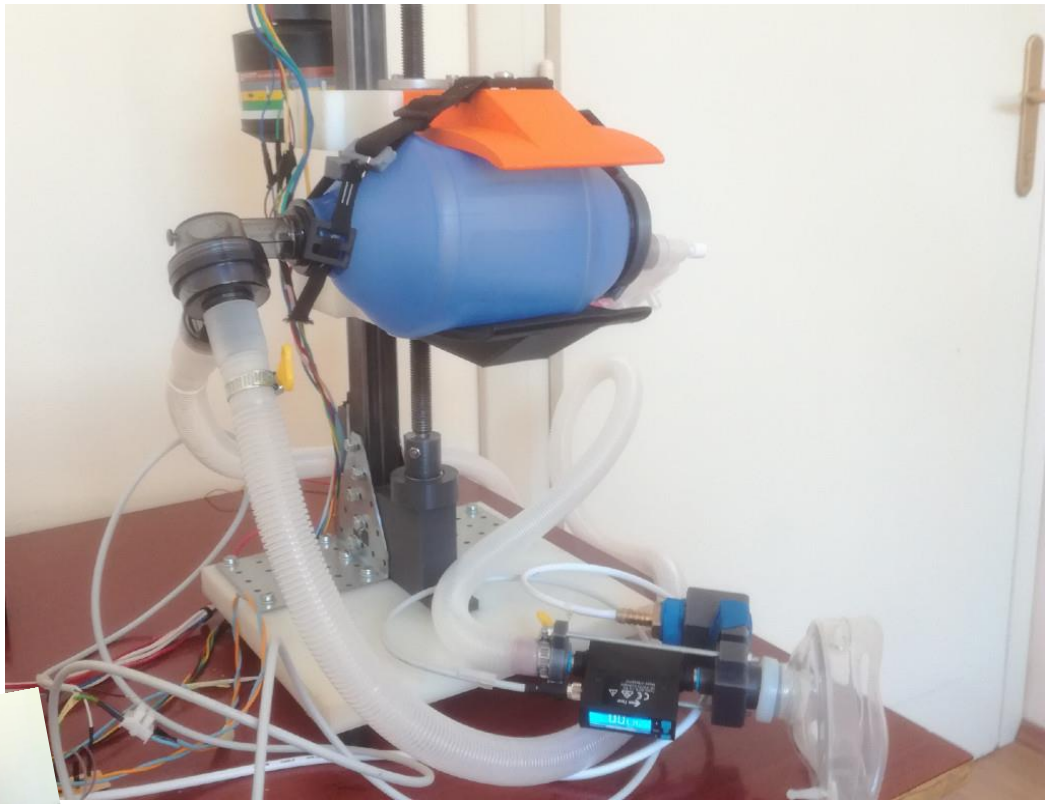
THE ADVENTAGE OF NEW METHODS OF RAPID PROTOTYPING

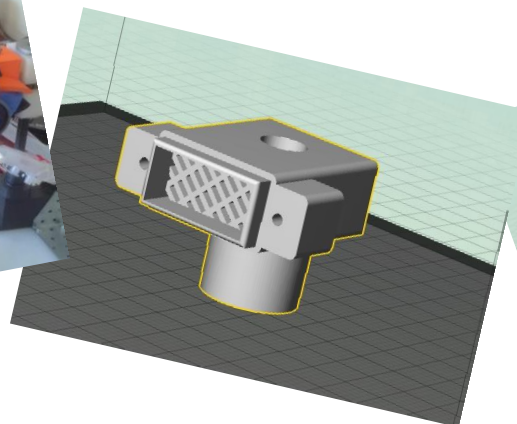
- Reducing development and prototyping time 
- Use of modern high-precision tools 
- Creating model with materials of high performans 
- The posibility of prototyping from biocompatible materials 
- Absence of possibility of damage or disappearance of the model due to transport 

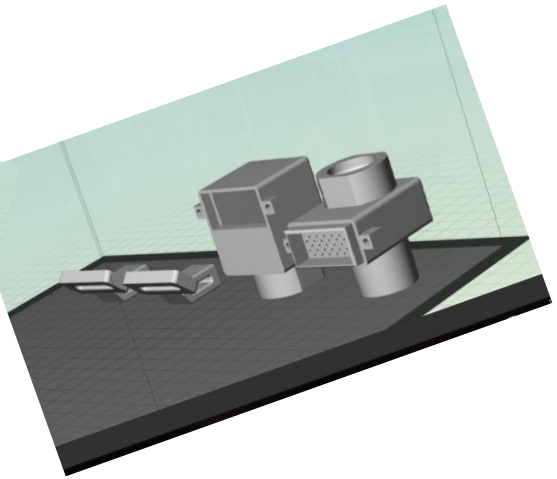
RAPID PROTOTYPING IN ACT

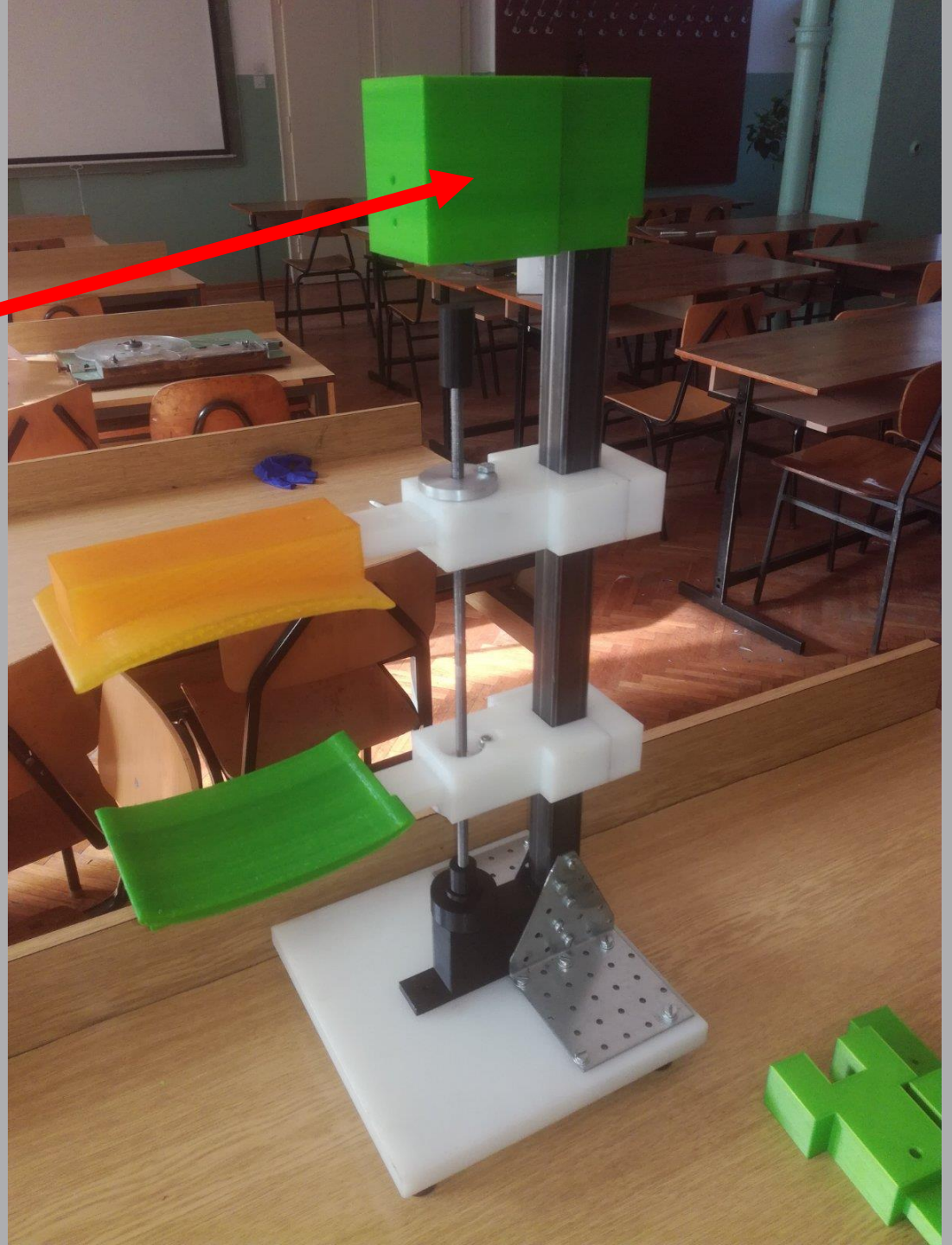
PROTOTYPE OF RESPIRATOR COVID-19









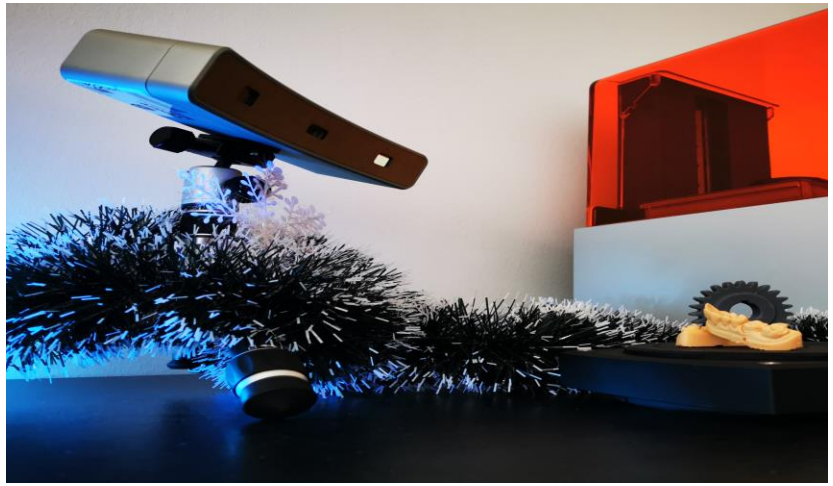


EQUIPMENT FOR CREATING AND EXAMINATION PROTOTYPES

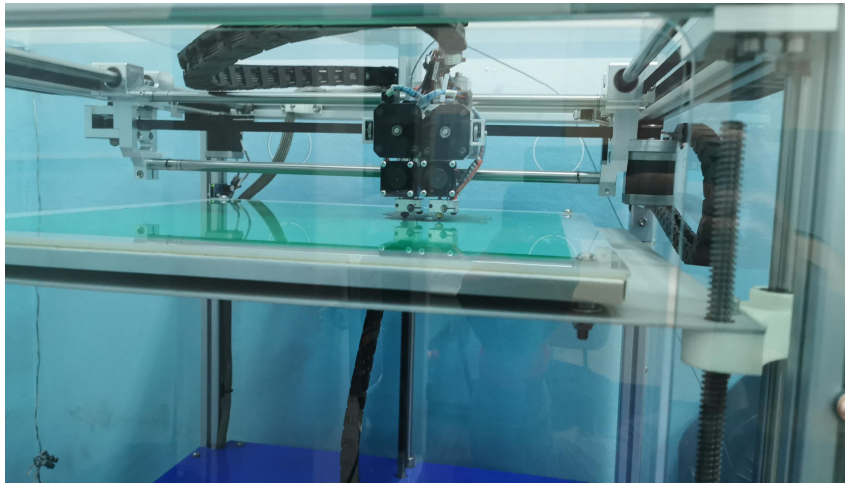
3D PRINTERS /
3D SCANNERS

SHIMADZU AGS-X
100kN

ARAMIS GOM
(DIC)



3D PRINTING/ 3D SCANNING



German RepRap x400 (FMD)

Dimension of platform: *350 x 400 x 310 mm*
***Accuracy*:** *+/- 0.1 mm*
Type of filaments: *PLA; ABS; PET-G; PP; composite filament*

Formlabs form 2 (SLA)

Dimension of platform : *145 × 145 × 175 mm*
***Accuracy*:** *+/- 25 µm*
Type of resines: *Dental SG Resin SDS; Flexible Resin SDS ; Grey Resin SDS; High Temp Resin SDS; Tough Resin SDS; White Resin SDS.*

Geomagic Capture

Measuringfield: *124 x 120 mm (veća preciznost)*
190 x 175 mm (manja preciznost)
Accuracy : *60–118 µm*

ATOS GOM

Measuringfield : *100 x 70 mm (veća preciznost)*
500 x 370 mm (manja preciznost)
Accuracy : *4 - 15 µm*

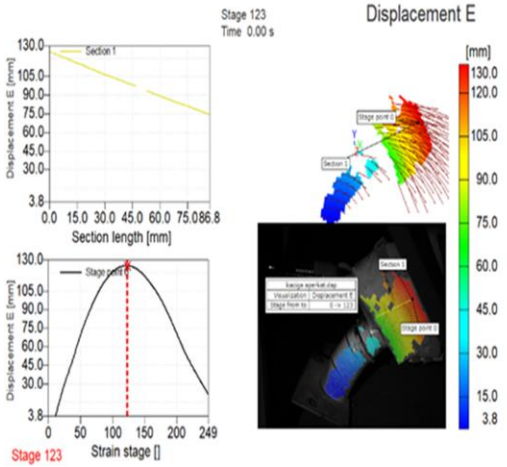
ARAMIS GOM
(V6.0.2)

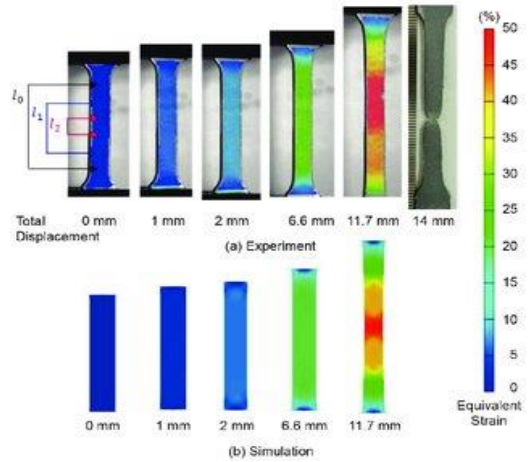
*Aramis is a 3D optical contactless system consisting of two ultra-fast cameras with adjustable stands, a light source and a computer for processing the obtained images.

*This system is used to measure the displacement field and the distribution of deformations over the entire analyzed area based on the correlation of digital images (DIC), in contrast to systems that give only individual measured values such as extensometer.

*Thanks to the ARAMIS system, it is easier to understand the behavior of both materials and structures during the action of the load.

*Its application is increasingly widespread in the analysis of materials and structures, and in the improvement of numerical calculations..





SPECIFIKACIJA

MODEL	AGS – X 100kN
Traverse movement speed	0.001 do 800 mm/min
Accuracy of traverse speed	±0,1 %
Data capture speed	1000Hz
Effective height/width	1255 mm/425 mm
Accuracy of force measurement during testing	±0,5 %

SHIMADZU AGS-X (100KN)

*Universal machine for testing materials for tearing, breaking and bending.

* Adapted to standards
EN 10002-2 Grade 1
ISO 7500-1 Class 1
BS 1610 Class 1
ASTM E4
JIS B7721 Class 1

*This device allows you to set the load in the direction of tension and in the direction of pressure.

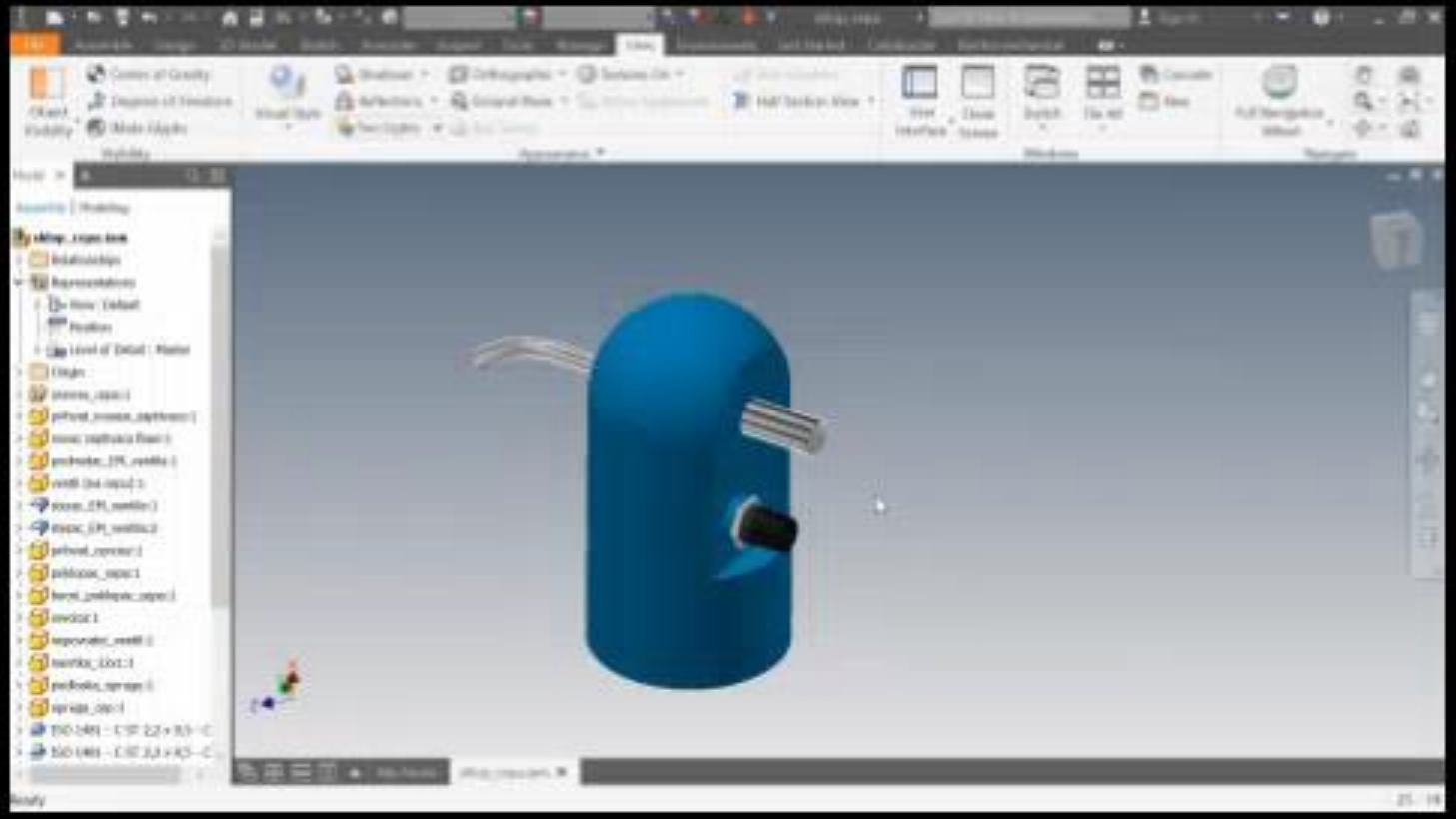
* Depending on the type of test, various tools are used adapted to the desire type of test.

TECHNICAL SOLUTIONS

The Innovation Center of the Faculty of Mechanical Engineering is a recognizable institution for the development of technical solutions and patents such as:

* Wine dispensing and preservation device– an invention that is the result of many years of research by members of the Innovation Center of the Faculty of Mechanical Engineering in Belagrade and the company PORT-TR.

* Auxiliary accessories for testing aluminum and PVC windows– created also in cooperation with the company as a solution to a specific problem that will be overcome thanks to the test than can bi performed on this accessory.



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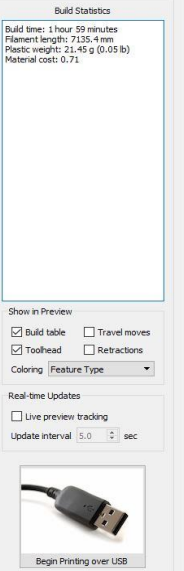
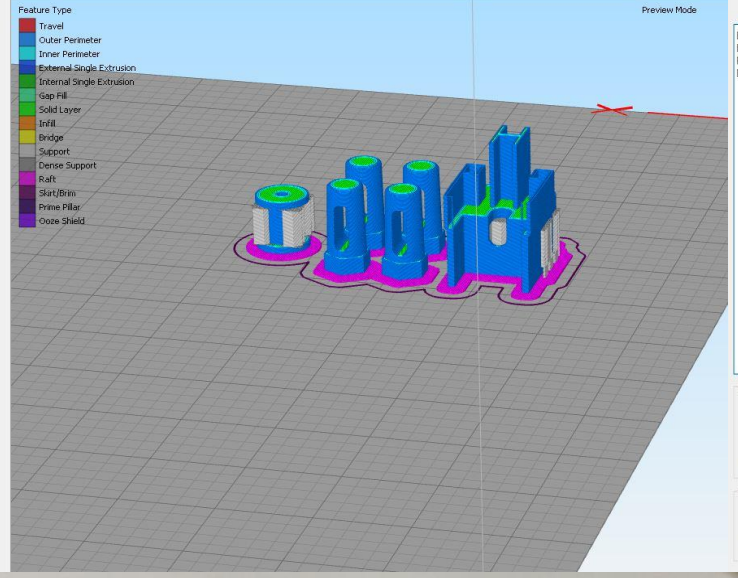
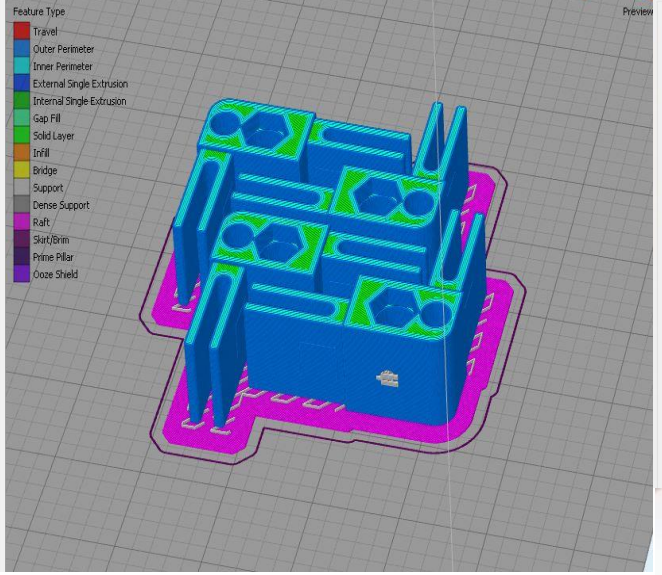
SHIMADZU


Build Statistics
Build time: 1 hour 59 minutes
Filament length: 7135.4 mm
Plastic weight: 21.45 g (0.05 lb)
Material cost: 0.71
Show in Preview
Build table
Travel moves
Toolhead
Retractions
Coloring
Feature Type
Real-time Updates
Live preview tracking
Update interval
5.0
sec
Begin Printing over USB


Feature Type
Preview Mode
Travel
Outer Perimeter
Inner Perimeter
External Single Extrusion
Internal Single Extrusion
Gap Fill
Solid Layer
Infill
Bridge
Support
Dense Support
Raft
Skirt/Brim
Prime Pillar
Ooze Shield


Build Statistics
Build time: 14 hours 46 minutes
Filament length: 33432.0 mm
Plastic weight: 100.52 g (0.22 lb)
Material cost: 3.32
Show in Preview
Build table
Travel moves
Toolhead
Retractions
Coloring
Feature Type
Real-time Updates
Live preview tracking
Update interval
5.0
sec


Feature Type
Travel
Outer Perimeter
Inner Perimeter
External Single Extrusion
Internal Single Extrusion
Gap Fill
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Infill
Bridge
Support
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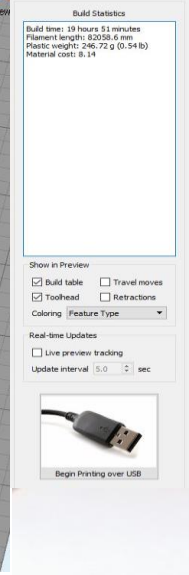
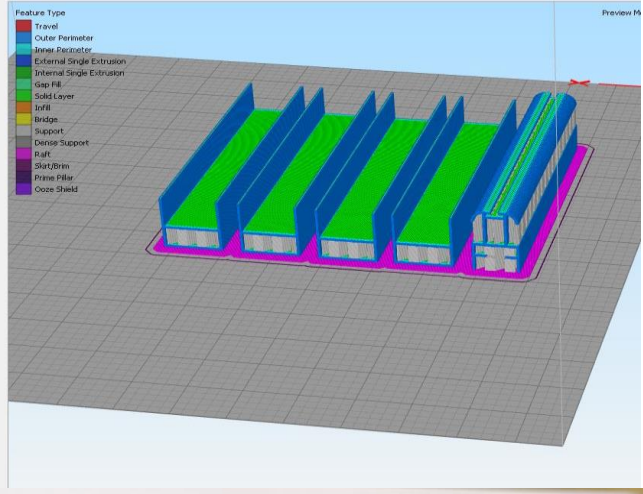

Build Statistics
Build time: 19 hours 51 minutes
Filament length: 82058.6 mm
Plastic weight: 246.72 g (0.54 lb)
Material cost: 8.14
Show in Preview
Build table
Travel moves
Toolhead
Retractions
Coloring
Feature Type
Real-time Updates
Live preview tracking
Update interval
5.0
sec
Begin Printing over USB


Feature Type
Travel
Outer Perimeter
Inner Perimeter
External Single Extrusion
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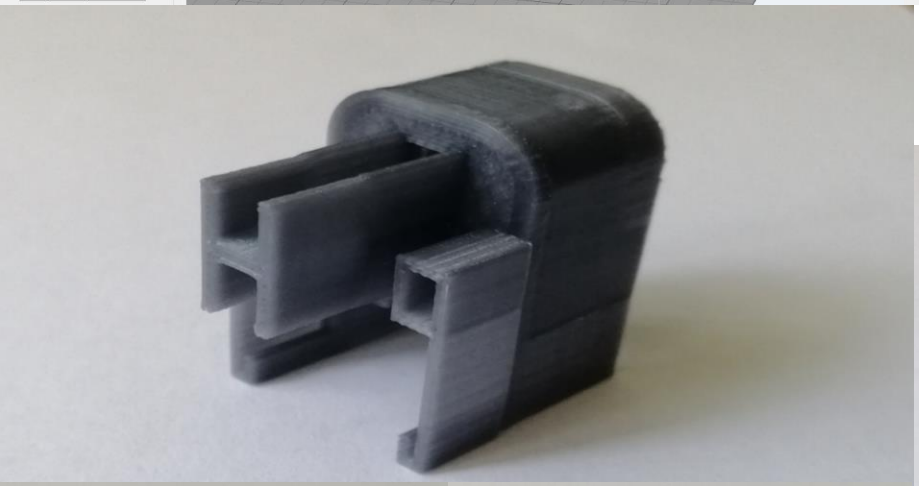
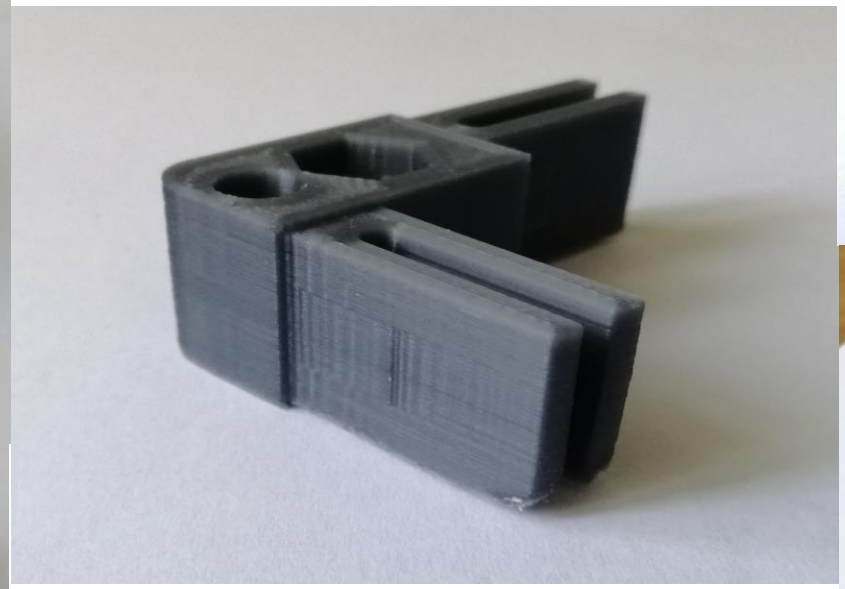
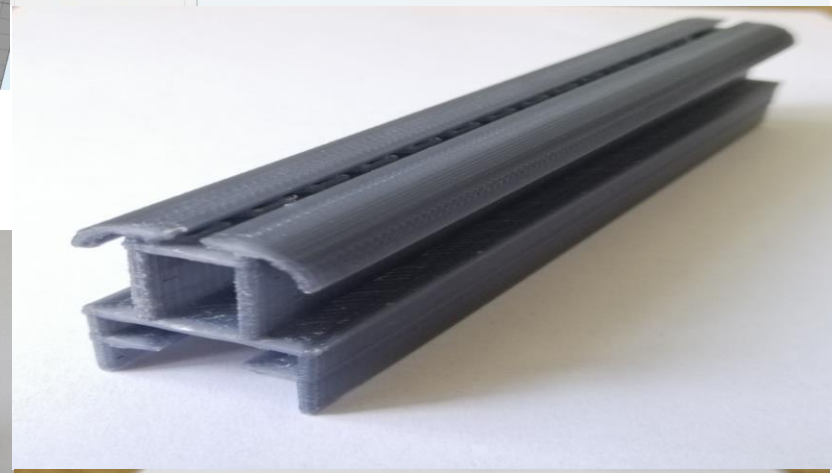
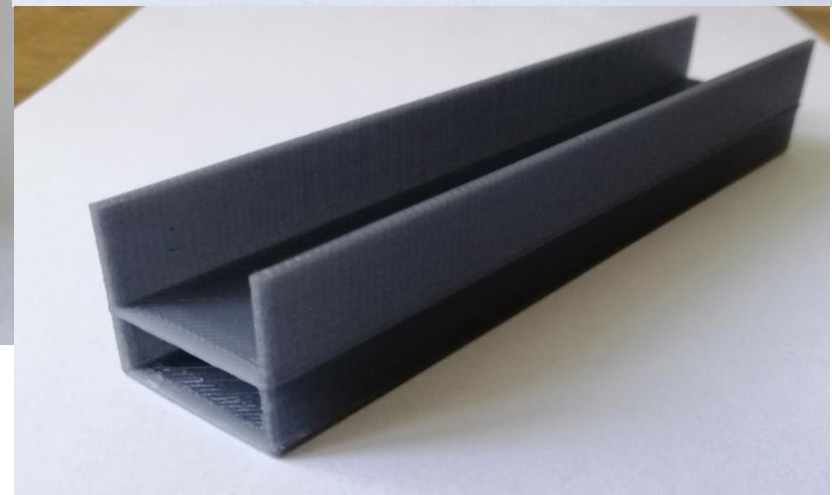






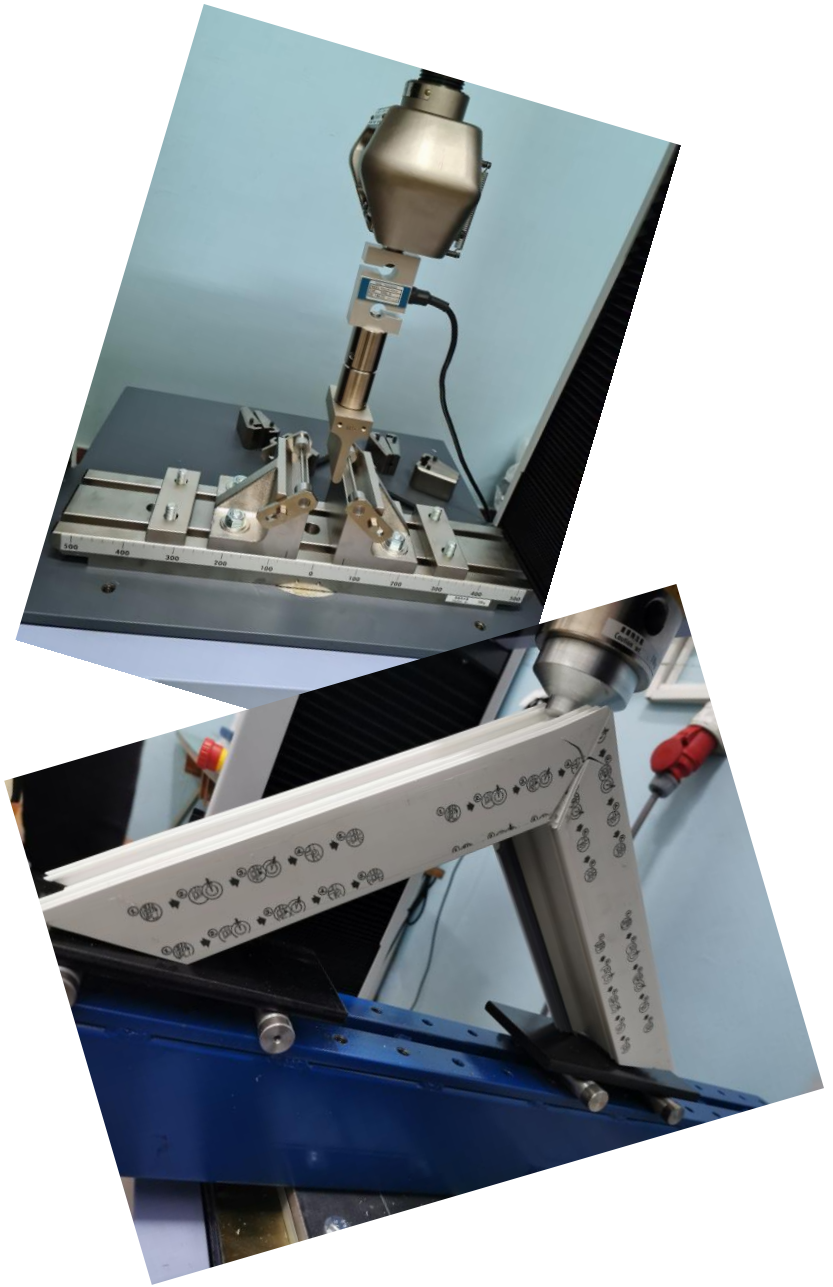


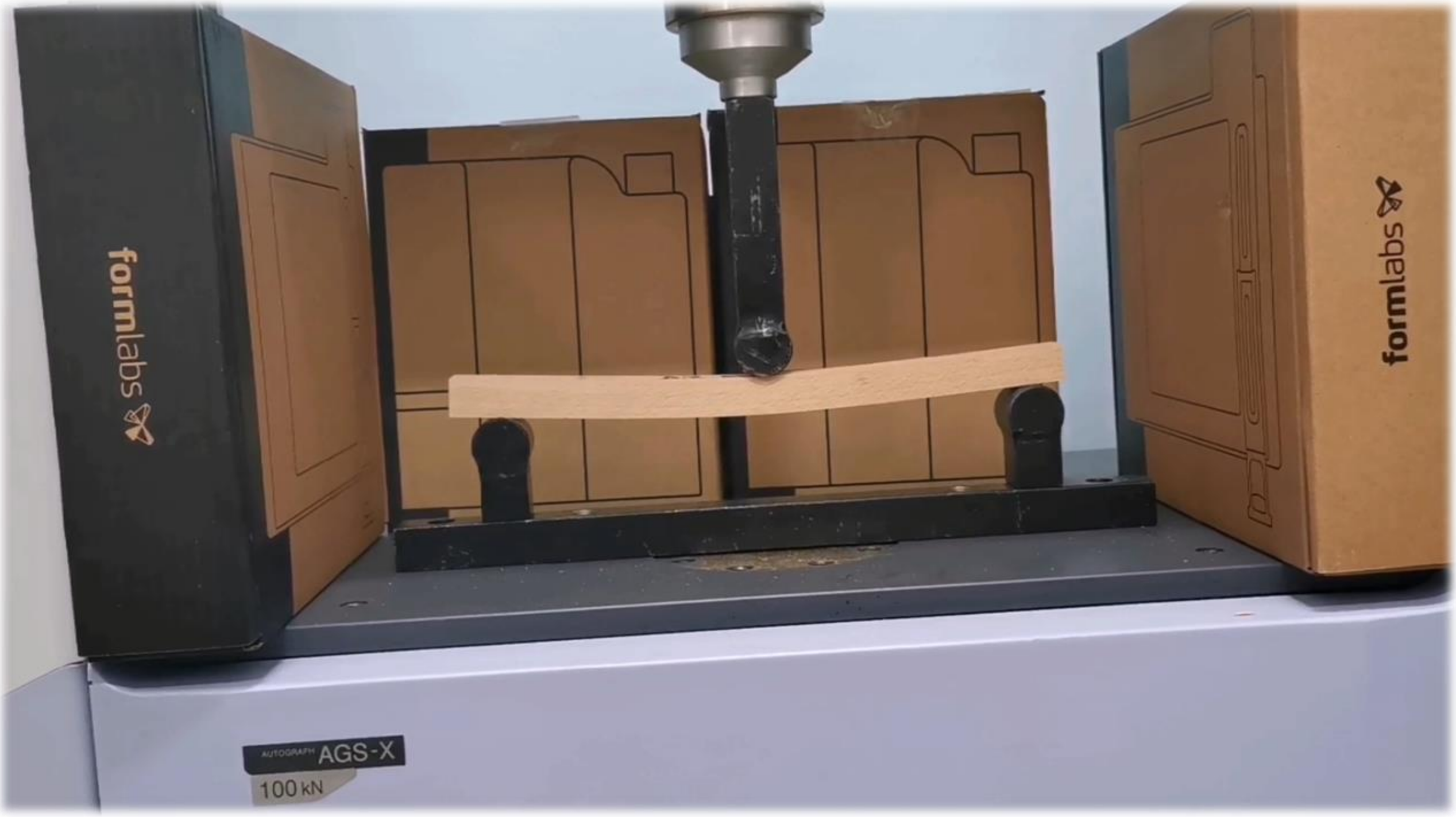
CREATING MATERIAL TESTING TOOLS

Production of specific tools and accessories for testing materials according to the request.

Wide range of available tools and accessories designed for testing materials for tension, pressure and bending in three and four point.

The high precicion of the universal material testing machine we possess and the precisely created tools provide reliable experimental data..

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AUTOGRAPH AGS-X
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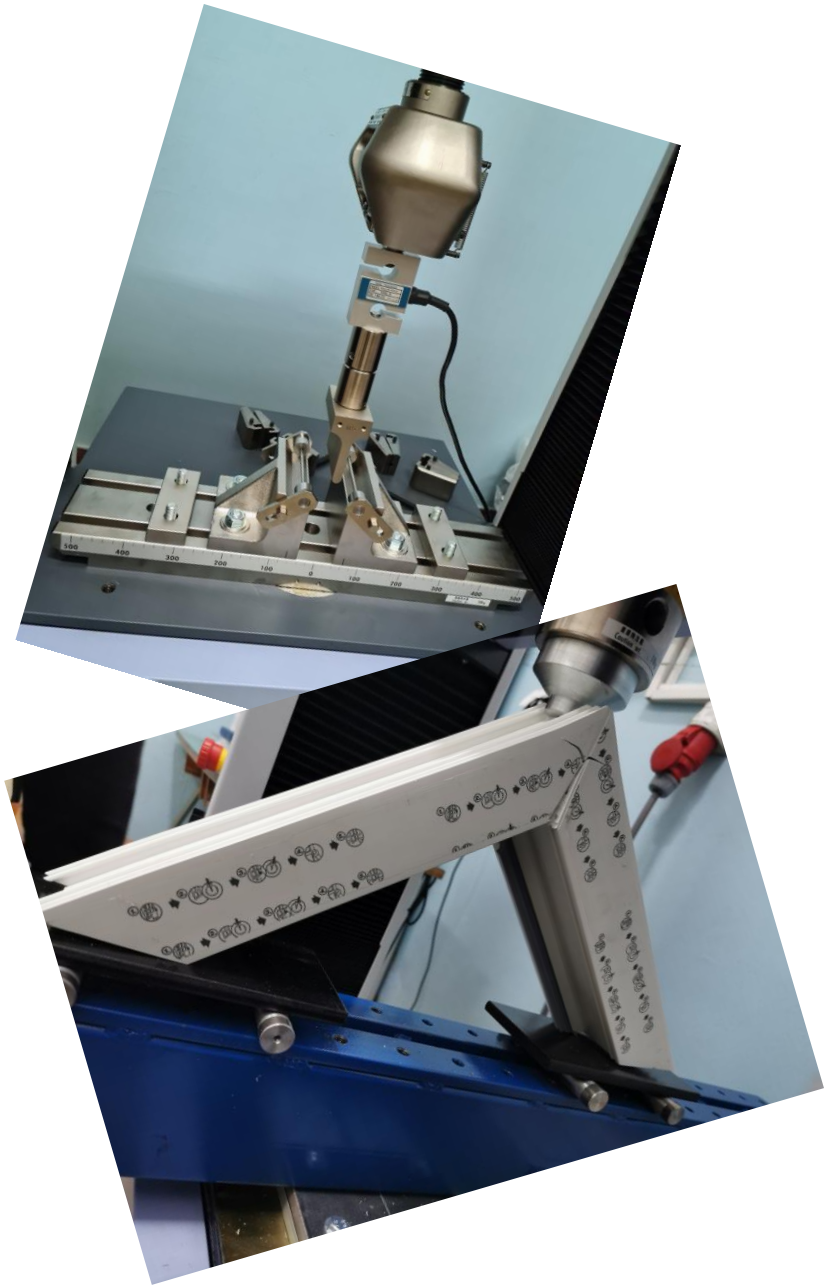

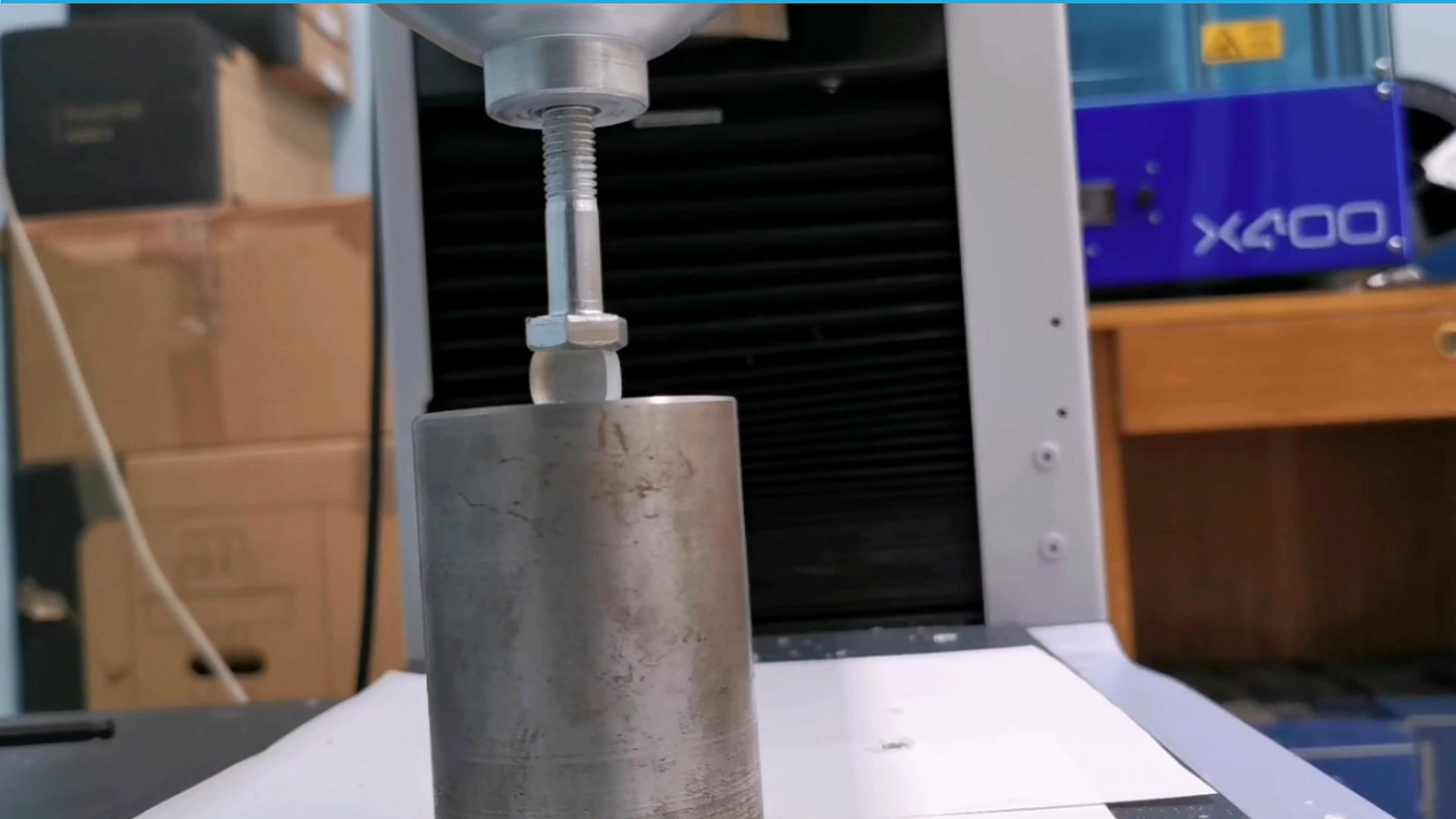
X400

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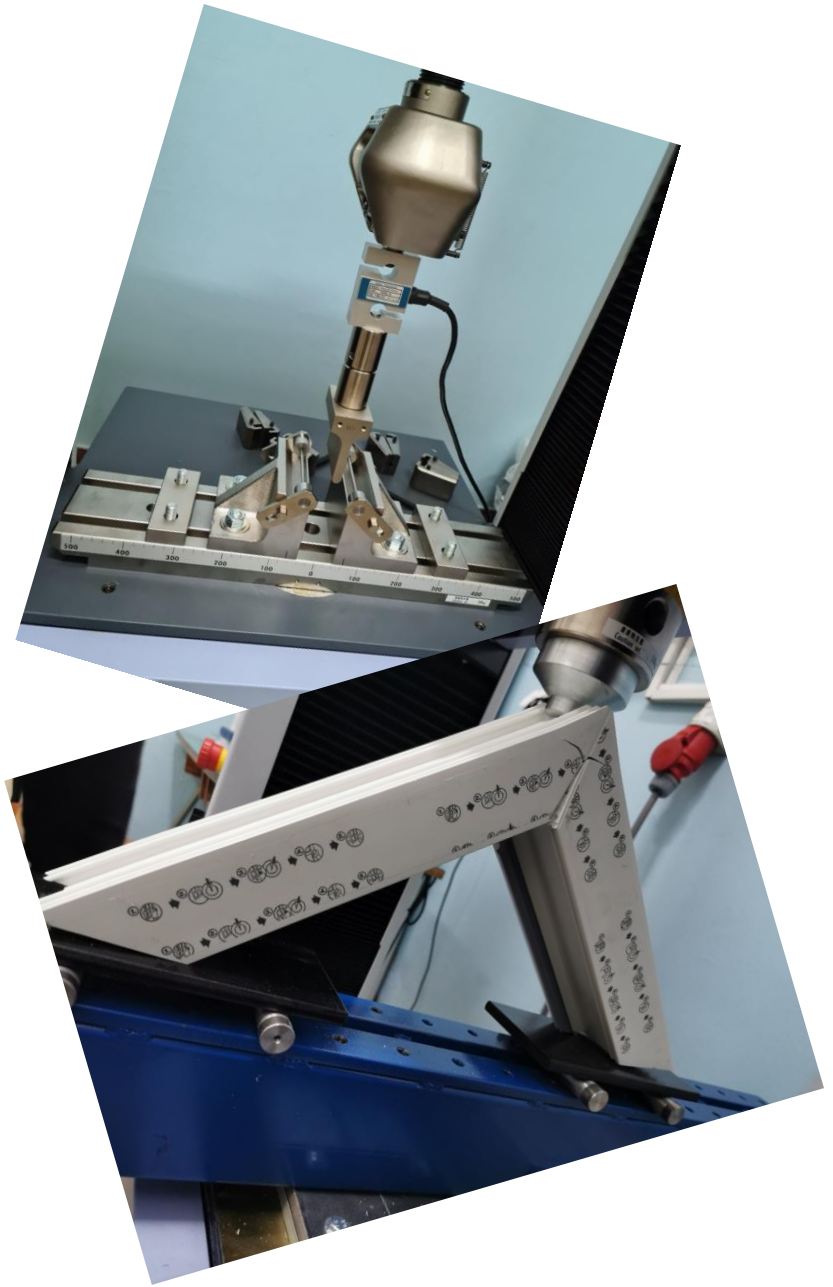
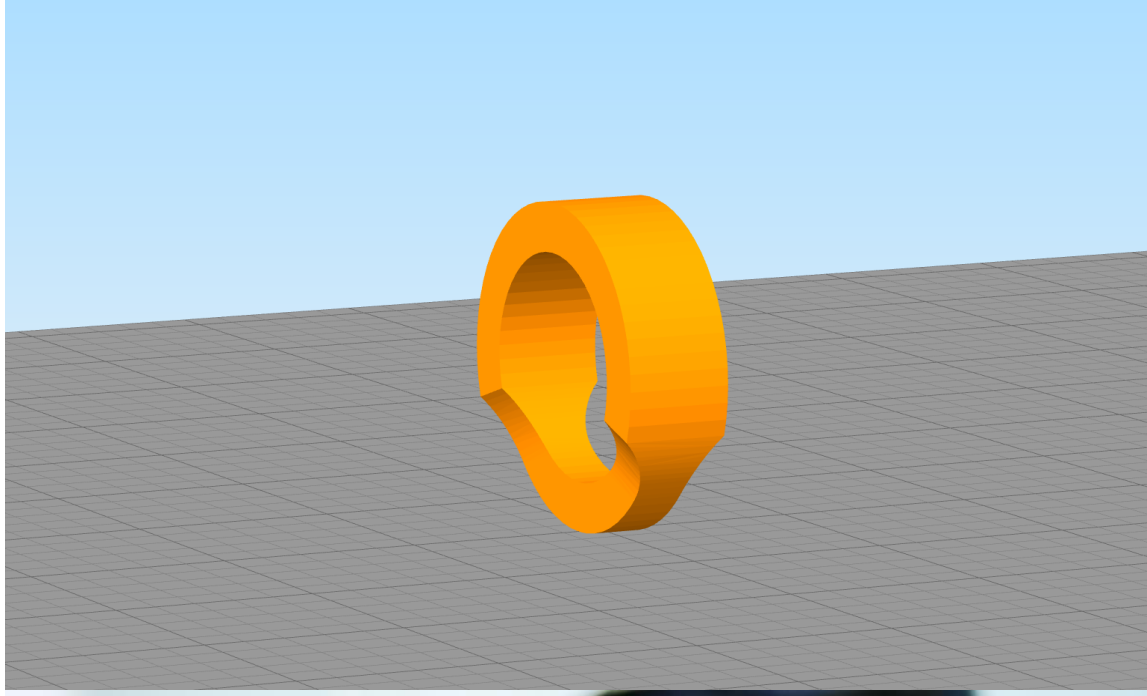
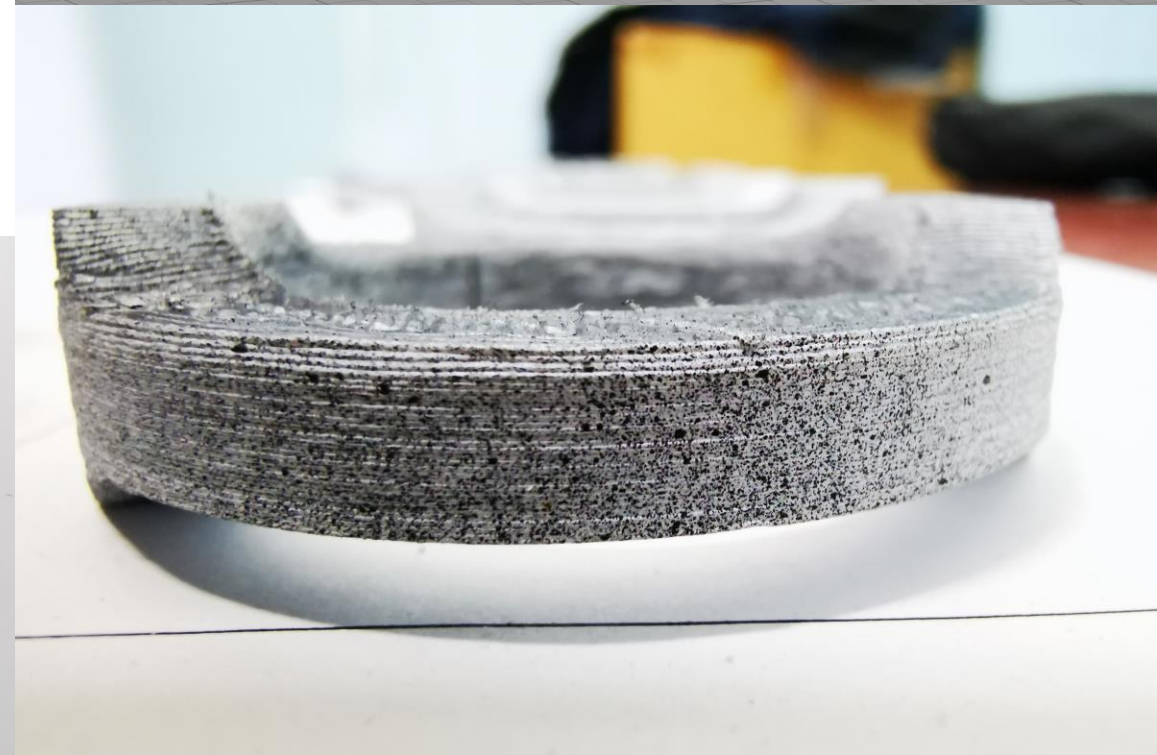


https://www.crainscleveland.com/real-estate/broken-pipeline





DEVELOPING NEW TESTING METHODS

*Solving problems in testing smaller diameter pipes *(<DN100…)*

*This procedure analyzes new form specimen and develops a new method of testing the mechanical properties of materials by the DIC method.

* This test can give useful results for predicting pipe exploitation.

https://www.nuflowmidwest.com/pull-in-place-pipe-lining-a-new-pipe-inside-of-your-old-pipe/

WHAT DO WE HAVE FROM EVERYTHING TOLD?

- WE HAVE AN OPPORTUNITY TO PUT A LONG AWAITING IDEA ON THE TABLE FASTER AND CHEAPER THAN EVER BEFORE!
- IT CAN BE PRODUCED OUT OF VARIOUS MATERIALS WHICH ARE PROVIDED BY ADDITIVE TECHNOLOGIES.
- “IDEA FROM THE TABLE” DOES NOT HAVE TO BE EXPLOITED AT FIRST, WE CAN TEST IT BEFOREHAND.
- IF WE ARE NOT SATISFIED WITH THE RESULT, WE CAN GET A NEW ITERATION OF THIS IDEA EVEN FASTER THAN BEFORE.

THANK YOU FOR YOUR ATTENTION !

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M. Milosevic
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Isaak Trajković
mail: itrajkovic@mas.bg.ac.rs