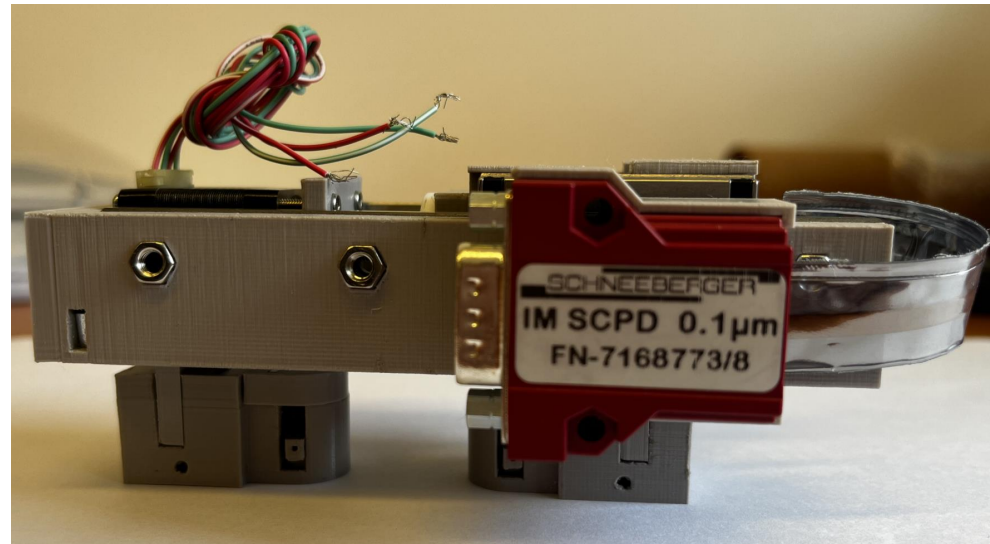


# Novel design of a device for measurement of human skin viscoelastic properties

Perrine BEGON & Flavie DELOUYE

INSA Centre Val de Loire, Blois, France – Institute of Thermomechanics, Prague, Czech Republic



SPMS conference, Rumburk, Czech Republic, 23 - 27 June 2022

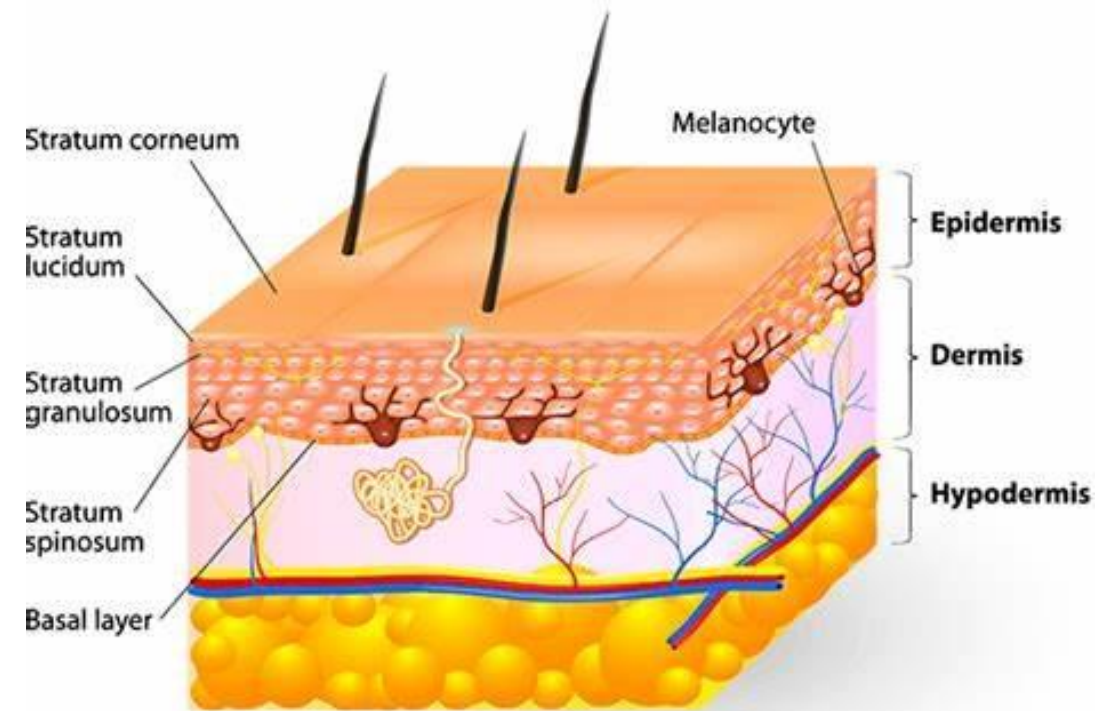
# OUTLINE

- **Introduction**
- **Design specifications**
  - Previous design
  - Novel design
- **Mechanical design**
  - Motor piece
  - Movement transmission piece
  - Strain gauges piece
  - Ultrasonic transducer pieces
- **Future steps**
  - Electrical part
  - Novel device assembly and verifications

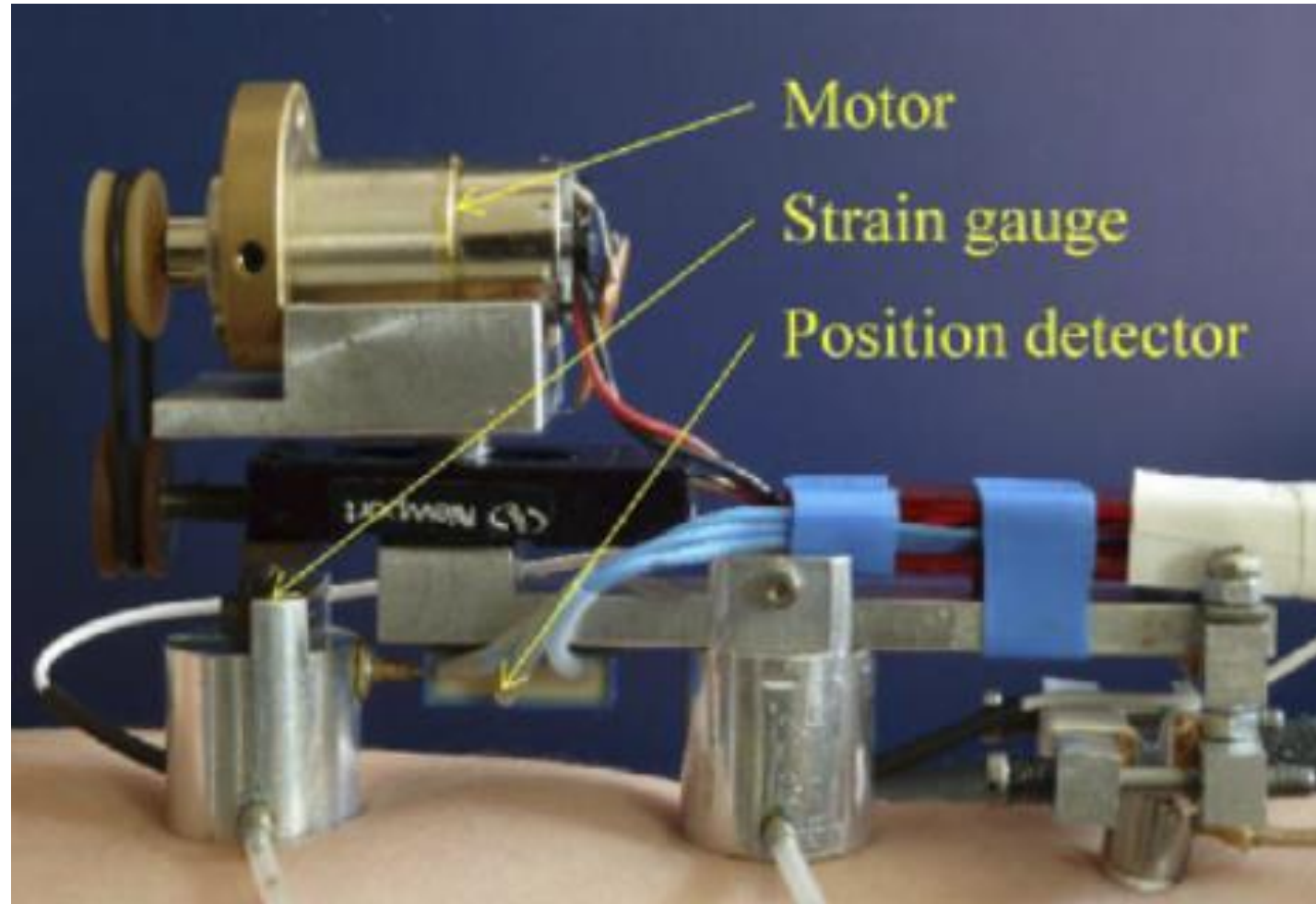
# INTRODUCTION

- Anisotropic and non-linearly viscoelastic properties
- Cosmetic industry and aesthetic medicine

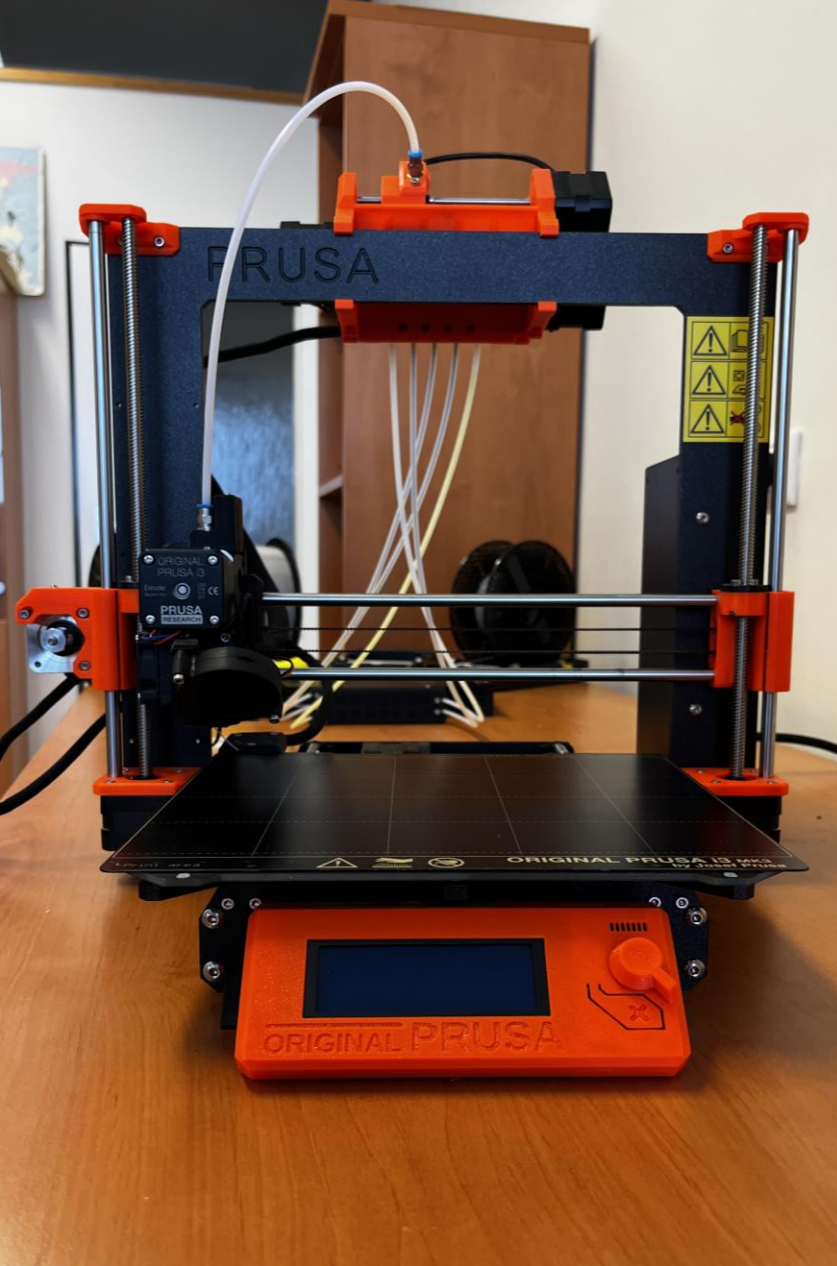
## THE LAYERS OF HUMAN SKIN



## PREVIOUS DESIGN



*Mechanical loading and ultrasonic testing device in 2013*



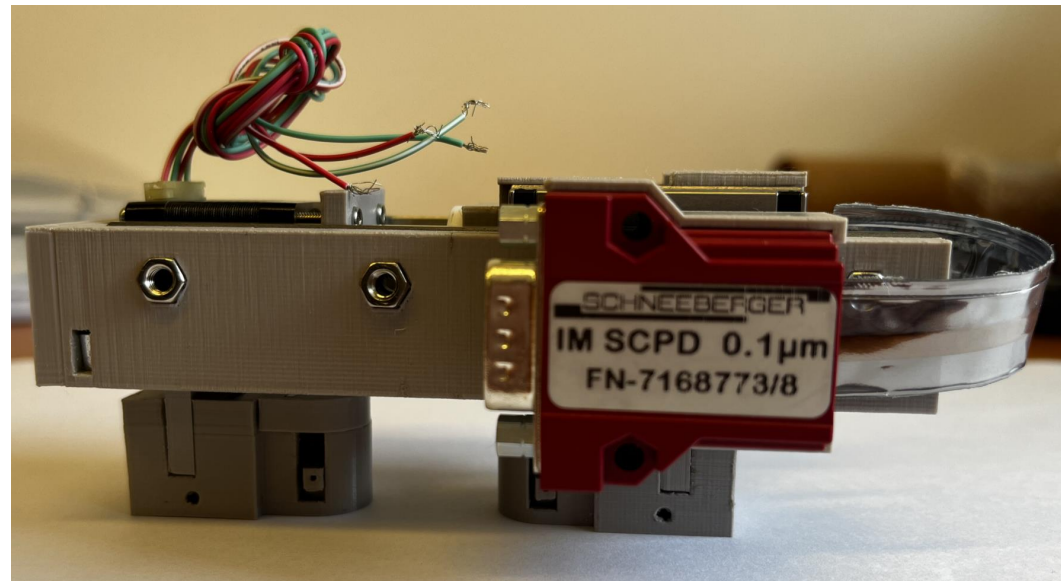
PRUSA I3 MK3, 3D printer

## NOVEL DESIGN

- 3D-printing
- Modelisation with Fusion software
- Dimensions not lower than 1 mm



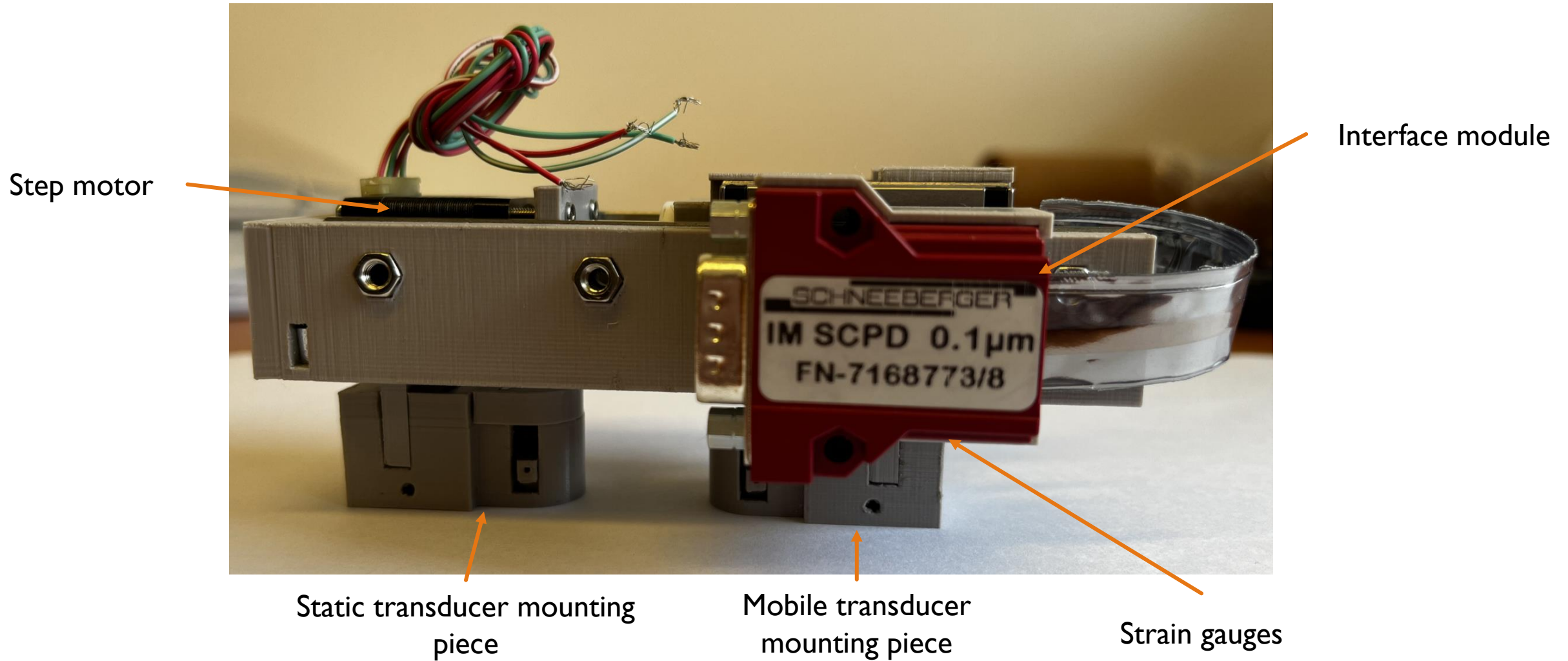
AUTODESK®  
FUSION 360™



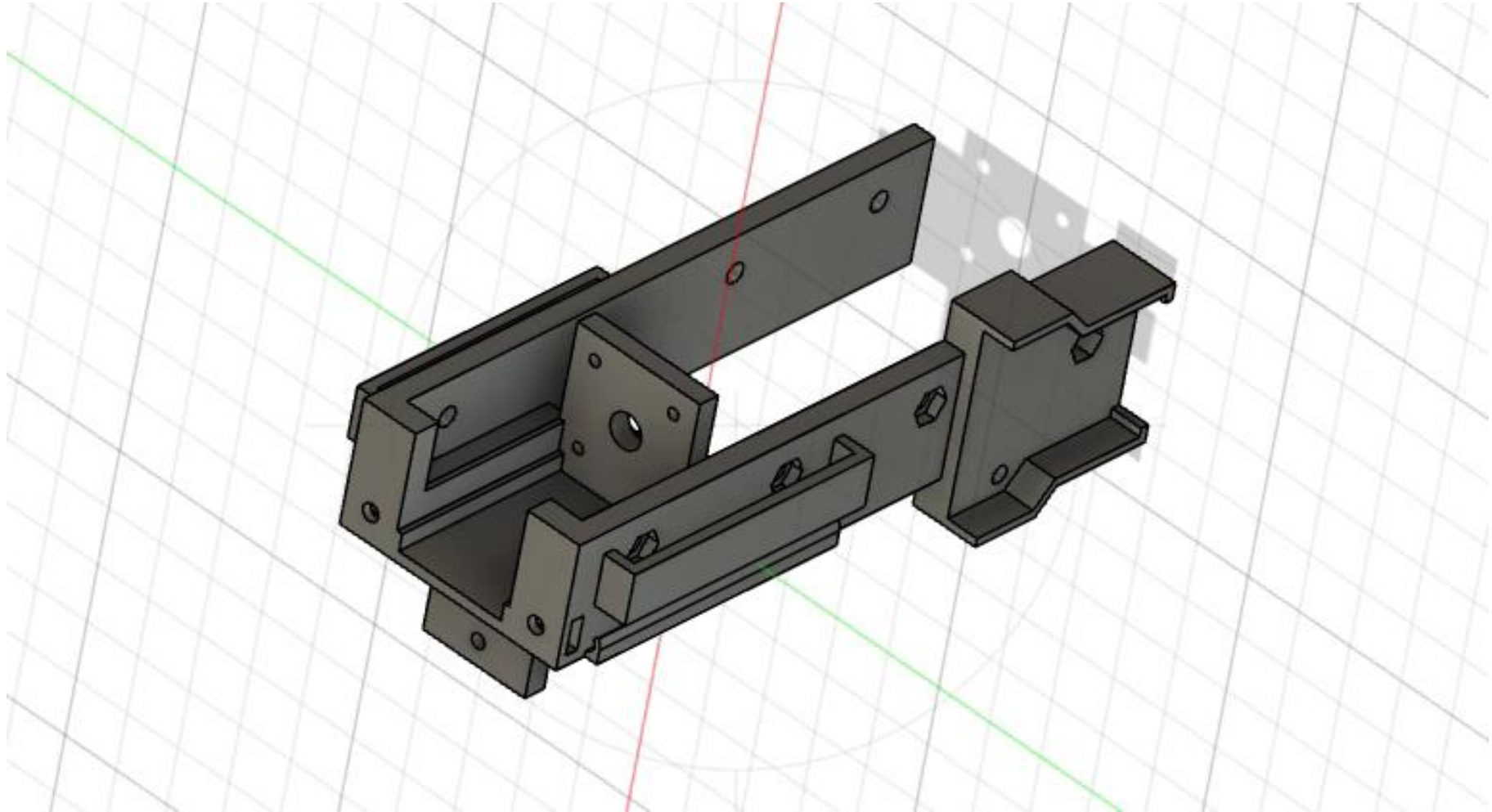
Novel device in June 2022



# NOVEL DESIGN

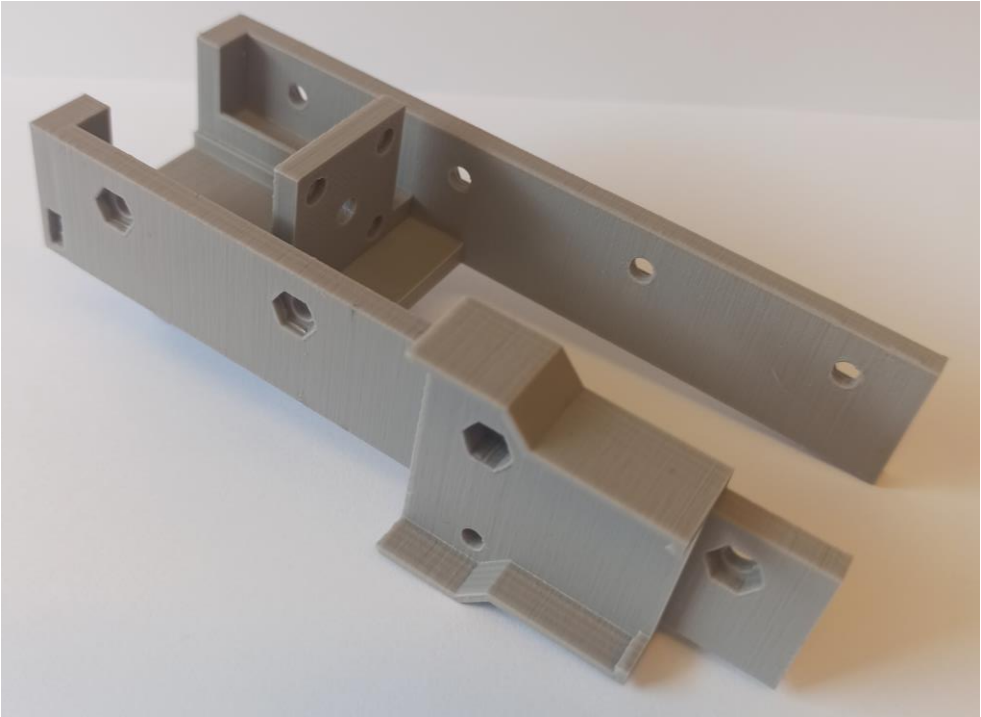


# MOTOR PIECE

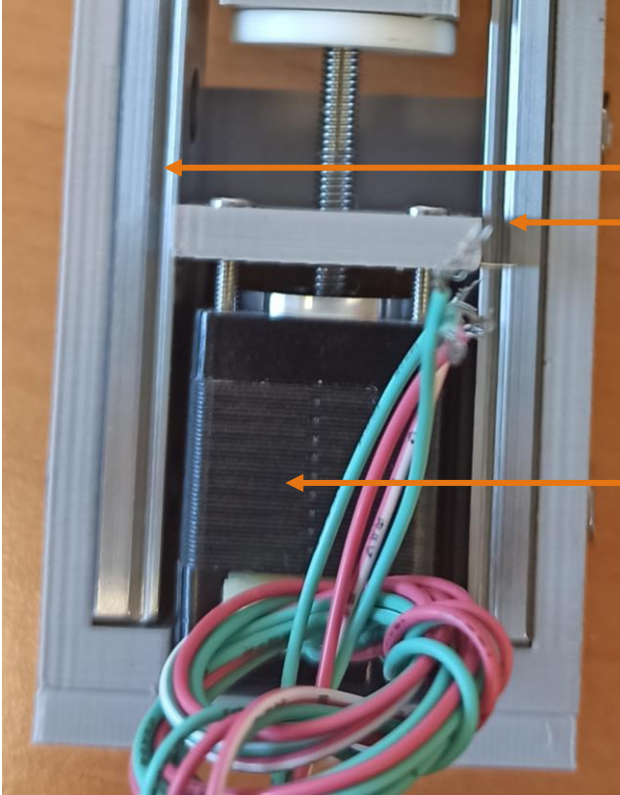


*General view*

# MOTOR PIECE



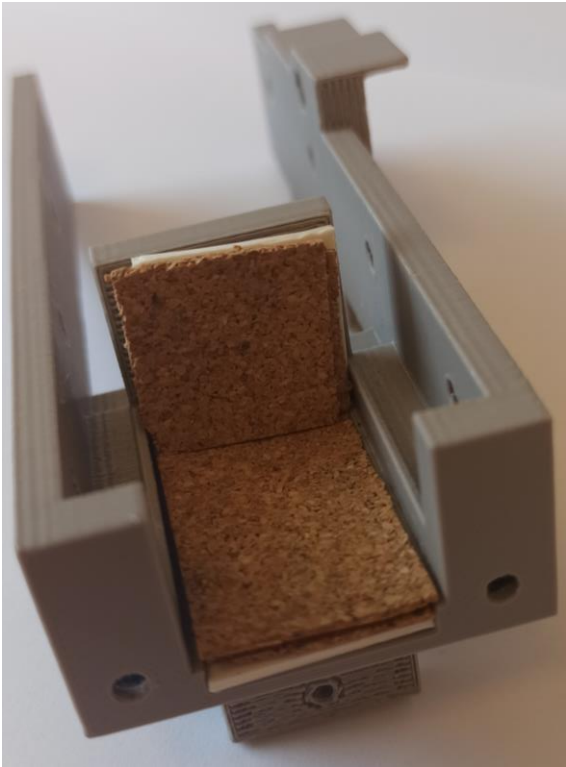
*Printed piece*



Rails

Step-motor

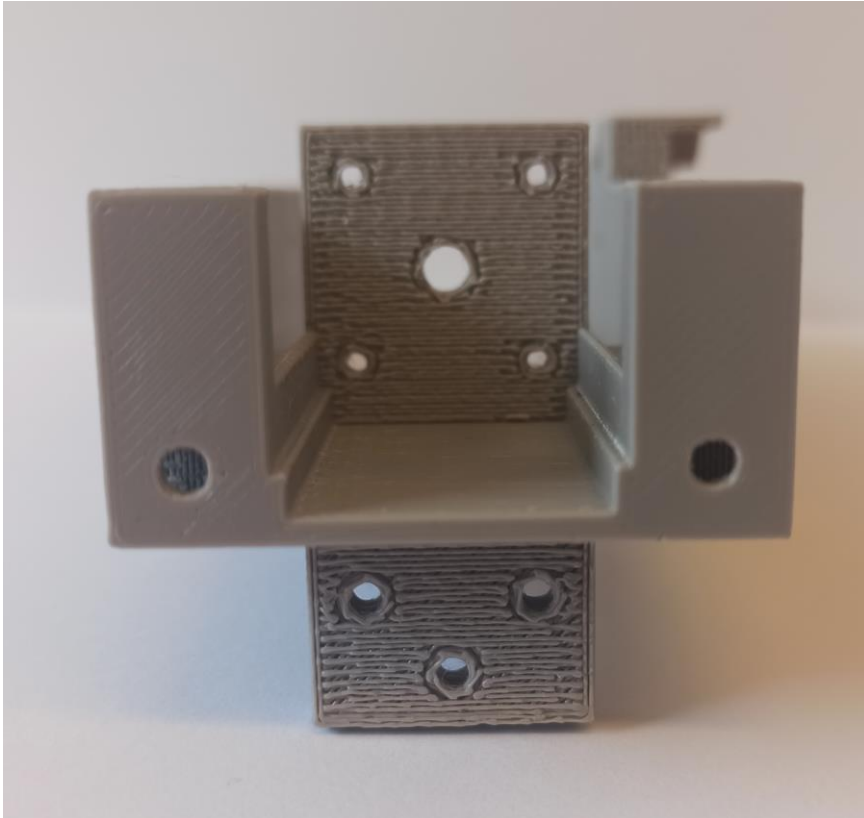
*Assembly with the step-motor and the rails*



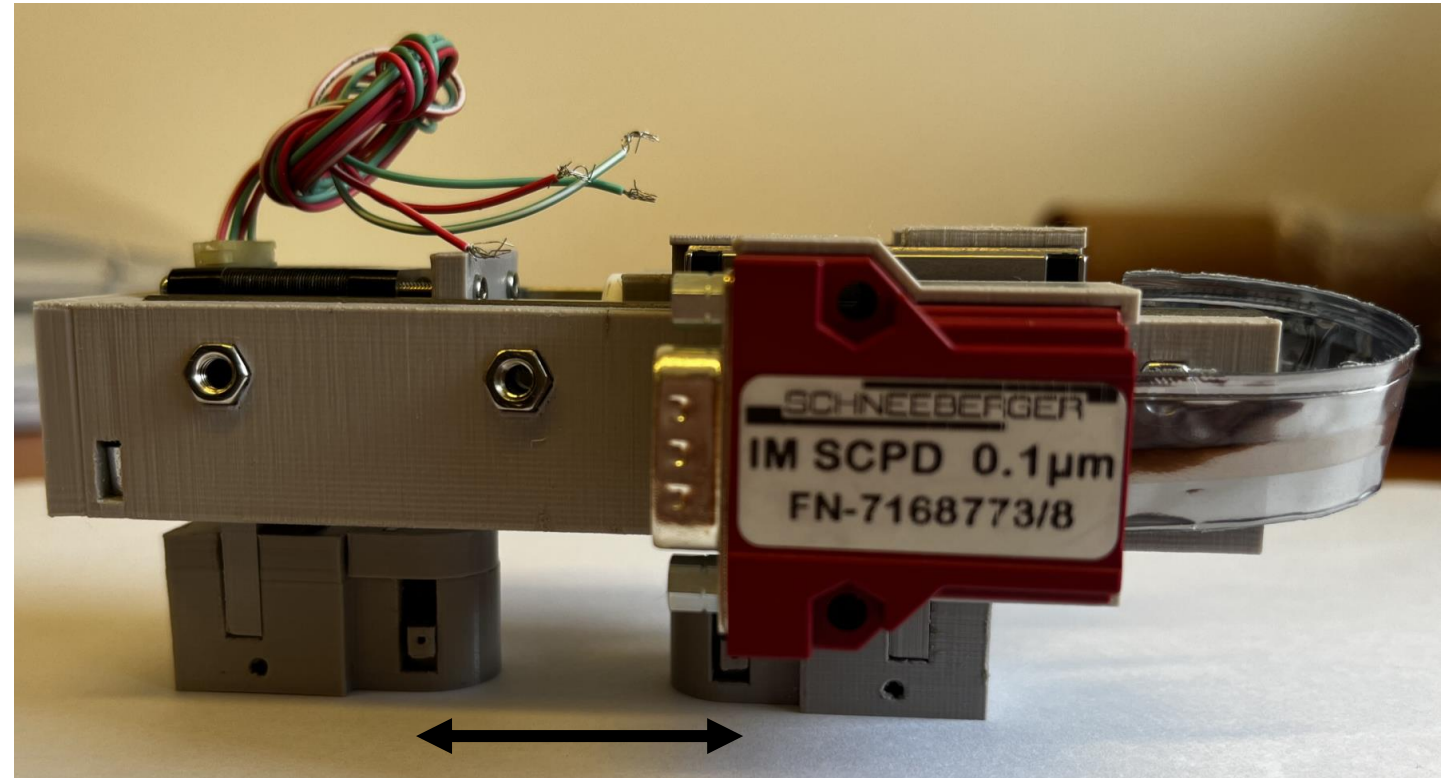
*Printed piece with cork and silicon layers*



# MOTOR PIECE

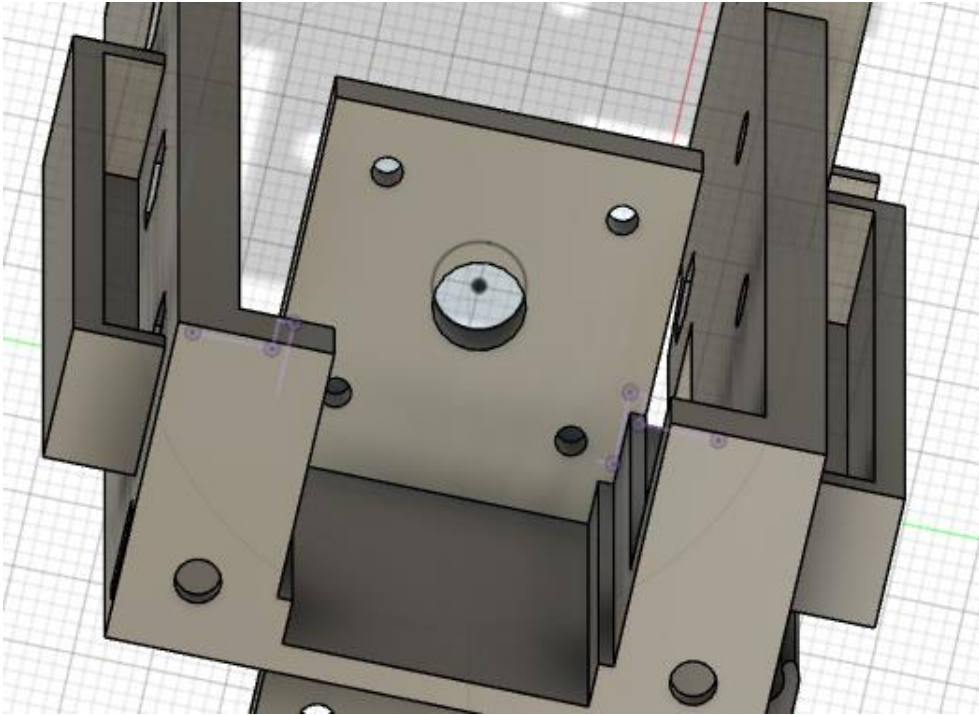


*Back view of the motor piece*

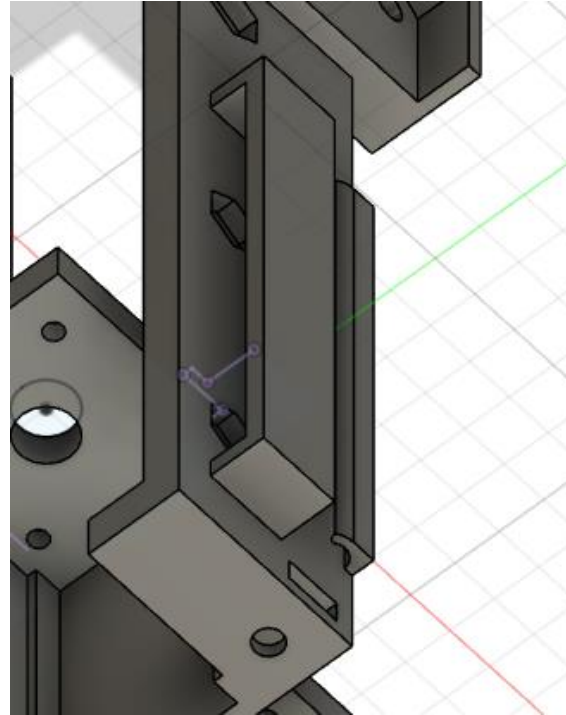


5-7 cm between the center of the two ultrasonic transducers

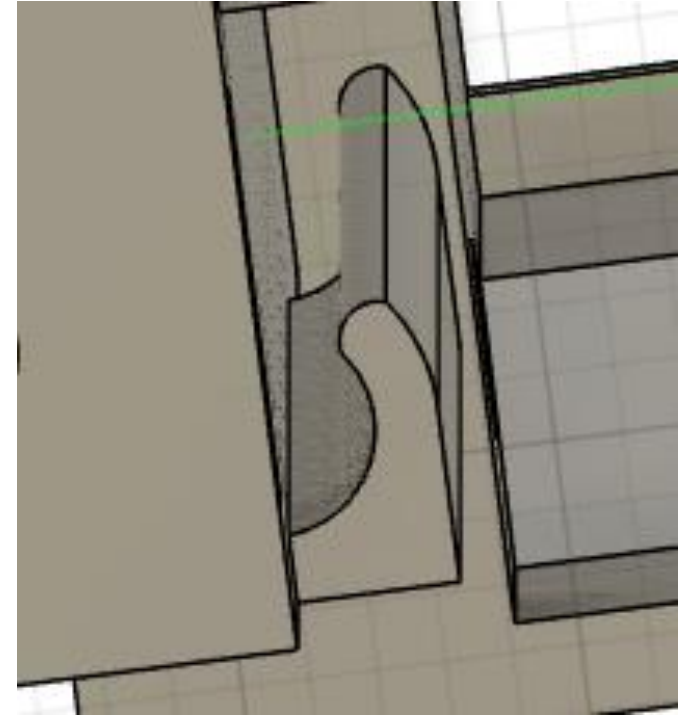
# MOTOR PIECE



*Back view*

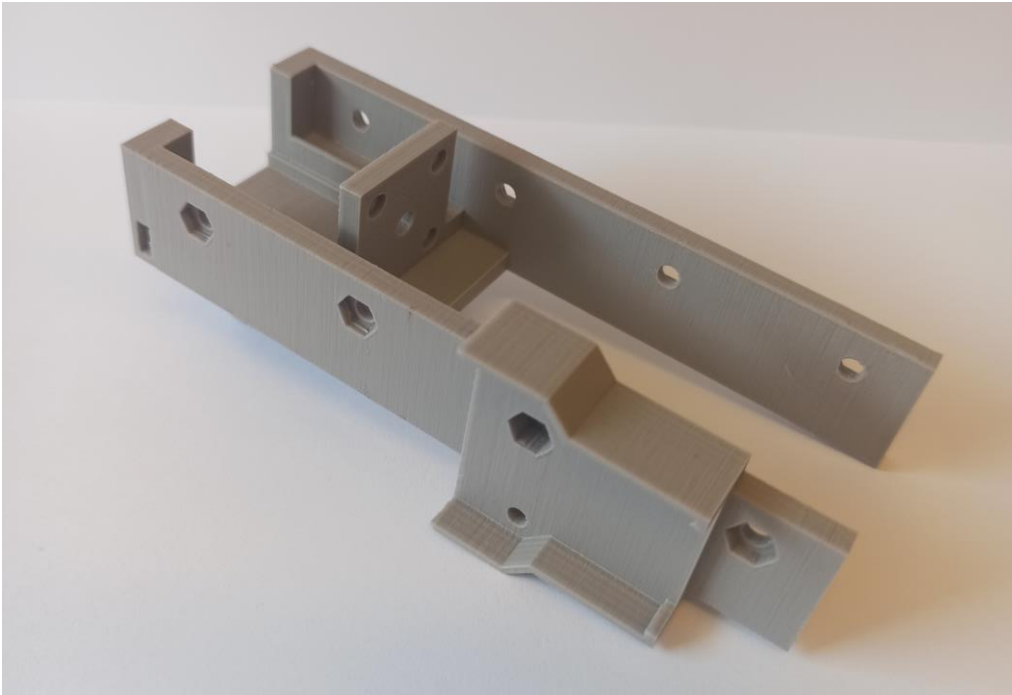


*Elastic strip hook*

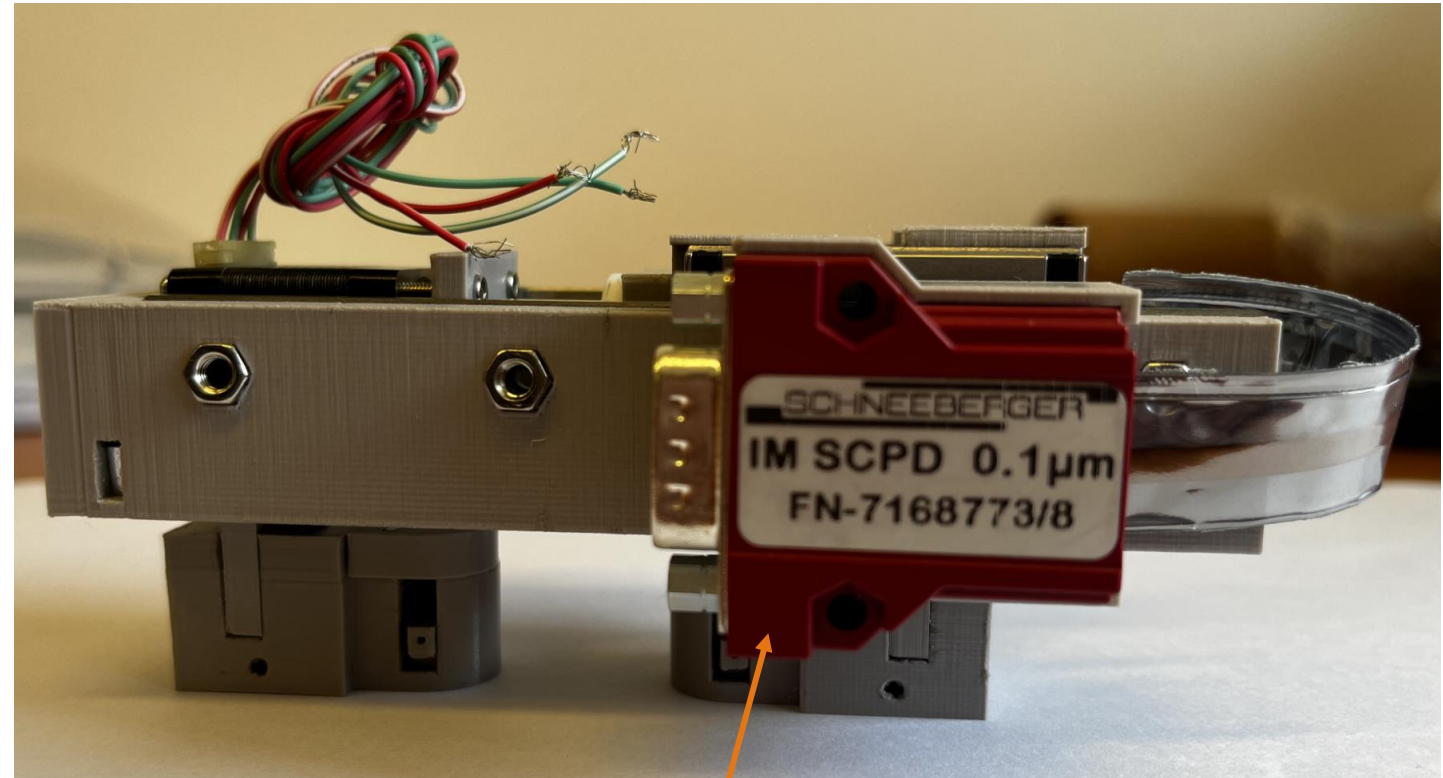


*Coaxial cable hook*

## MOTOR PIECE

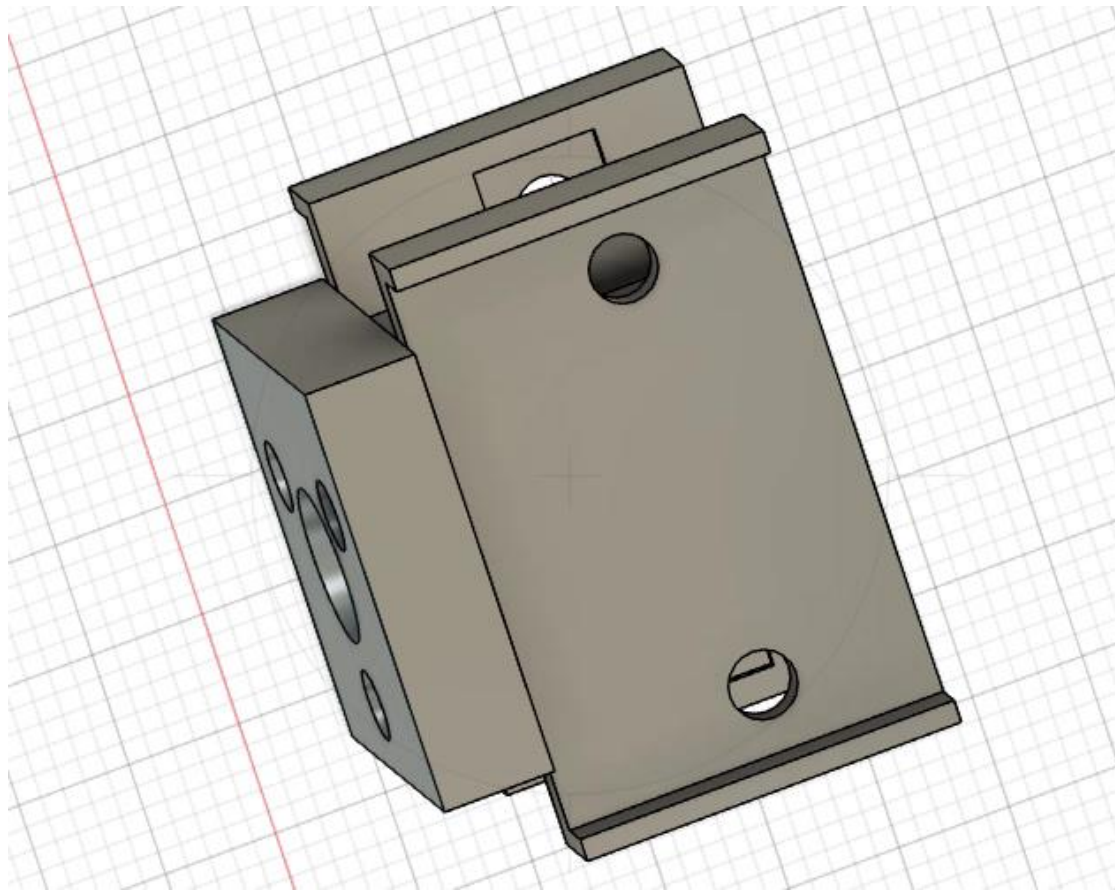


*Printed piece*



Interface module for position measurement

## MOVEMENT TRANSMISSION PART



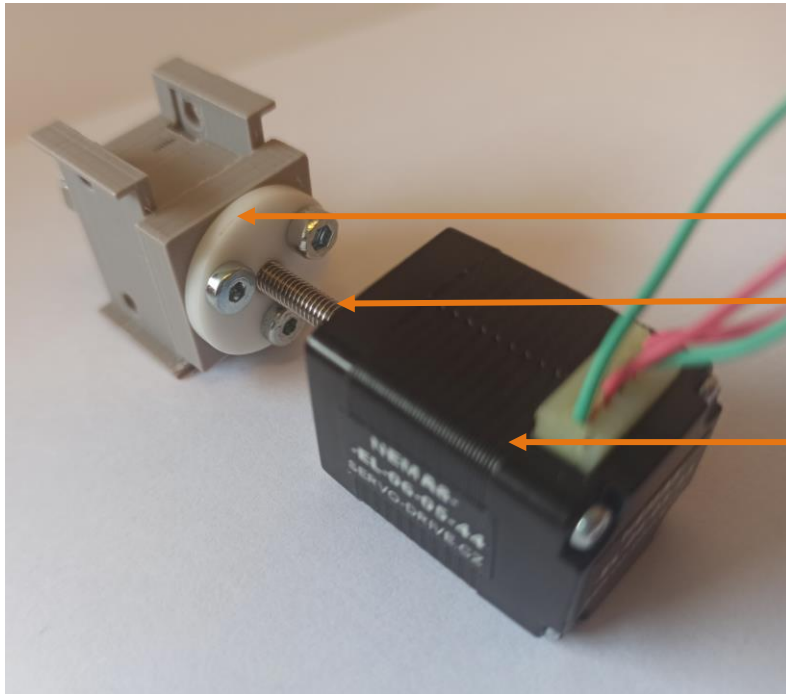
*General view*



*Step-motor*



## MOVEMENT TRANSMISSION PART

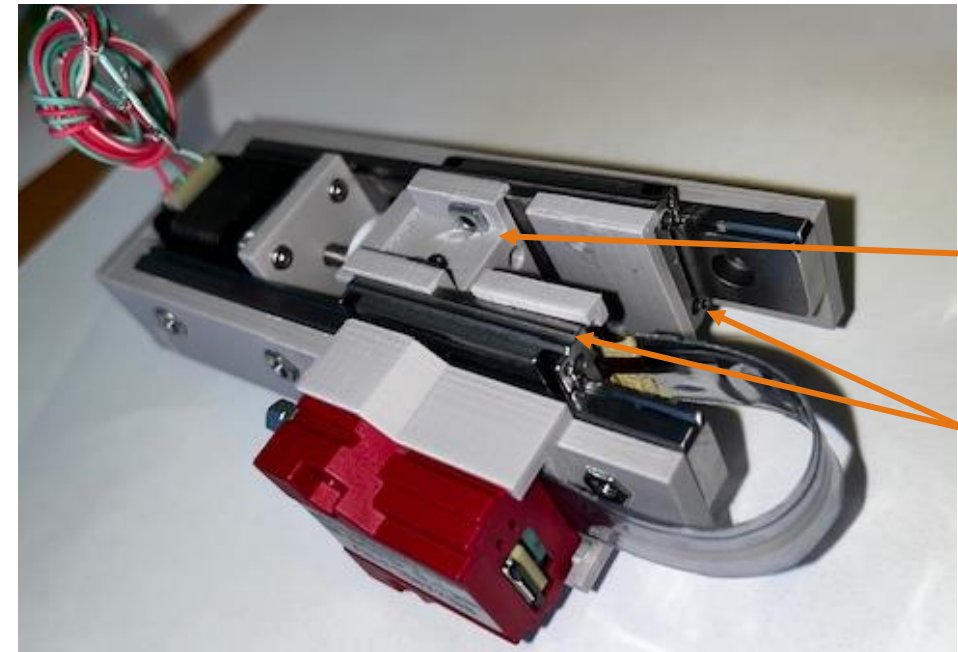


White plastic nut

Motor screw

Step motor

*Movement transmission part  
assembly with the motor*

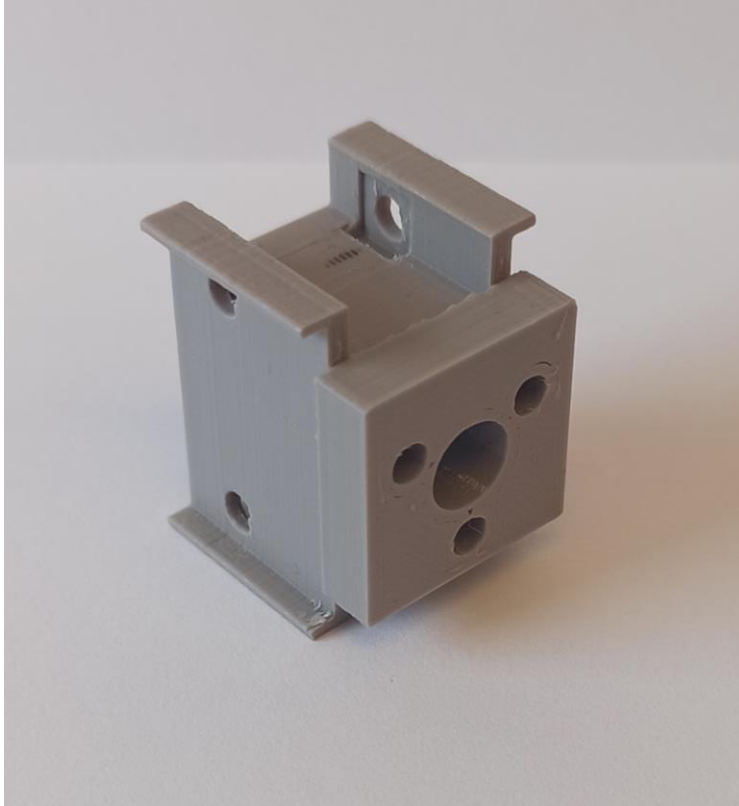


Printed part

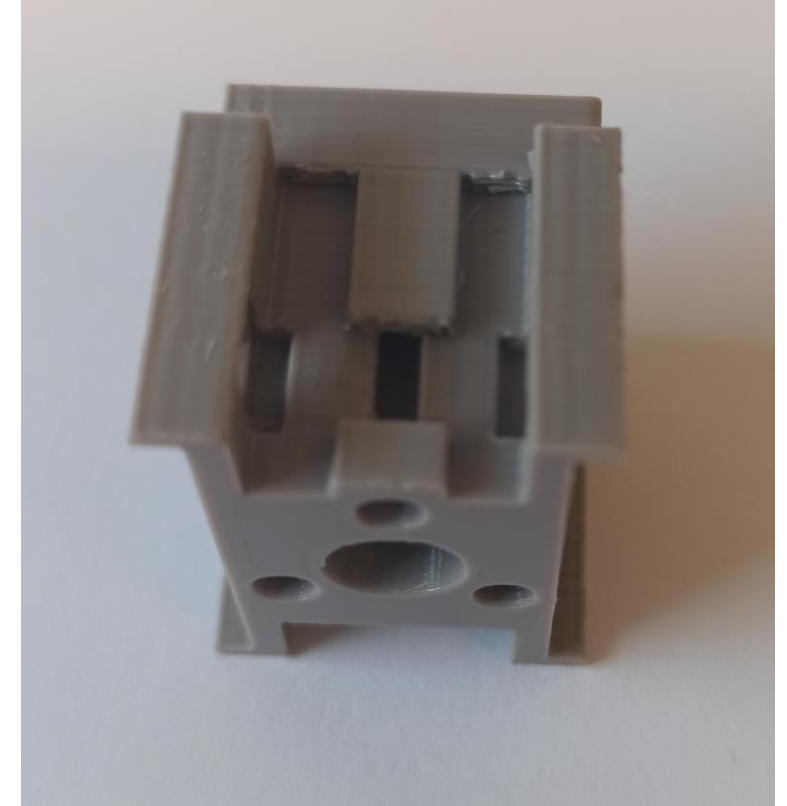
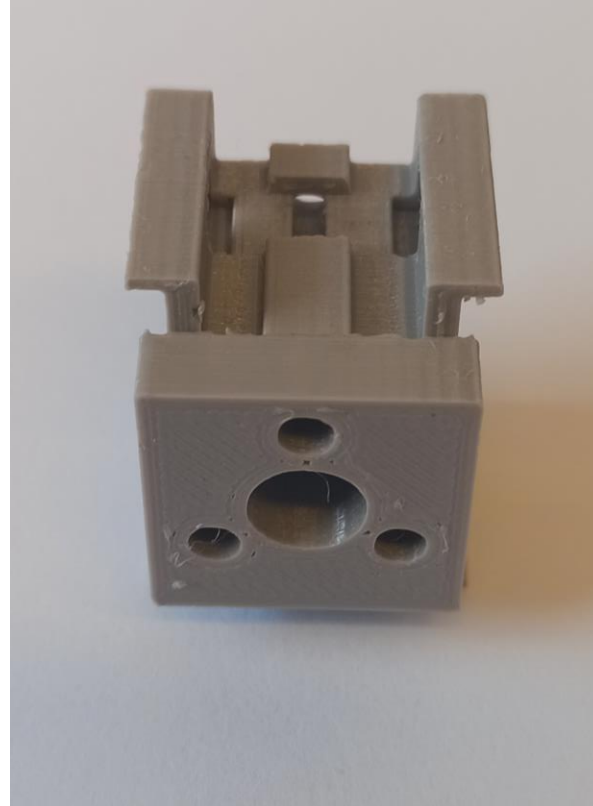
Wagons

*Assembly of the new device*

## MOVEMENT TRANSMISSION PART

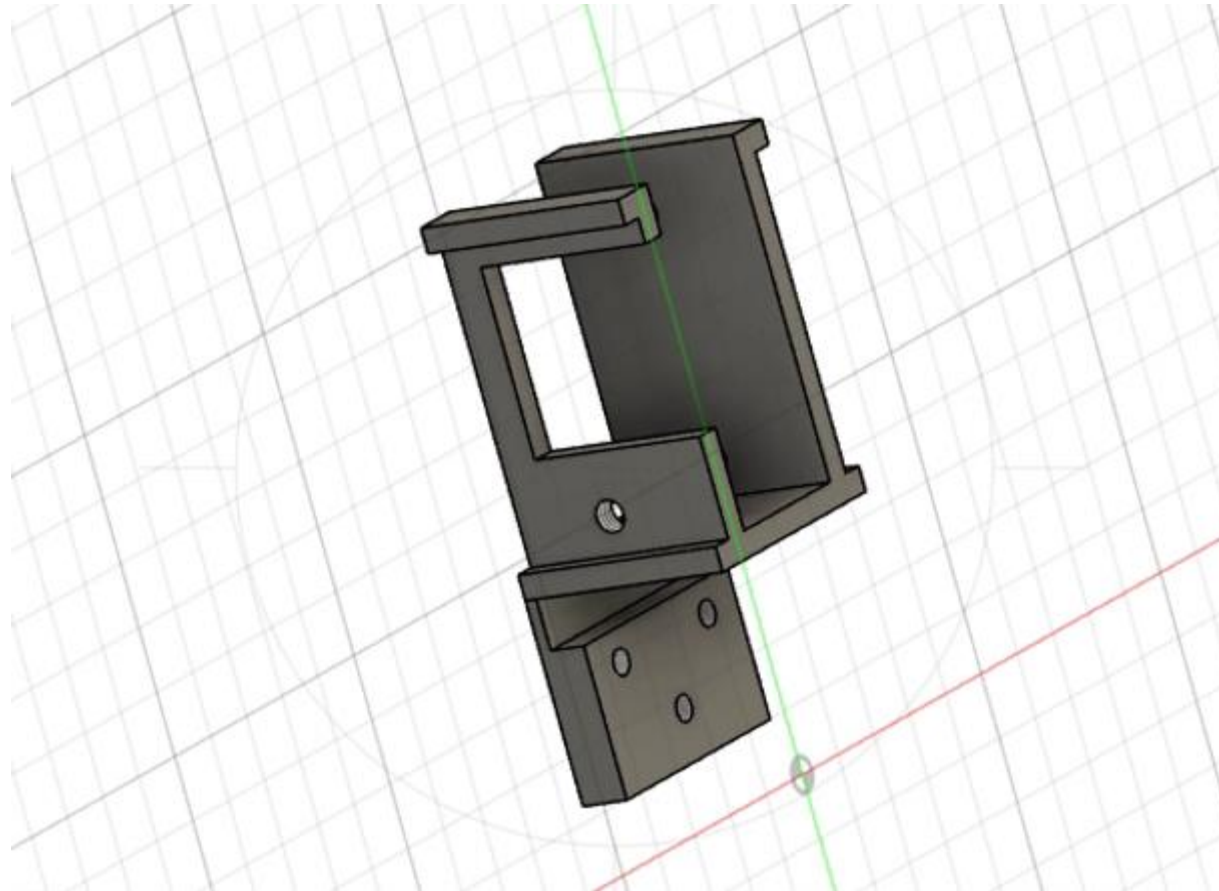


*Printed part with 3 equidistant holes*



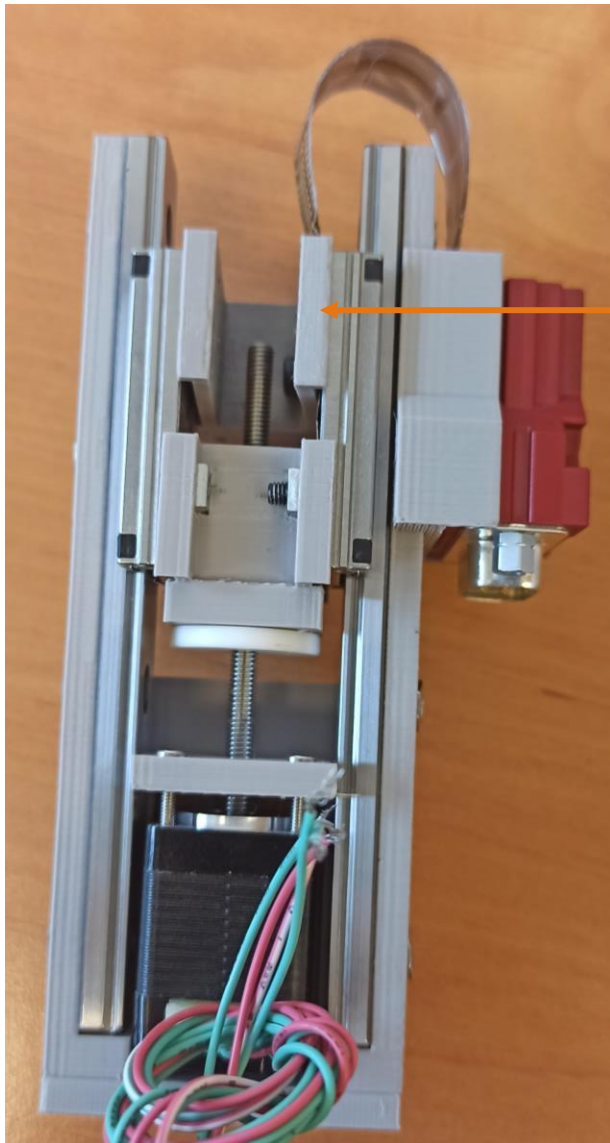
*Bottom views*

# STRAIN GAUGES PIECE

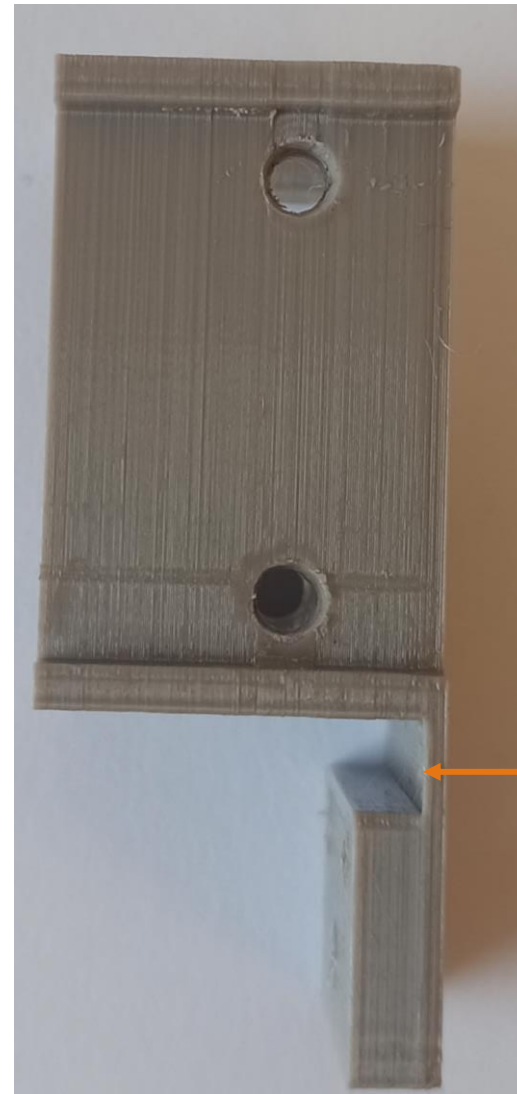


*General view*

## STRAIN GAUGES PIECE



Strain gauges  
piece

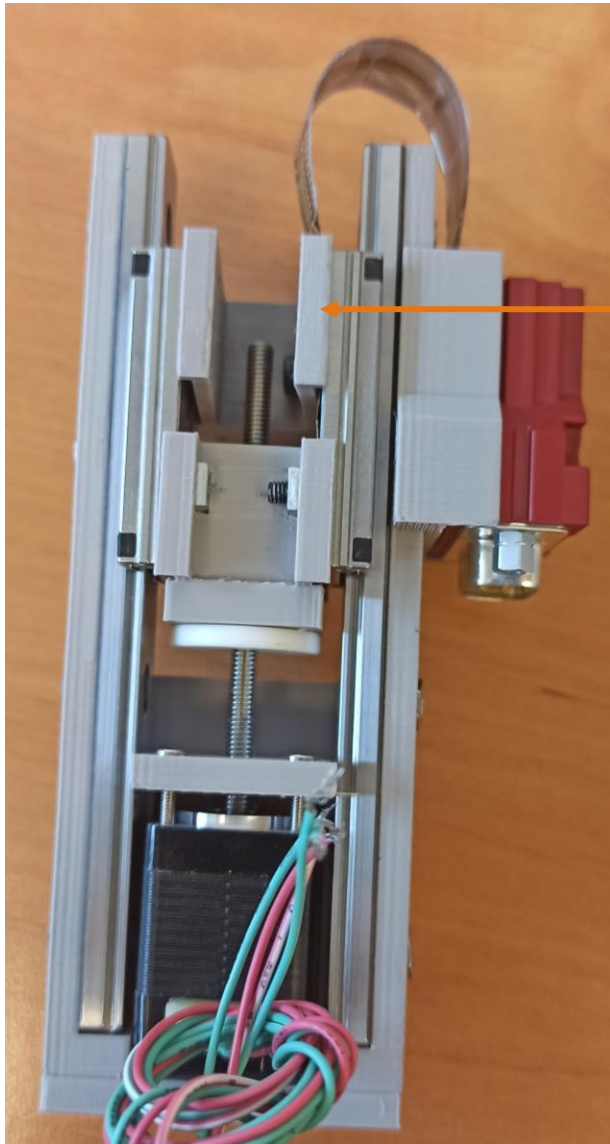


1 mm thickness  
rectangle to put the  
strain gauges on

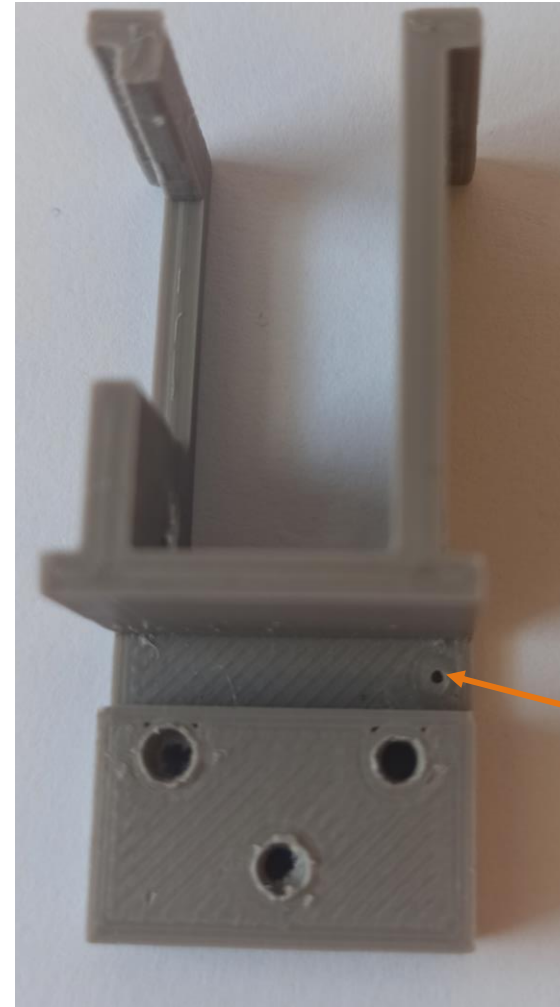
*Printed strain gauges piece*



## STRAIN GAUGES PIECE



Strain gauges  
piece

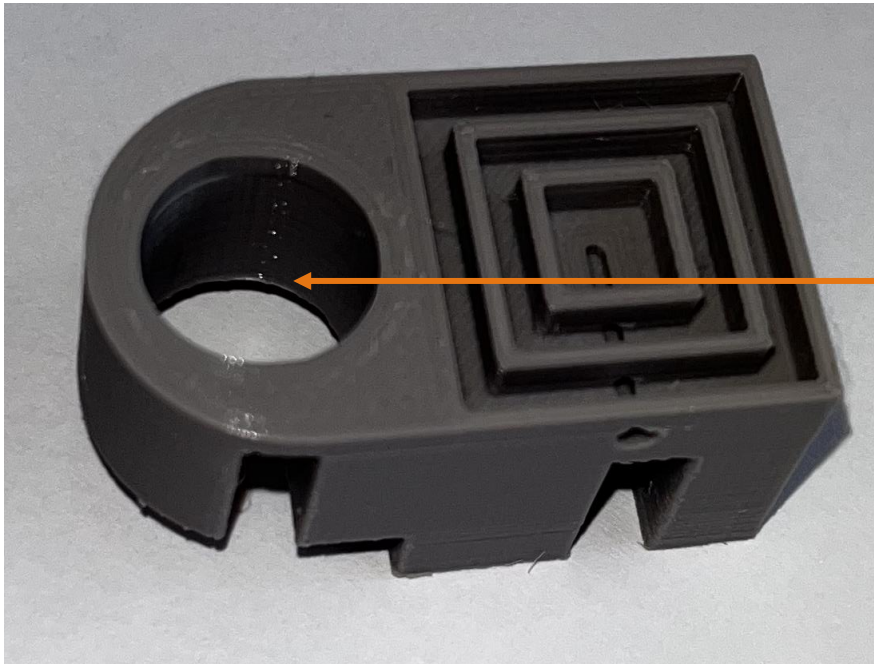
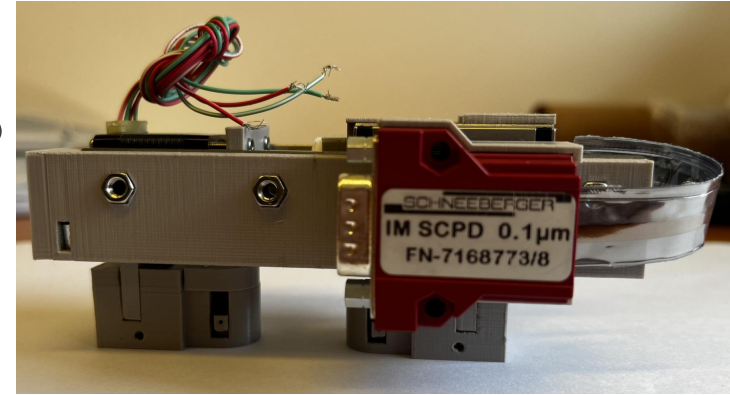


Hole connecting  
the sensors

*Printed strain gauges piece*

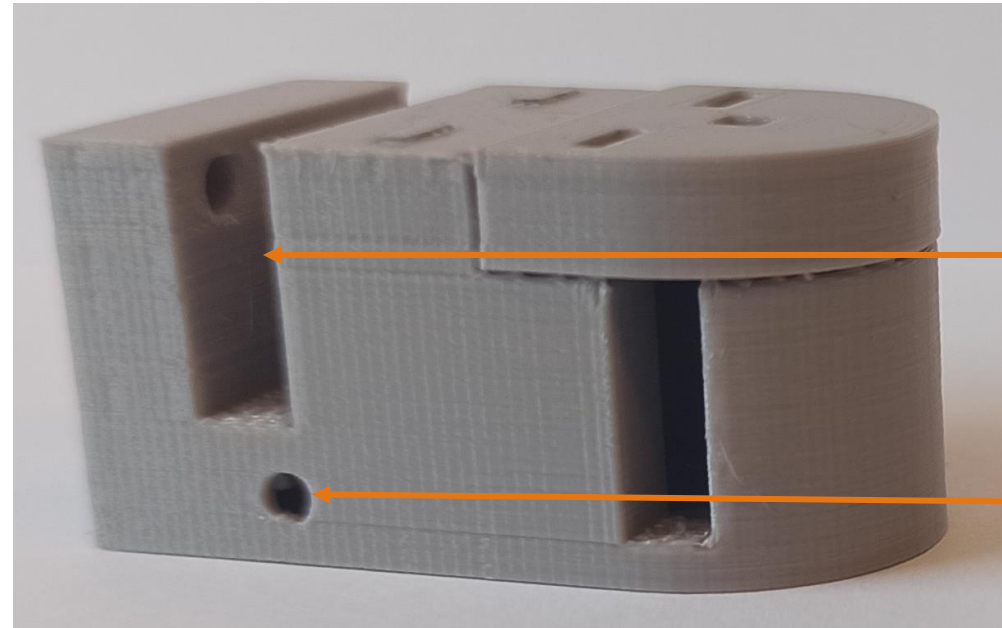
# ULTRASONIC TRANSDUCER PIECES

## TRANSDUCER MOUNTING PIECE



Hollow cylinder

*Bottom view*



Empty part for the motor part or the strain gauges part

Hole for negative pressure

*Loading part*

# ULTRASONIC TRANSDUCER PIECES

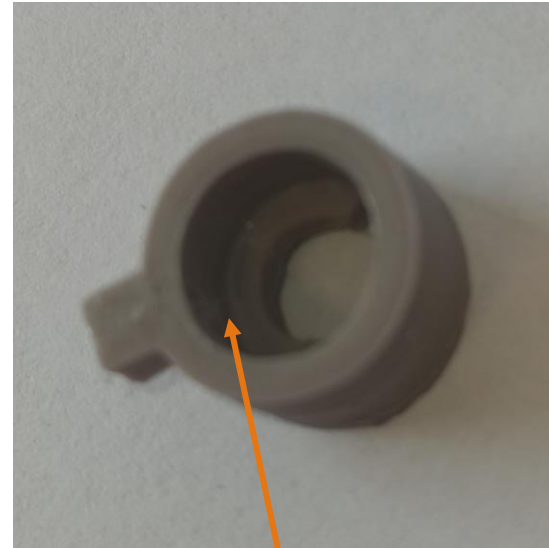
## ULTRASONIC TRANSDUCER CUP



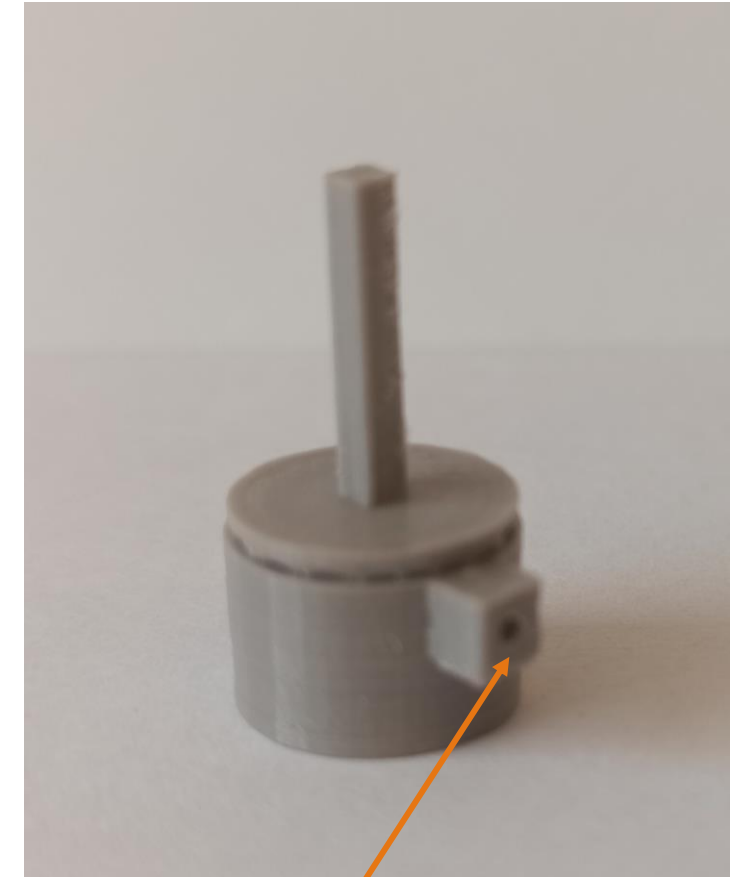
*Ultrasonic transducer cup*



*Ultrasonic transducer in the cup*



Shielding



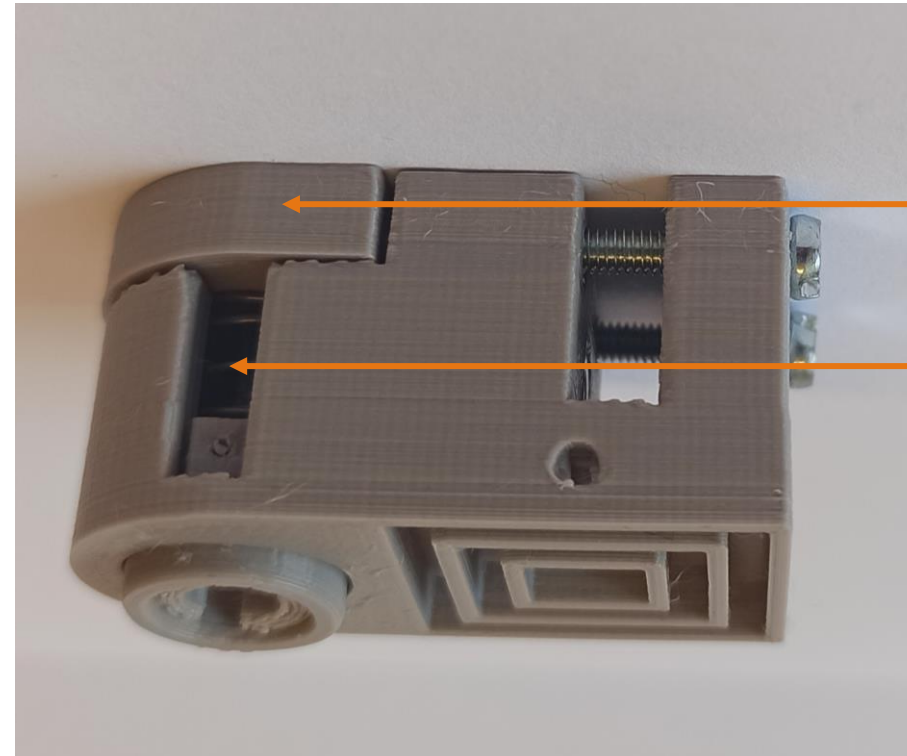
Hole for the coaxial cable

# ULTRASONIC TRANSDUCER PIECES

## ULTRASONIC TRANSDUCER CUP



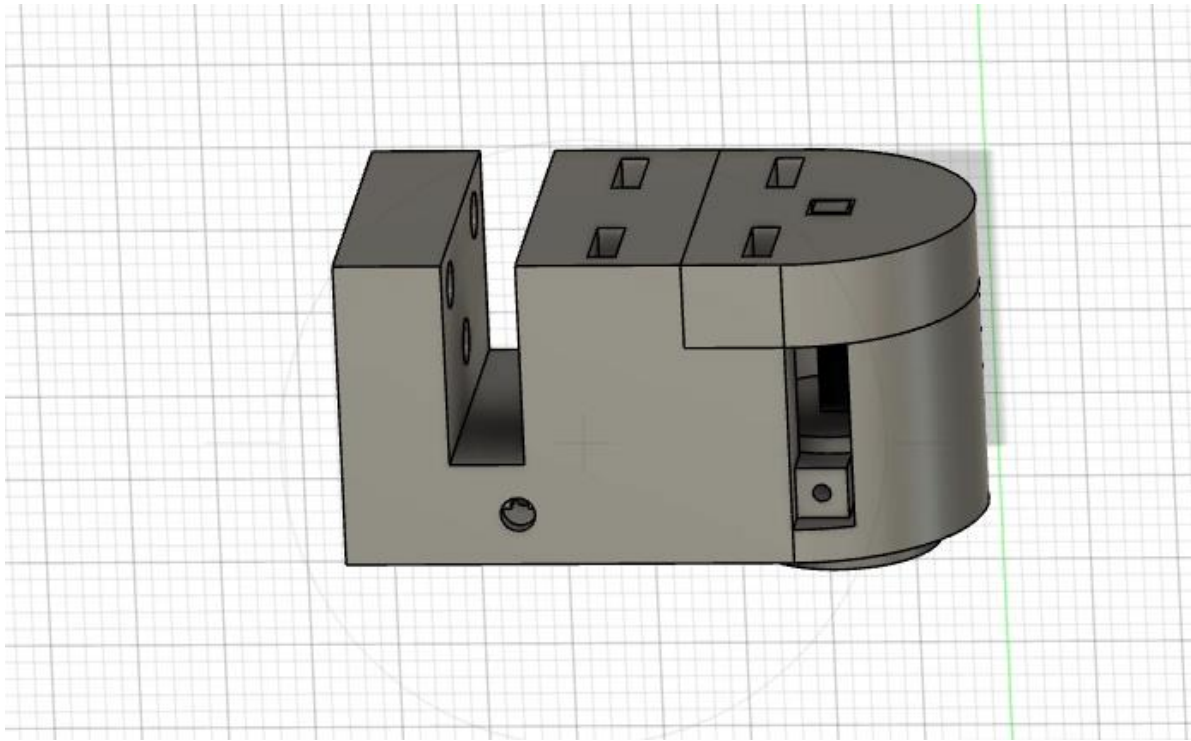
*Printed ultrasonic transducer cup  
with the spring*



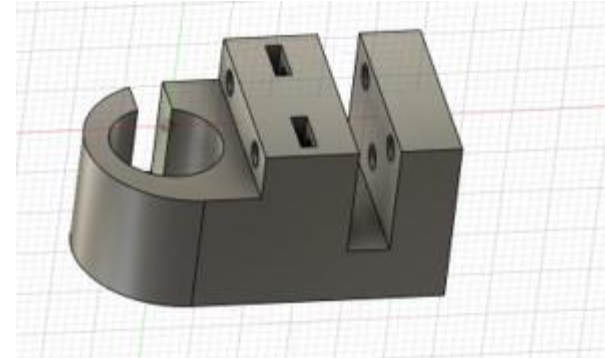
*Printed loading part*



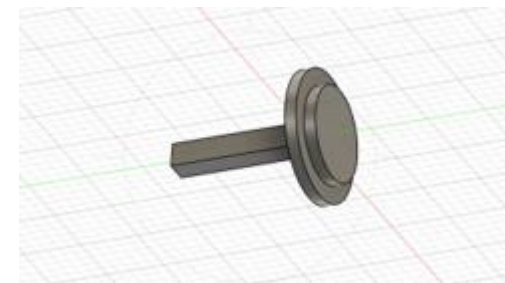
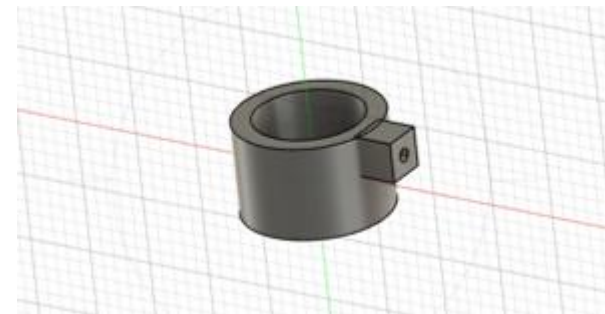
# ULTRASONIC TRANSDUCER PIECES



*Assembly*

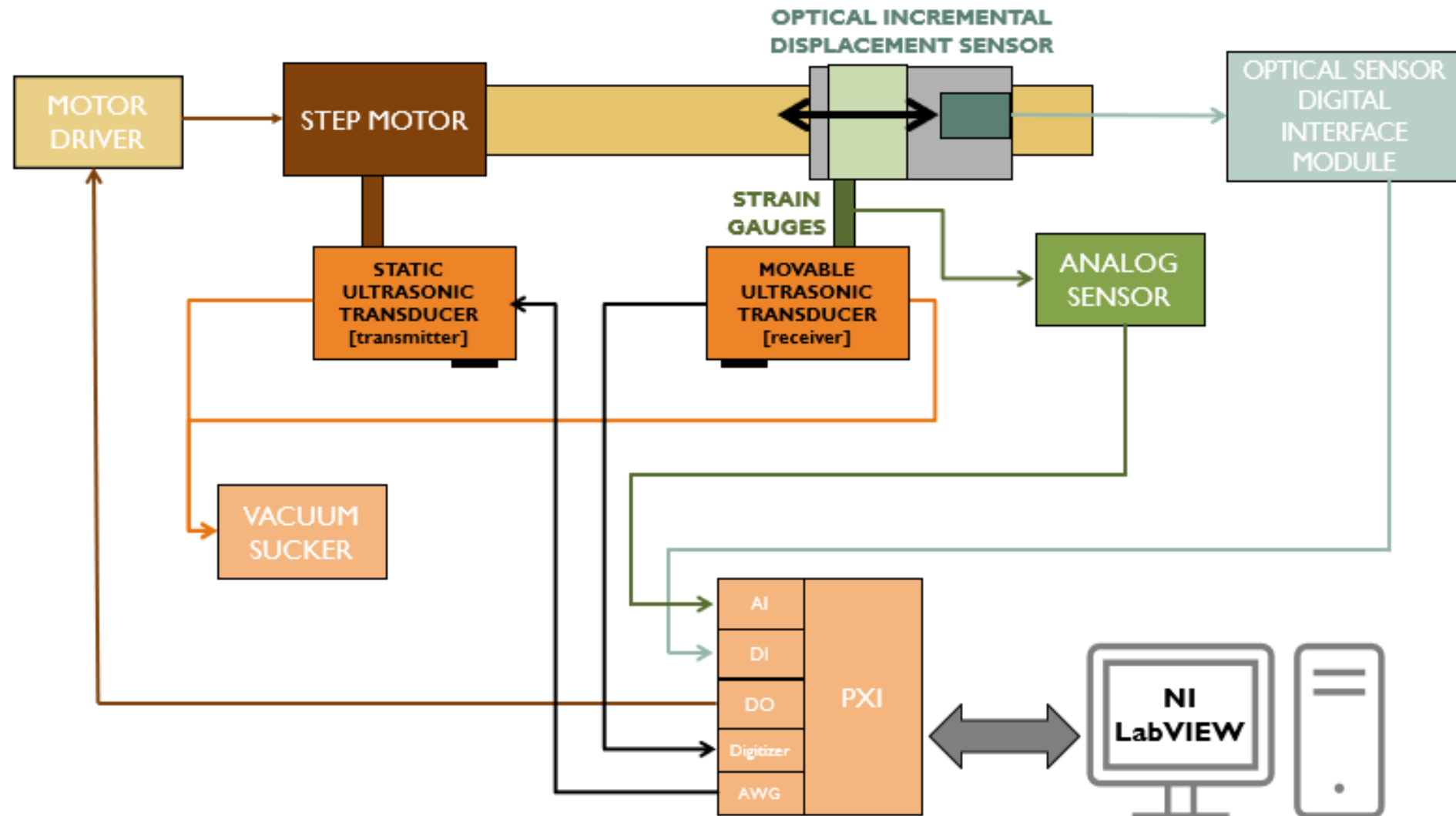


*Transducer mounting piece and its cap*

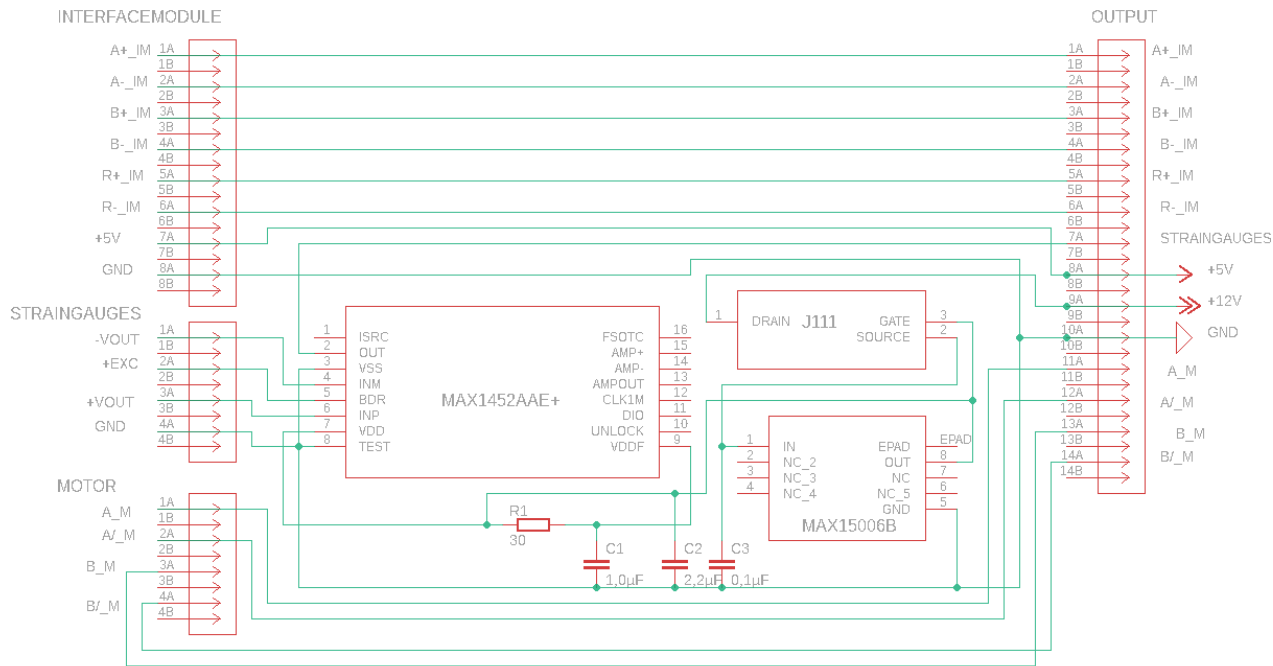


*Ultrasonic transducer cup and its cap*

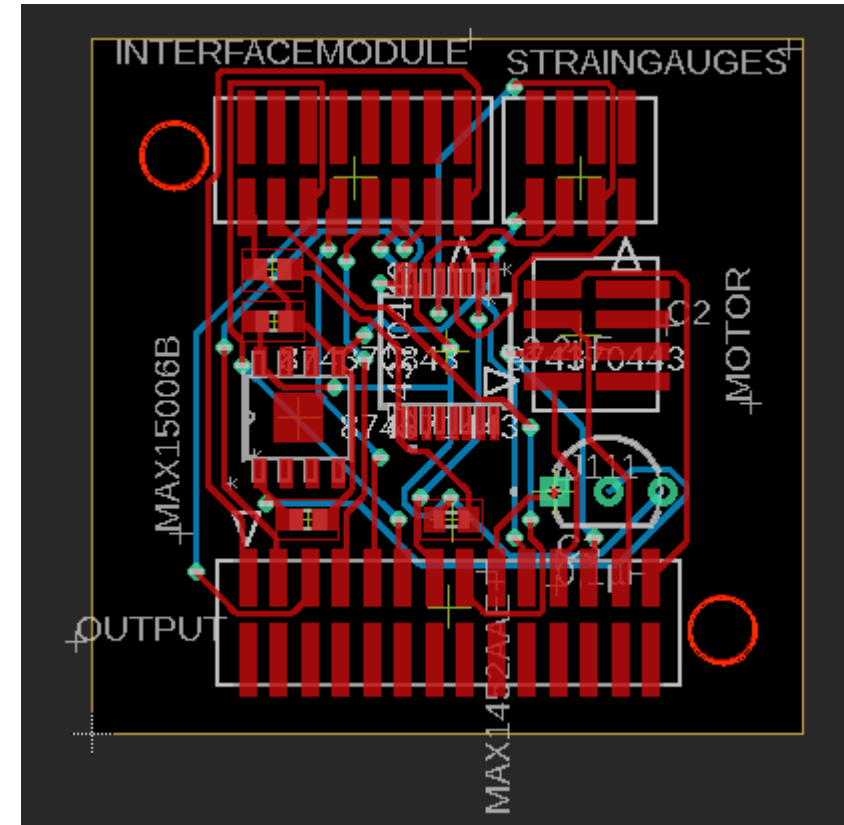
# NOVEL DESIGN BLOCK DIAGRAMM



# DESIGN OF 2 PRINTED CIRCUIT BOARDS WITH EAGLE SOFTWARE

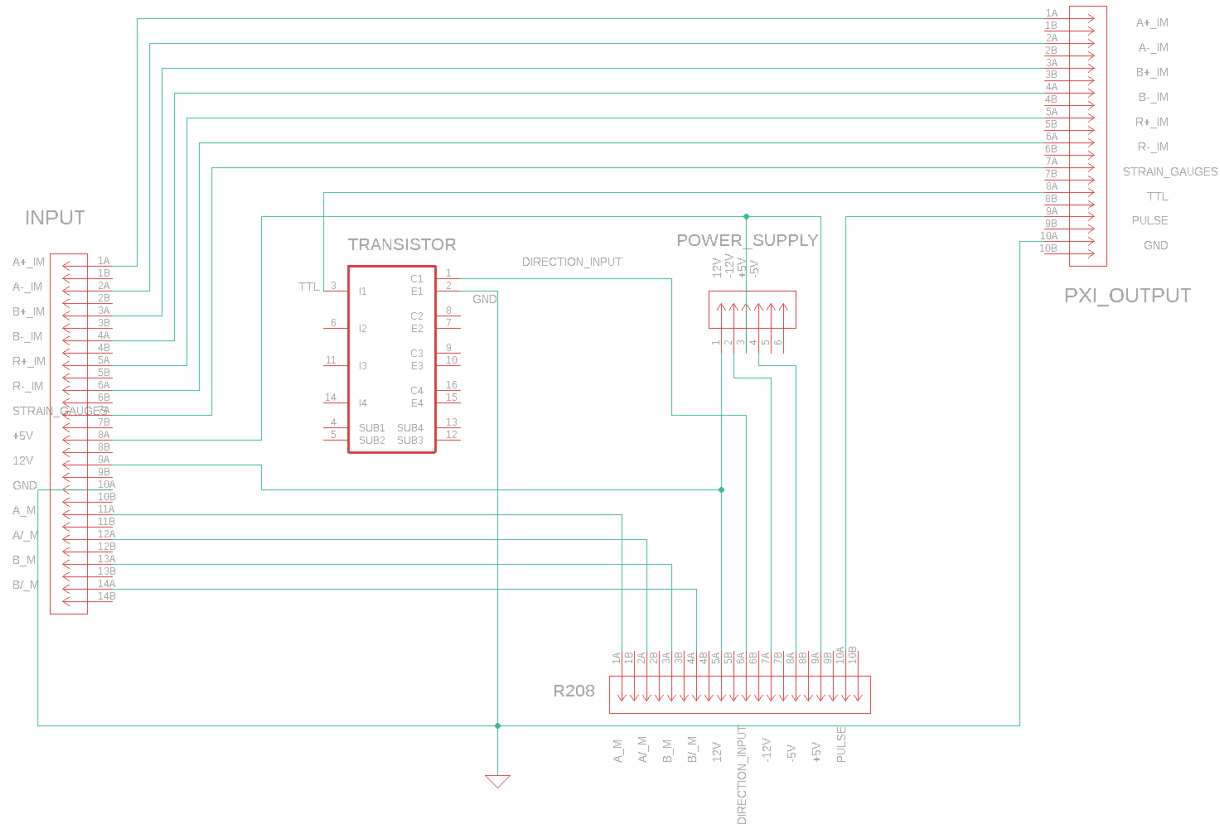


*Schematic of the internal PCB*

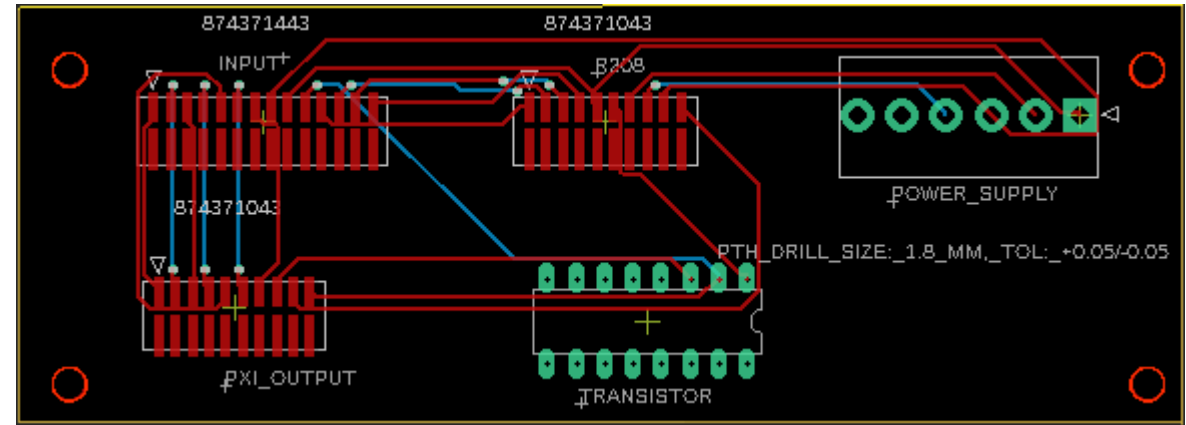


*Internal PCB*

# DESIGN OF 2 PRINTED CIRCUIT BOARDS WITH EAGLE SOFTWARE



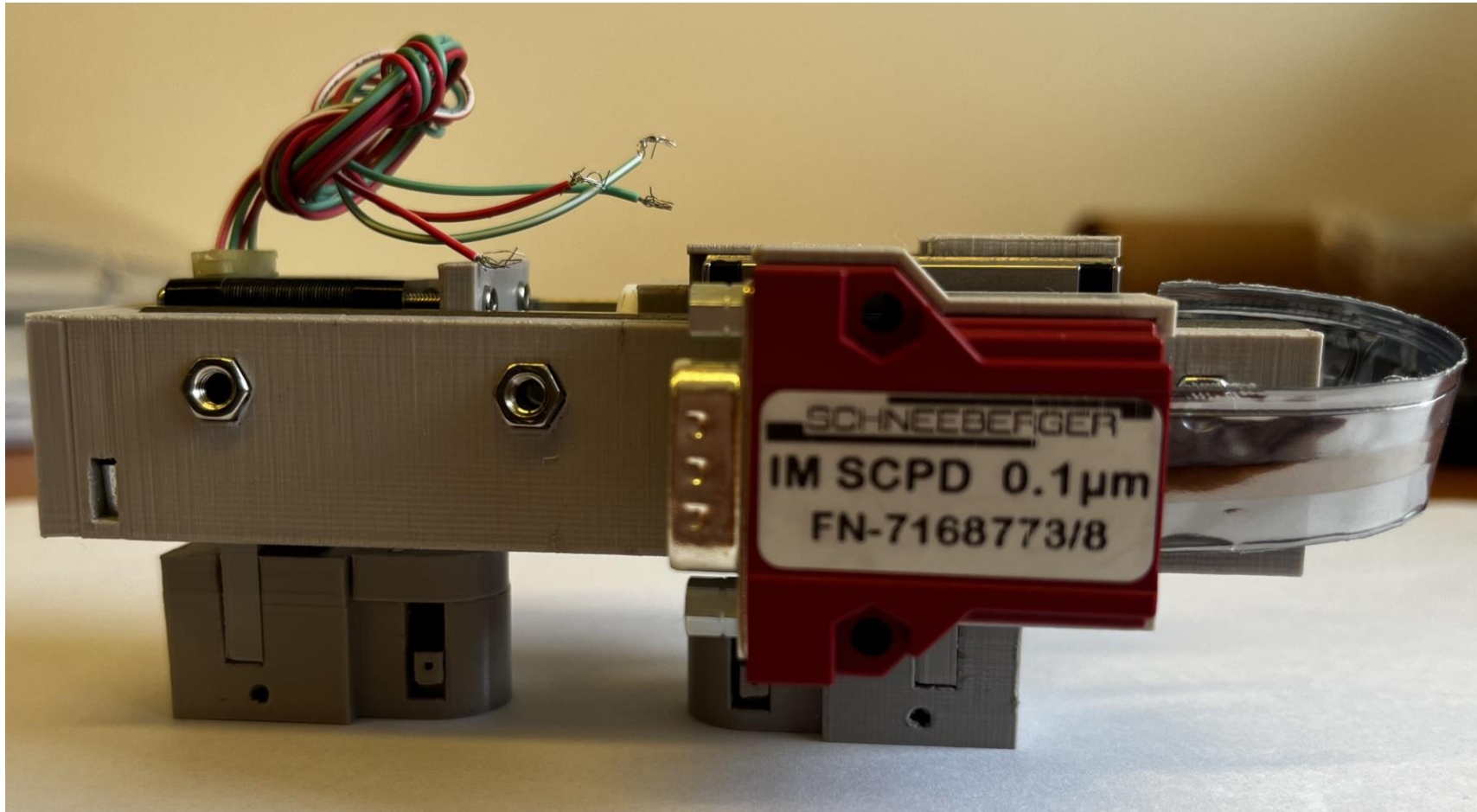
*Schematic of the external PCB*



*External PCB*



# NOVEL DESIGN ASSEMBLY AND VERIFICATIONS



*Assembly of the new device*



# CONCLUSION

- Interest in scientific area
- 3D-printing → many advantages

## SUPERVISORS

- Ing. Daniel Tokar, prototype design concept lead and internship project supervisor
- Dr. Zdeněk Převorovský, internship project supervisor

## ACKNOWLEDGEMENT

- Dr. Josef Krofta, technical support
- Dr. Milan Chlada, technical support



**THANK YOU FOR YOUR ATTENTION!**