Study and realization of a piezoelectric actuator/sensor by the laser manufacturing process

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Objectives

Implementation of the laser manufacturing method.
Realization of the piezoelectric actuator with collocated sensor modeled in [1].

Requirements

- Outer layers used for actuation (PZT)
- Middle layer used for detection (PVDF)
- Insulating adhesive used to avoid interference between the different electrodes.

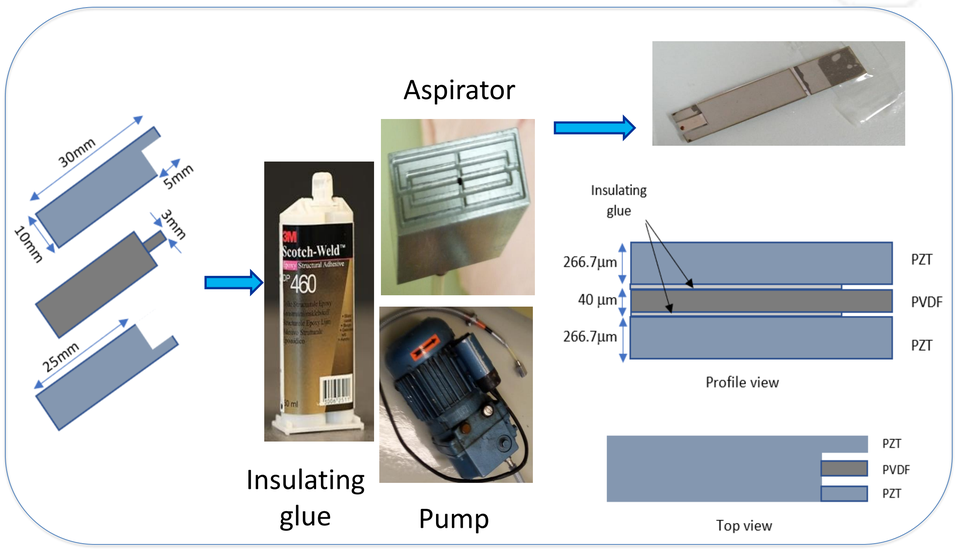


Fig. 2 Structure and dimensions of the piezoelectric actuator with collocated sensor.

Materials

- Lead Zirconate Titanate (PZT)
- Polyvinylidene difluoride (PVDF)
- Insulating glue

Equipment

Laser etching machine

Fig. 1 Laser etching machine.
'Nison Lasertec'

Principle

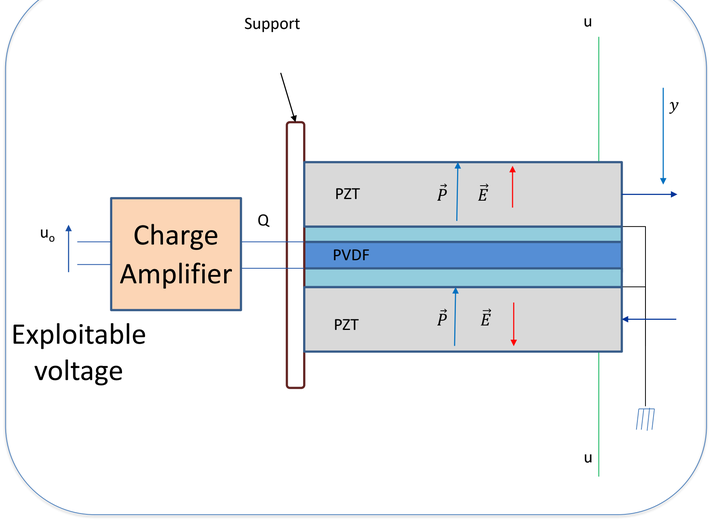


Fig. 3 Operating principle of the piezoelectric actuator with collocated sensor.

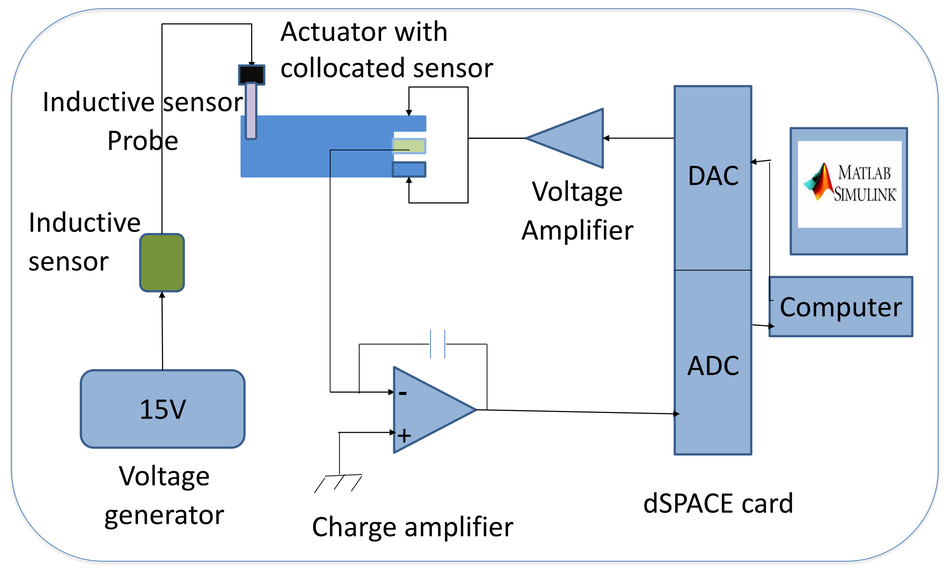


Fig.4 Diagram of the electrical circuit.

Advantages

- Fast, accurate, unalterable, durable, flexible.
- Work possible on many materials, and on all surfaces.
- Negligible influence on the **piezoelectric constant d_{33}.**

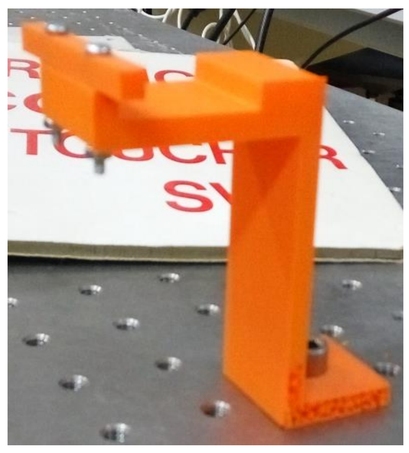


Fig. 5 Support designed with AutoCAD and 3D printed.

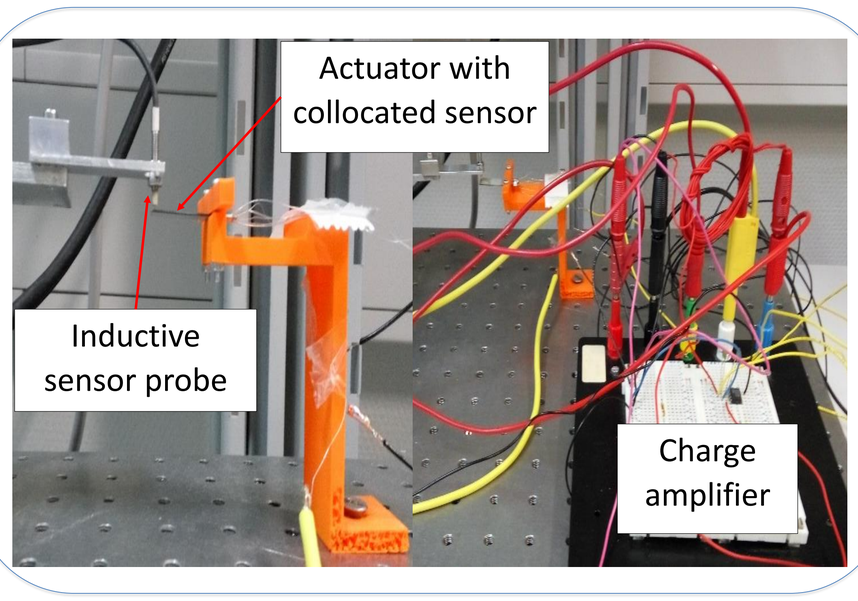
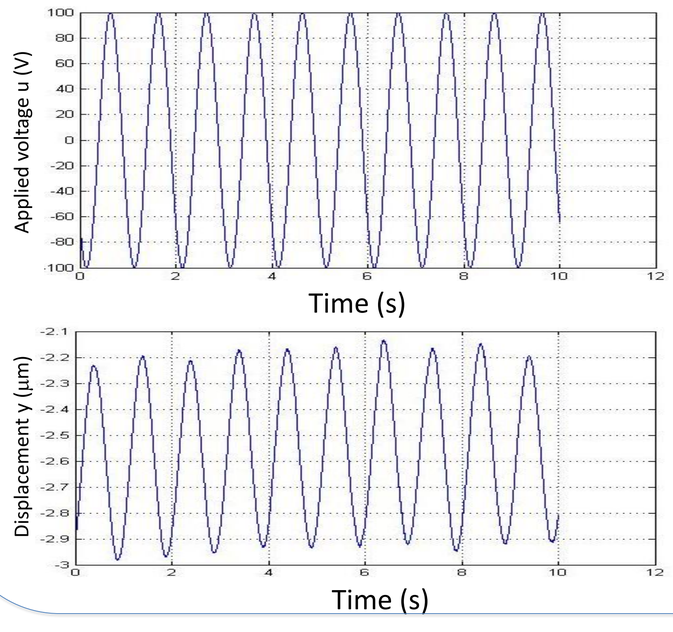
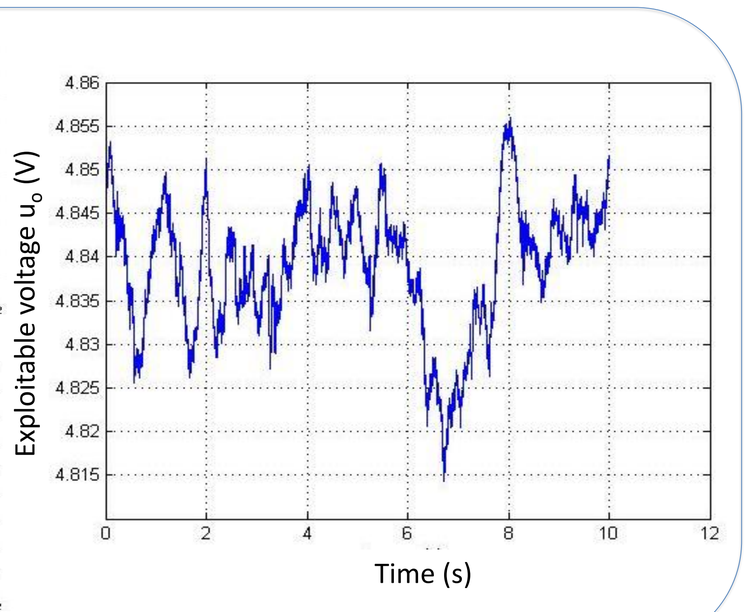


Fig. 6 Electrical circuit.

Results





Conclusion

- Several processes have been implemented during this project such as laser etching, bonding of layers and silver welding of electrical wires.
- Our piezoelectric actuator with collocated sensor works well in both operating modes: actuation and detection.
- The load generated by the integrated sensor is converted into an exploitable voltage ≈4.83 V.

Reference

[1] P. Rougeot, A. Mohand-Ousaid, D. Gendreau, M. Hammouche and M. Rakotondrabe "Design, modeling and simulation of a three-layers piezoelectric cantilevered actuator with collocated sensor", *Sensors for Next-Generation Robotics III, 98590F.USA 2016.*

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