INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

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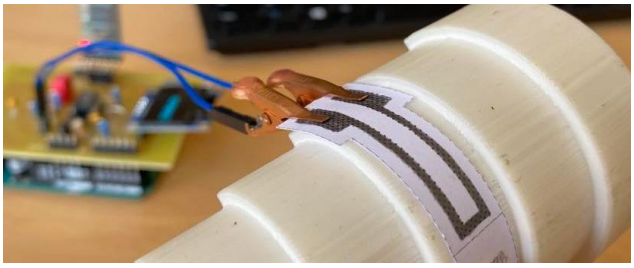
Low-tech graphite based on strain sensor

Main features

- Low cost
- Environmental friendly
- Easy to use
- Portable



Description

The sensor is a sheet of paper on which graphite has been deposited. This sensor is a strain gauge that is composed of a network of graphite particles. The mechanical stress (compression or expansion) applied to the sheet will change the distance between these graphite particles and therefore the resistance to the passage of current. Indeed, when the graphite particles get closer, the current flows more easily and the resistance value decreases. Conversely, when the graphite particles move away, the current flows less easily and the resistance value increases. By measuring its resistance, it is possible to determine the angle of the strain gauge.

The conductivity depends on the type of pencil and graphite we use. We characterized the sensor with 3 different types of pencils : B and HB, but we can also use 6B, 2B or H.

To read the resistance values of the strain gauge, we used a transimpedance amplifier and an Arduino Uno board. The resistance can be read on the OLED screen or, thanks to the Bluetooth module, on an Android phone using the application we developed on Mit App Inventor. To evaluate the quality the quality of this strain gauge, the results can be compared to those obtained with the flex sensor.

Spécifications

Type	Strain Sensor
Materials	- Paper - Graphite (B, HB) - Metal clips
Sensor type	Passive sensor
Power supply	+5V
Measurand	Voltage
Strain measure	Resistive
Response time	0,1 ms

Pin configuration

Pin's number	Usage
1	Connection to Vin
2	Connection to +Vcc

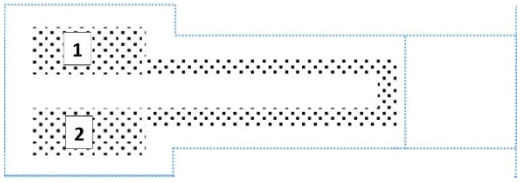


Figure 1 : Top view – Connection pins

Structure and dimensions

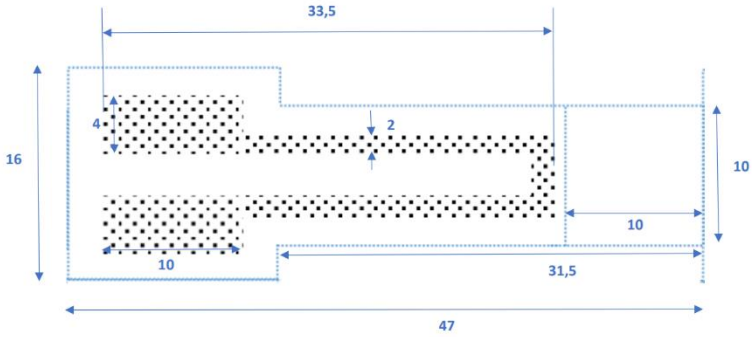


Figure 2 : Top view – Dimensions (mm)

Standard use condition

	Unit	Typical value
Temperature	°C	20 ± 5
Humidity	%	60 ± 5

Electrical characteristics

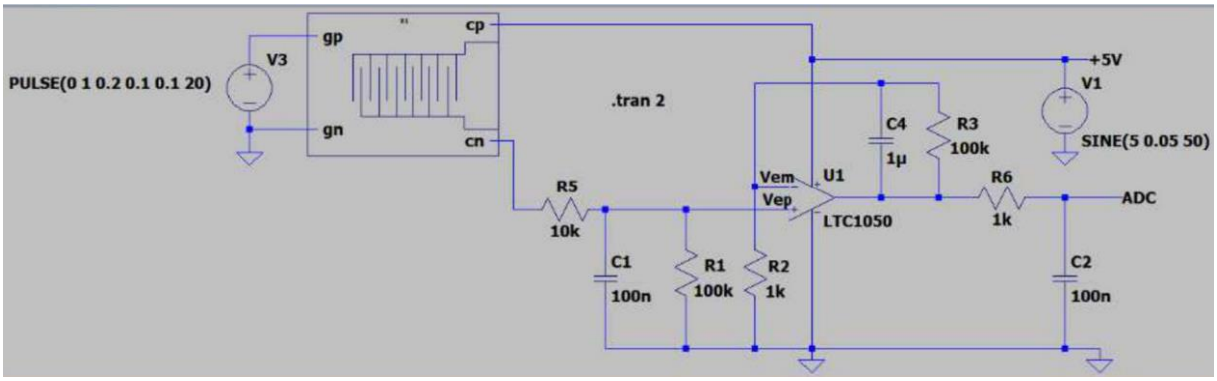
Compression :

Pencil type	Min	Typical	Max	Unit
HB graphite	65	90	120	MΩ
B graphite	550	650	800	MΩ

Expansion :

Pencil type	Min	Typical	Max	Unit
HB graphite	80	120	150	MΩ
B graphite	350	450	600	MΩ

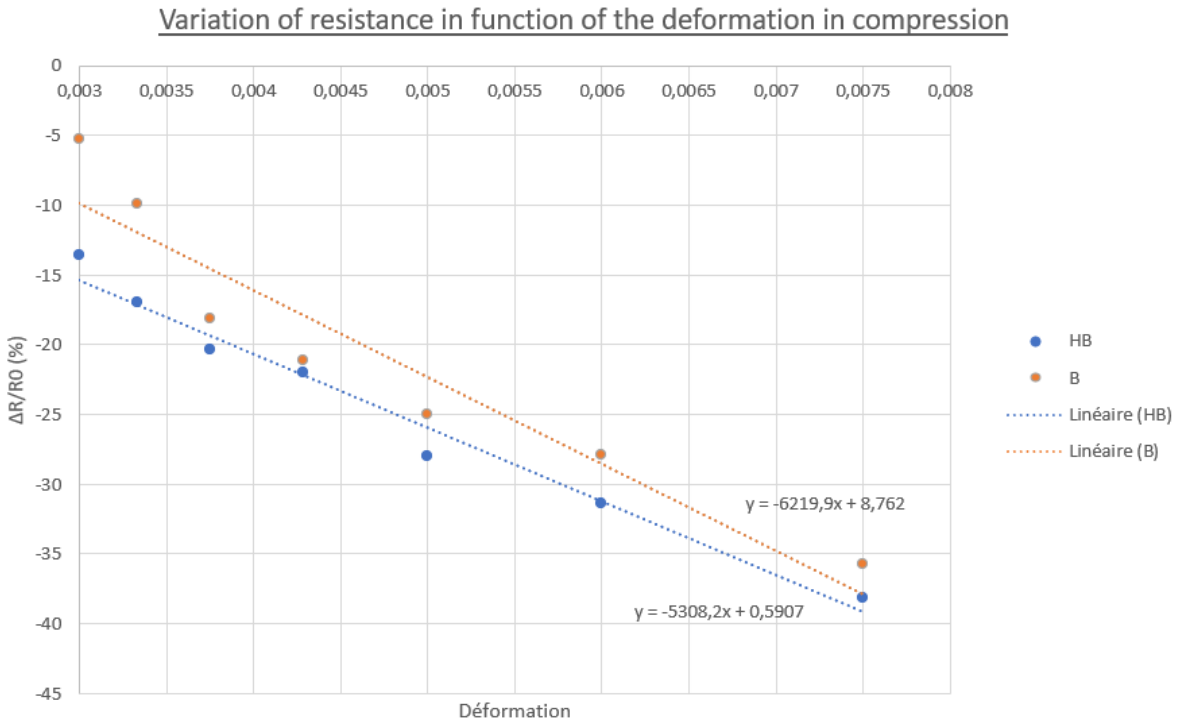
Examples of integration



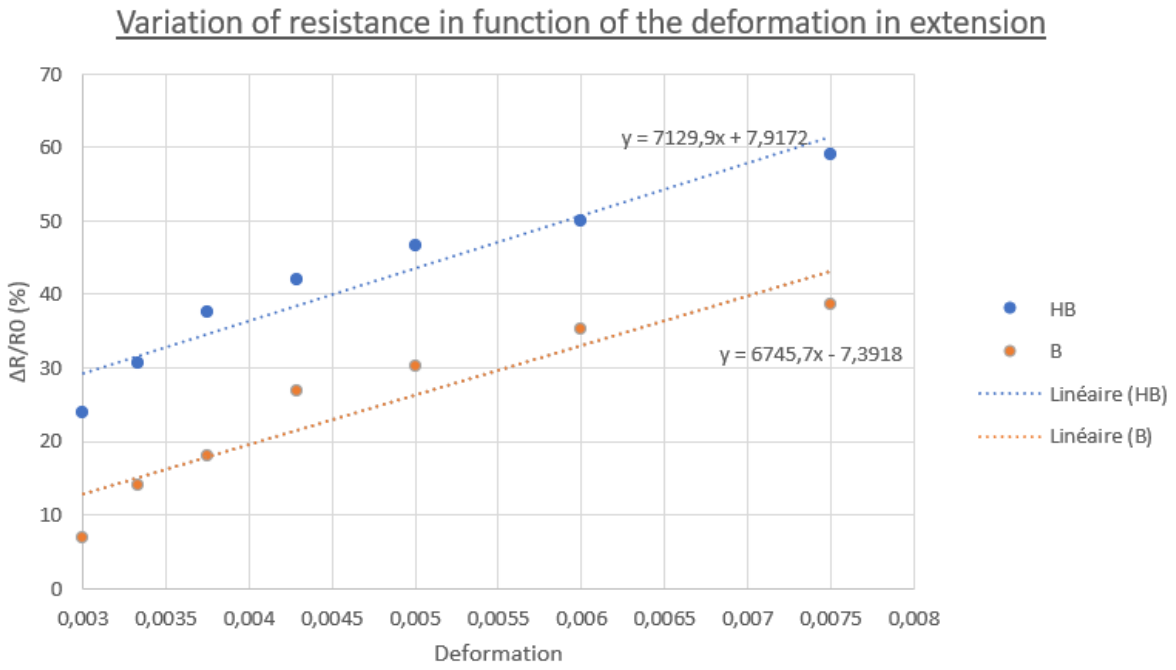
Figur 3 : Exemple of integration of the sensor

In this circuit, the outcoming tension is amplified by a LTC1050 operational amplifier. We can connect the ADC tension with Arduino to capture the measure. This circuit manages both amplification and signal filtering to limit amplification of noise.

Sensor characteristics



Figur 4 : Variation of resistance in function of the deformation in compression



Figur 5 : Variation of resistance in function of the deformation in extension