Topic of the talk:

3D-printed sensor inspired by trichoid sensilla of insects, early studies of the mechanical structure

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Nature has, for the longest time, inspired mankind in the development of new technologies. In the past few decades, thanks to thorough biological studies on insects, we have come to better understand how their different sensory systems work. A fascinating sensing mechanism is the hair-like structure, often called trichoid sensilla or trichobothria, which are used to sense low frequency, near field, sound and air vibrations. Nevertheless, some iterations of this sensing mechanism are used as touch sensors, and it is believed that from this structure stem other sensilla that sense odour, temperature, and acceleration, as well as gyroscope-like mechanisms.

This project will use 3D printing techniques to create a sensor inspired by the trichoid sensilla of insects (mainly the hinged structure of the caterpillar *B. Brassicae*, and the cerci of crickets previously studied by the EU CILIA project). This would provide sensing of low frequency sounds at different frequencies based on small variations of the structure (e.g., different diameter or hair length). This can allow sensing of frequency specific sounds with great accuracy.

Early experiments have been based on the hair connected to a base containing a piezoelectric chip in order to record, with the aid of a vibrometer, the resonant frequency of the sensor structure due to vibration of the piezoelectric. The results showed the best response on a 4 mm long hair, where the hair had cantilever-like movements and the resonant frequency was a distinguishable single peak.

Further testing will involve experiments in the acoustic domain without the piezoelectric chip.

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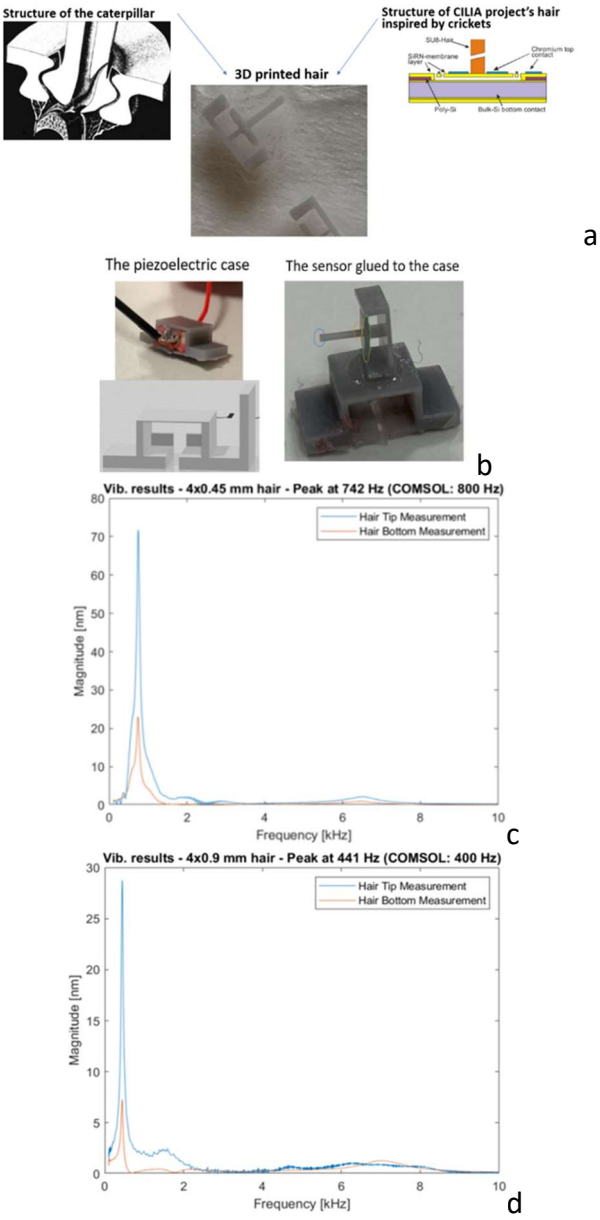

Figure 1. Structure of the 3D printed hair and its inspirations (a); piezoelectric case used for experiments (b); vibrometer results for the hair long 4 mm, with a 0.45 mm (c) and 0.90 mm (d) diameters.

Key Words: trichobothria, trichoid sensilla, 3D print, insects, sensors.