Vibration and worms project

February the 1st, 2017

For the Biosensors challenge in the FDV licence, we had to desing a project about a biological sensor and its ability to sense a force. Then, we had to compare this ability with the one of an electronic sensor that we had to build.

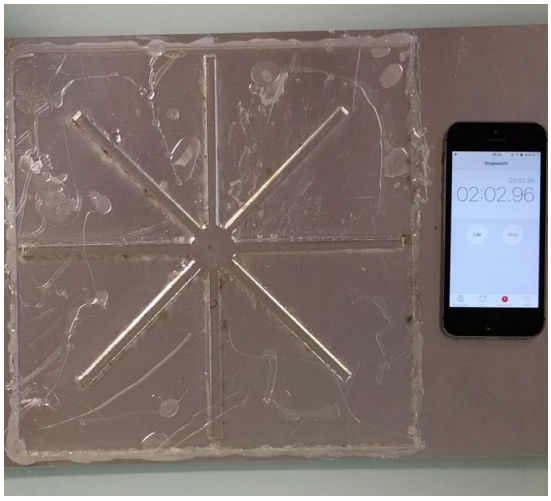
You might know that some worm species are able to sense the vibrations. Indeed, the common bloodworm that we find in our garden needs this sensibility to get noticed when it is raining or even to warn him if there is a danger. We decided to put our interest on another type of worm in order to see if it has the same ability. The *Chironomus plumosus* is a nonbitting midge, and its larvae has little hair all over its body allowing it to sense vibrations just like the common worm[1]. This *Chironomus plumosus* larvae looks like a little red worm of 3 to 5 mm, and it is usually sell in pet shop as food for fish. You can see a detailed video description of this organism here.

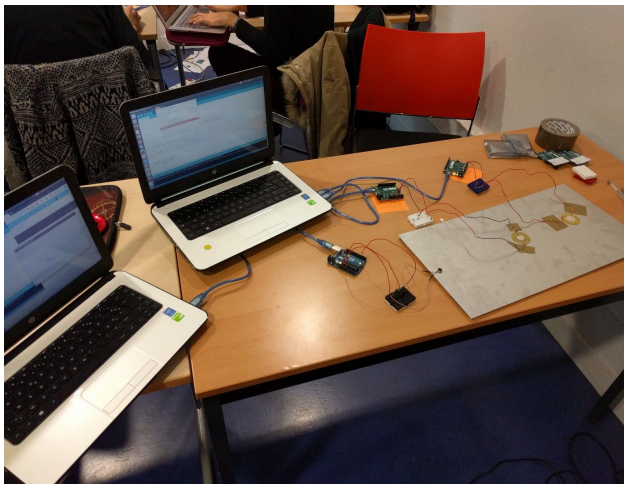
We asked ourselves this question :

How accurate is Chironomus plumosus larvae to detect the origin of a vibration ?

In order to test that and to compare it to the accuracy of an piezo-electric sensor, we designed a protocol in which we test 3 different intensities of vibration: 0, 100, 150, 200 and 255 (in arbitrary unit (AU)). For the electronic sensor, we measured the difference of intensity detected by two sensors separated of 15 cm from each other, with an exposure to vibrations of 4 seconds. For the biological sensor, we measured the evolution along time of the distance between the worm and the vibration motor during an exposure to vibrations of 2 minutes.

[1] Seifert, P. & Heinzeller, T. Mechanical, sensory and glandular structures in the tarsal unguitractor apparatus of Chironomus riparius (Diptera, Chironomidae). *Zoomorphology* **109,** 71–78 (1989).





Once the data were gathered, we used python and Image J to analyzed our result.

What happened?

We spent a lot of time analysing our data. Indeed, we had a lot of them and we had a few troubles... However, we did not give up and finally had some results !

For our Arduino sensor, we noticed that it is indeed able to sense vibration, but it does not seems to have a high accuracy level. Indeed, we increased the intensity of the motor progressively during the experiment and the graphs we observed about the intensity gathered by the sensors was not increasing the same way. Also, we could not conclude if it is able to determinate the origin of the vibration. Indeed, the data collected by the two Piezo at different distances from the motor did not seem to indicate any better sensitivity of any of both.

Furthermore, our biological sensors didn't have the reaction we expected them to have. Indeed, we thought they would try to flee from the source of the vibrations but what we observed was kindly different. With no vibration, their position remained stable. However, it seems that increasing the vibrations makes them move more in any direction. That could mean that they are effectively reacting to vibration but our results do not show that they are able to detect its origin.

These results are definitely influenced by others factors that we didn't control. For example, there was a leak under the plexiglass plate, that could create a current. Also, maybe our worms would have better move if they were on a non-smooth surface or if the channels were bigger.

What can we conclude ?

In a nutshell dear readers, we can say that both our biological sensors and electronic sensors were able to detect vibrations. We wanted to know if they have the capacity to detect its origin, and our results can let us think that it is a skill they don't have. However, some bias have been identified and may have influenced our results. What if the worms were communicating with each other, and amplify the signal of flee when there are several worms in the device ? We let you discover that by yourself !

If you want to know more about *Chiromonus plumosus*, we invite you to check this article.

Presentation link here.

Link to our GitHub here.

You can find here our Storify

If you want to know more about our team :
Nina
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