Progress Report CW8

start of the bachelor thesis

working on improving LBB's self-excited FluidFM cantilever system

What is a Fluid-FM

Introduction to the Problem

Getting the Fluid-FM to resonate at its first order resonant frequency. When trying to excite the cantilever that carries the oil droplet we currently face the issue that the cantilever does not always resonate at its first order resonance frequency but sometimes enters different modes at higher frequencies. Since the mass of the oil droplet at the tip of the cantilever differs in size and density the resonance frequency is not always the same and differs from droplet to droplet and thus from experiment to experiment

Problem Statement

Why exactly is this a problem?

Research Motivation

What would be the advantages if we solve these

Current Approach

problems:

1. higher resonance frequencies, using a low pass filter
2. unstable system, (goes to infinity or maximum) amplitude threshold filter
3. excitement, the threshold filter introduces a new problem it prevents excitement of the oscillation in the beginning. Just applying a step function does not solve it

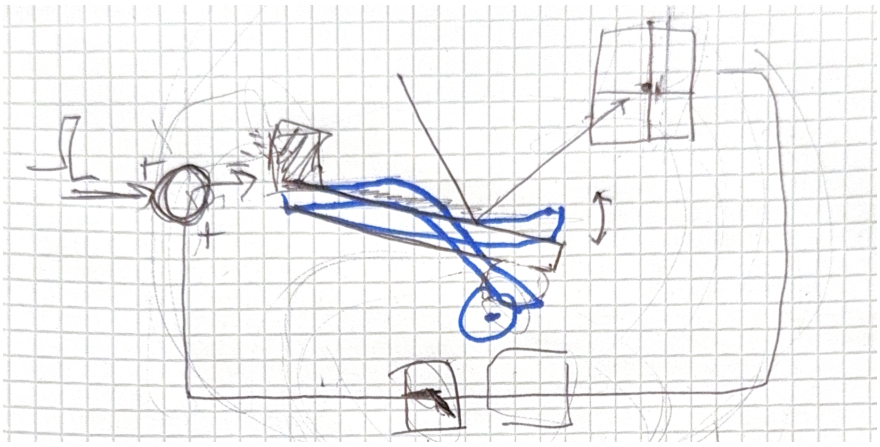

Figure 1: Informal schematic oversimplified representation of a Fluid-FM and the device requirements which are to be designed in the bachelor thesis.

Towards a Solution: Developing a logical Filter

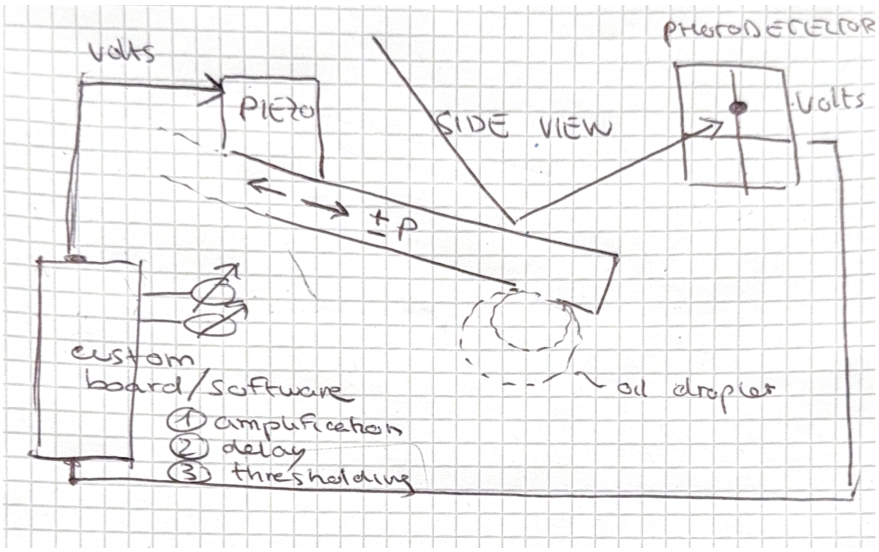

Figure 2: Informal schematic oversimplified representation of a Fluid-FM and the device requirements which are to be designed in the bachelor thesis.

Technical requirements

high sampling rate, high resolution DAC, ADC, two cores, networking, coxial input

Hardware Selection

1. Arduino Pro™ Portenta H7 REV2
2. Arduino Pro™ Portenta Max Carrier
3. Arduino Pro™ Portenta Breakout

Issues

Altough programming with the Arduino IDE was possible the whole Arduino Ecosystems lacks a lot of great features such as a debugger and uses their own version of C which i found to tedious to work with. Trying to program/flash the Portenta with rust seemed like a good idea at first (advantages of rust embedded) so I wrote a simple program, but flashing the program seemed impossible dfu-util and the amazon zyphr tutorial were helpful here

But since we need to design a pcb anyway to mount the coxial connector since the portenta master carrier coxial connectors are only connected to the Lora chip and the gsm module.

On top of that both the max carrier board and even the portenta h7 come with a lot of components we dont use. So if we want to develop an actual useable solution for this problem it would be wise to create an own pcb where we can place all and only the neccessary components

Since the stm32h7xx family is a great choice for our tasks since the adcs have quite a high resolution at a high sampling rate. Additionally the two cores allow us to simultaneously run the logic that transforms the signal the we get from the Fluid-FM and the networking and and interae to the control unit and in the future maybe even an labview interface.

Making our own board would probably even cheaper, especially for people who want to use this device as well

Also looking at jlcpcbs parts stock, we can see that assembly at their plant is feasible which makes the whole process easier

Test results

using the arduino protenta h7 with my oscilloscope