Master's Thesis Engineering Technology

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Evaluation of linear displacement technologies suitable for monitoring the position of the pumps in sensors

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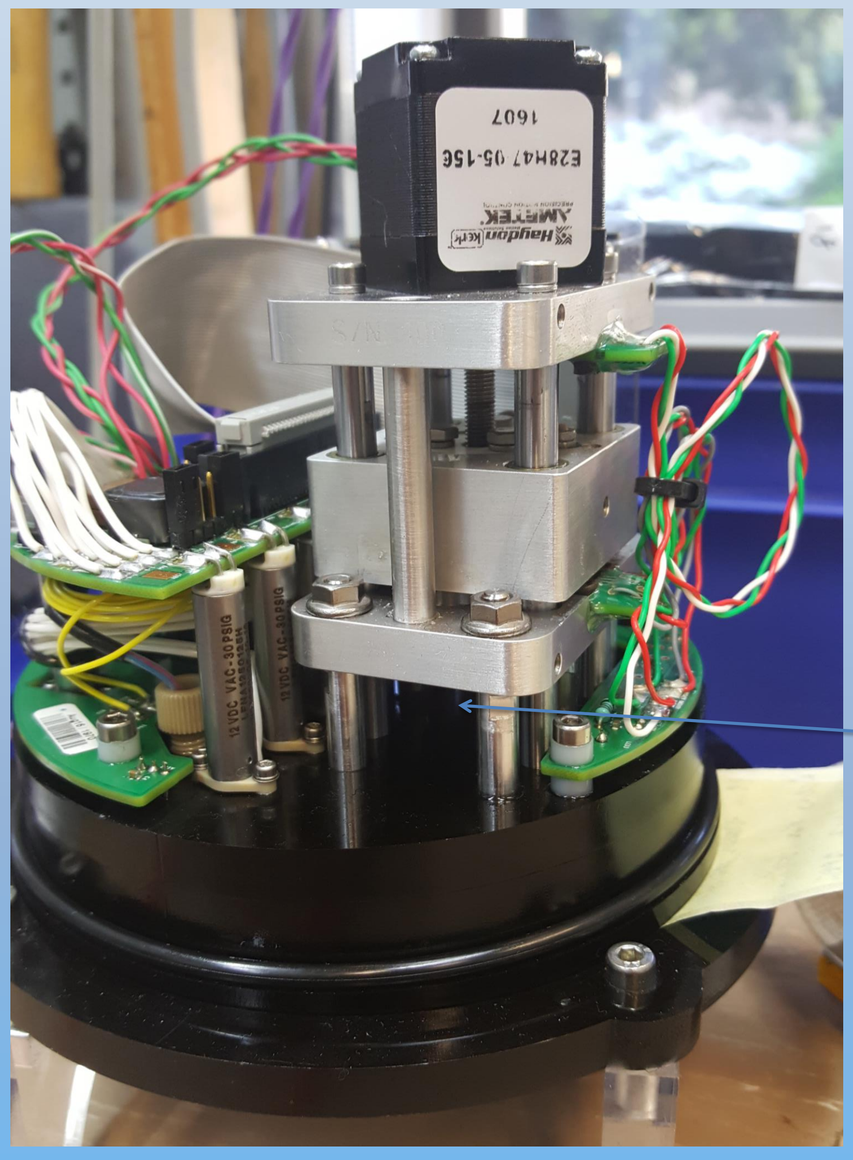
The National Oceanography Centre in Southampton (United Kingdom) develops sensors for oceanography research. One of their sensors is the 'wet chemical sensor' which is a small-scale chemical lab. The sensor uses multiple syringe barrels to mix sampled water with chemical reagents in microfluidic channels to be measured afterwards. In the current design the syringe pistons cannot be moved individually. This is not power efficient. An improved design would use separate individual pumps. Another benefit of this approach is that the ratio of the chemicals being mixed can be changed.

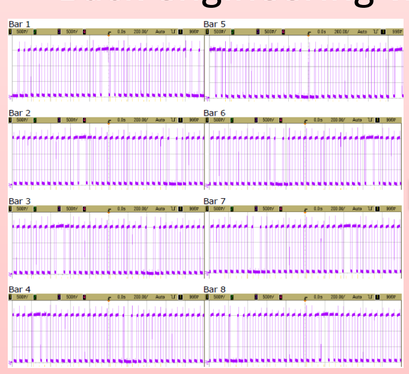


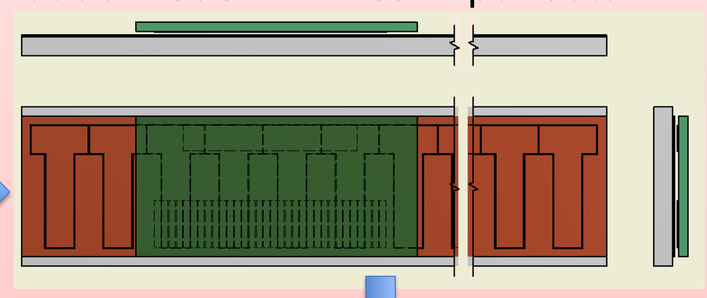
Problem:

The problem with using multiple pumps is that synchronisation across the pumps is no longer guaranteed when the pistons are not joined. Therefore it will be necessary to accurately measure the position of each pump so that it can be monitored by software. Therefore different techniques for measuring the linear displacement of a syringe pump are researched for synchronising the pumps.

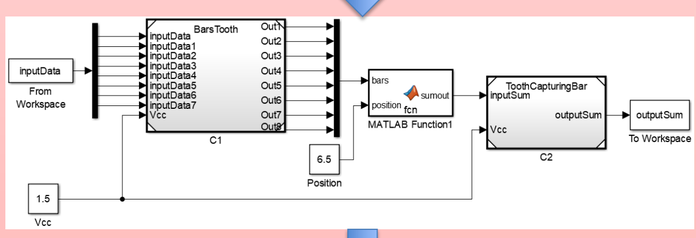
Capacitive measurement method

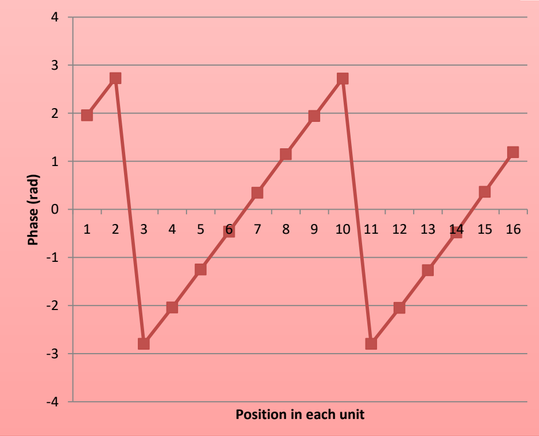
- Based on digital caliper.
- Back engineering with Matlab model with real input data

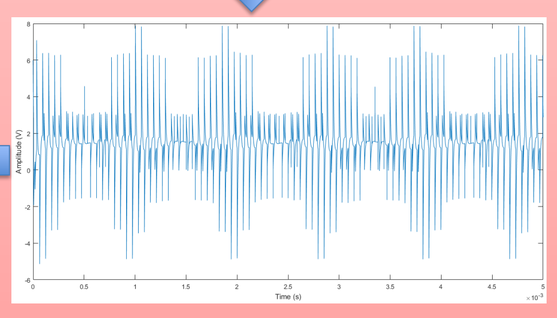




- Hard to design

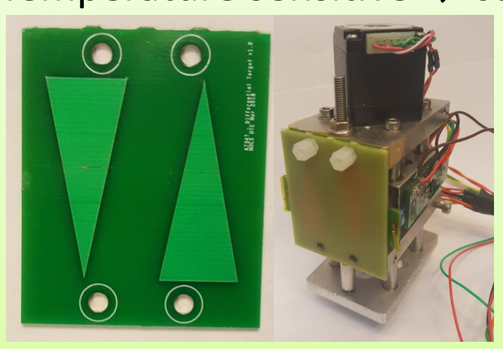


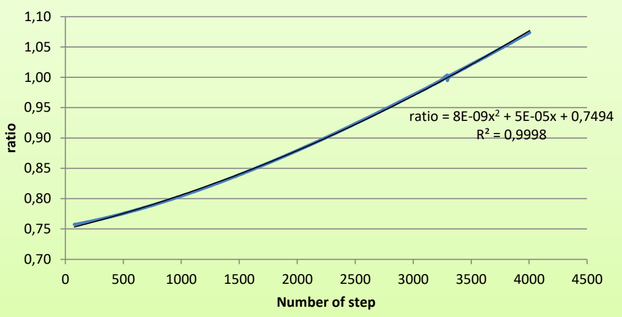




Inductive measurement method

- High accuracy inductance to digital convertor
- Temperature sensitive → compensation





- Reaches the desired accuracy of 3,1 µm

Optical measurement method

- Optical encoder
- Only achieves 3,1 µm accuracy with 27 encoders → to big

Mechanical measurement method

- Measuring spring tension
- Temperature sensitive
- Not efficient

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