Development of a Temperature Sensor Test-Bed and Characterization of a Fast, High-Resolution Temperature Sensor

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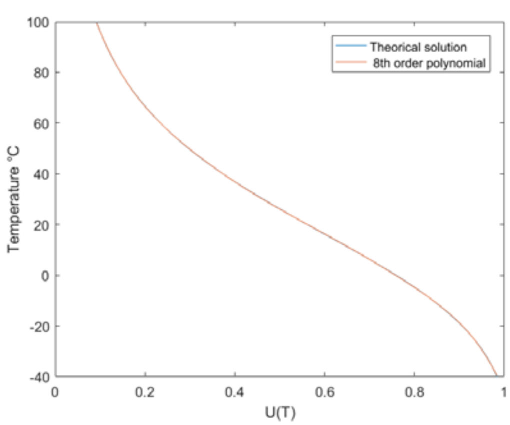
The current article aims at developing a testbed for characterizing a superfast sensor allowing future measurements of microstructures and turbulences in the Lake Geneva. To that end, a very high resolution temperature sensor has been developed and characterized and has been designed to be embedded in an autonomous underwater vehicle (AUV) to collect data. The superfast sensor is made from a FP07 thermistor which is widely used in water environment for high resolution mesurements. Its data sheet provides a noise level of 5mK and a time constant of about 25ms. The coming experiments are made to evaluate these parameters for our home made sensor.

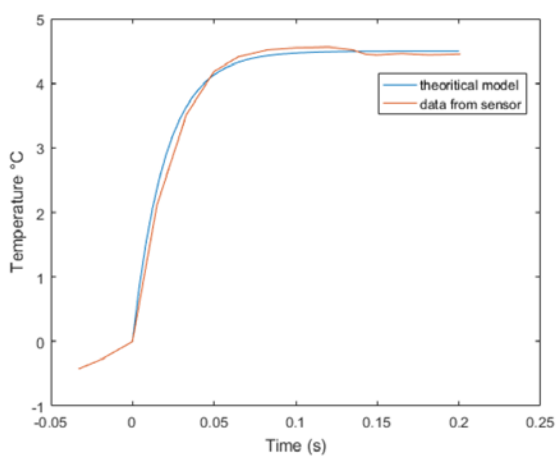
Since the sensing needle of the sensor is fragile, it was necessary to develop a custom testbed to ensure safe and reproducible experiments. For simplicity, it has been decided to import a 3d printer kit from China to use its structure and components to construct a test bed. It consists mainly of a linear axis to hold and move the sensor and a water basin with temperature control.

To control the temperature of the basin, it was necessary to make a model to simulate the system. The reason why it was mandatory is because since the system responds very slowly, about 30 minutes to increase the temperature of the water by 10°C, it would take too much time to find the best controller without a theoretic solution. A waterproof thermistor has been used to get the temperature of the water. The curve of temperature in function of the input voltage has been interpolated by a 8^{th} order polynomial to have a sufficient precise knowledge to compare with the superfast sensor.



To be able to increase the resolution of the input from the sensor of the basin and allow a good control of temperature, a filter has been implemented to reduce the noise level. Then a model of the basin has been determined by using an ARMAX algorithm to simulate the system by analyzing experimental data coming from the basin to calibrate a PID controller for the temperature of the water. However, experiments show that the model is not independent of the temperature. It induces that the PID controller is not able to follow reference for high temperature as good as planed due to heating loss on the system. More work on insulation parts should be done to compensate this issue.

Concerning the characterization of the superfast sensor, noise level has been evaluated by conducting an experiment in which the sensor was covered by a plastic protection, preventing it from external disturbances. Interpretations of the data with Matlab showed that 95% of the noise is within a range of ± 2.4 mK. Once the testbed was ready, a step response has been made to identify the time constant (τ) of the sensor. The value of τ is around 25mK which



corresponds to a frequency of 40hz.

Results show that the characteristics of the sensor are better than predicted by the data sheet.