MEK4600/9600: SensorLab

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1 Development of custom sensors

In the recent years, the cost of microelectronics has plummeted while the availability of, and resources for development of microelectronical sensors has increased drastically. Hence, it is now possible to do measurements of fluid mechanical processes in nature at a larger scale than what was feasible before. For this assignment sensors will be developed; programmed and built. The students are expected to take part in both the construction of, and the design of sensors that will deliver real-time data for important parameters that is chosen in class. After this lab module, a student should be familiar with all the necessary steps in constructing a sensor, and should have a basic understanding of how sensor measurements are made and how to treat the data afterwards. The research group has experience in constructing tailor-made sensors for fieldwork in the Arctic and has an "openSensor" solution that can and is used by other researchers, see e.g. Rabault *et al.* (2020) and Rabault *et al.* (2022).
For the report - please follow these steps;

1. Write a paragraph that explains and discuss the terms;
    - Arduino/Circuit Board
    - GPS; technical solution and accuracy
    - LoRa
2. Give an overview of the hardware used in this lab.
3. Show and explain the main steps in the program that is made in C++.
4. How is a sensor constructed?
5. Give an illustration of how you designed your sensor, and explain how the sensor operates.
6. What is soldering, and why is it important to do it correctly?
7. Why is validation important and how is this process conducted?
8. Find the accuracy of the GPS based on the validation experiments and compare with the numbers given in the datasheet.

Component list

In this lab exercise, we have used the following components.

- SparkFun LoRa thing plus - expLoRaBLE
- Adafruit Artemis Ultimate GPS Breakout
- Saft LSH 20 litium battery
- Pololu 3.3V Step-Up Voltage Regulator

Handy Notes

The component manufacturers have extensive documentation of product specification on their webpages, which might help when writing your report. Furthermore, sensor malfunction can happen. Be sure to download all the available datasets from your measurements. That way, you can always fill in any holes from technical malfunction with that of a similar device.

References

Rabault, J., Nose, T., Hope, G., Müller, M., Breivik, Ø., Voermans, J., Hole, L. R., Bohlinger, P., Waseda, T., Kodaira, T. *et al.* 2022 Openmetbuoy-v2021: An easy-to-build, affordable, customizable, open-source instrument for oceanographic measurements of drift and waves in sea ice and the open ocean. *Geosciences* **12** (3), 110.

Rabault, J., Sutherland, G., Gundersen, O., Jensen, A., Marchenko, A. & Breivik, Ø. 2020 An open source, versatile, affordable waves in ice instrument for scientific measurements in the polar regions. *Cold Regions Science and Technology* **170**, 102955.