FALL 2018 – COS 397 COMPUTER SCIENCE CAPSTONE PROJECT PROPOSALS

Title:
Fault tolerant ship-board data logging and processing system

Submitted by:
Nils Haëntjens
nils.haentjens@maine.edu
Graduate Student in Oceanography

Brief description:
The MISC Lab, part of the School of Marine Science of the University of Maine, frequently participate in month long expedition founded by NASA, NSF, and/or NOAA aiming at advancing our understanding of the plankton ecosystem through the study of the optical properties of the ocean. The most recent campaigns we actively participated in are:

- EXPORTS: 1.5 months in the North East Pacific, sailing from Seattle
- NAAMES: 4 times 1 month in the Western North Atlantic, sailing from Woods Hole
- Tara Expedition: 2 years in the Pacific Ocean

While at sea thousands of nautical miles away from shore, with an internet connection limited to a few emails per days, we operate a number of scientific sensors to primarily measure the hyperspectral attenuation and absorption, backscattering, and forward scattering of light through seawater. Complementary sensors are added depending on the need of each expeditions. The instruments are robust, however their software is not designed to operate for extended periods of time. This results in poor data logging and delayed processing to compute products for visualization which is necessary to check the quality of the data recorded.

We need a robust system able to log raw data output by each instrument, process it in real-time, and provide a simple visualization. The system should be able to replicate/backup the data acquired on multiple hard drive through the wired network of the boat to prevent the loss of data in case the logging unit is flooded.

The following instruments are expected to run on each expedition:

- ACS: 2x80 channels, serial port (rs232 or rs485), binary, 4 Hz
- LISST: 36 channels, serial port (rs232), ascii, 0.2 Hz
- ECO-BB3 : 3 channels, serial port (rs232), ascii, 1 Hz
- WSCD : analog 0-5V (12-bits), 1 Hz, (analog to serial port converter available)
- FlowControl: motor switching the type of water sampled by the other instruments, it allows to run a “blank” to calibrate all the instruments, communicate over USB and has his own software (the developer was a student at UMaine, it’s possible to get the communication protocol with the instrument)

Other instruments are added to the system depending on the expedition:

- GPS: NMEA 0184 over network or serial port, 10 Hz
- TSG: 5 channels, serial port (rs232), text, 4 Hz
- UBAT: 40 channels, serial port (rs232), text, 1 Hz

- PAR: 1 channel, serial port (rs232), text, 1 Hz
- ECO: 1-9 channels, serial port (rs232), text, 1 Hz

List of requirements:

- The code to process the instruments data is specific to each instrument and is available in MatLab.
- Generic and instrument specific visualization should be available for display and optionally from any computer connected to the boats network.
- As we update the processing routines with state-of-the-art algorithm the system should provide an easy way to reprocess data from previous expeditions.
- Files respecting NASA SeaBASS requirements as well as csv files should easily be extracted from the system.

Currently the data is logged on one Windows 10 computer, with some visualization on a 2.7K screen, and backed up daily on a computer in another room. The new logging system design is open to any proposition, hardware can be bought for the project.

Total duration: weeks

Extermal deadlines: The system will be run at sea as soon as it's ready this will likely happen for upcoming expeditions in 2020.

Learning Objectives for student teams:
Develop a robust data logging system
Process scientific data

Expected Project Experiences:

Problem definition
Project scope definition
Design and implementation of research methodology
Workflow analysis
Development of functional specifications
Identification of and negotiation for needed project resources
Examination of an unfamiliar technical area
Identification and evaluation of alternatives
Development and presentation of recommendations
Responsibility and accountability for a discrete product
Role definition in a task group and participation in group dynamics
Observation of supervisory activities (e.g., personnel assignment, training, development of procedural guidelines)
Observation of management styles
Observation of organizational politics
Preparation of a manuscript for publication

Expected Outputs/Products:
To be discussed, open to a proposition that fits our need.

Suggested Methodologies:

Project teams will develop the methodologies in conjunction with the Customer
Literature Review
Websites reviews
Groups Usability testing
Other:
follow Agile, DevOps & Craftsmanship trends

Benefits to UMaine:
Collaboration between departments

Project Sponsor(s):

Instruments access:
Instruments will be at the disposition of the students in the Emmanuel Boss' lab (4h floor Aubert Hall) when not at sea. A schedule of when instruments are accessible could be provided. However, developing a mean to test the system without the instruments should be considered.