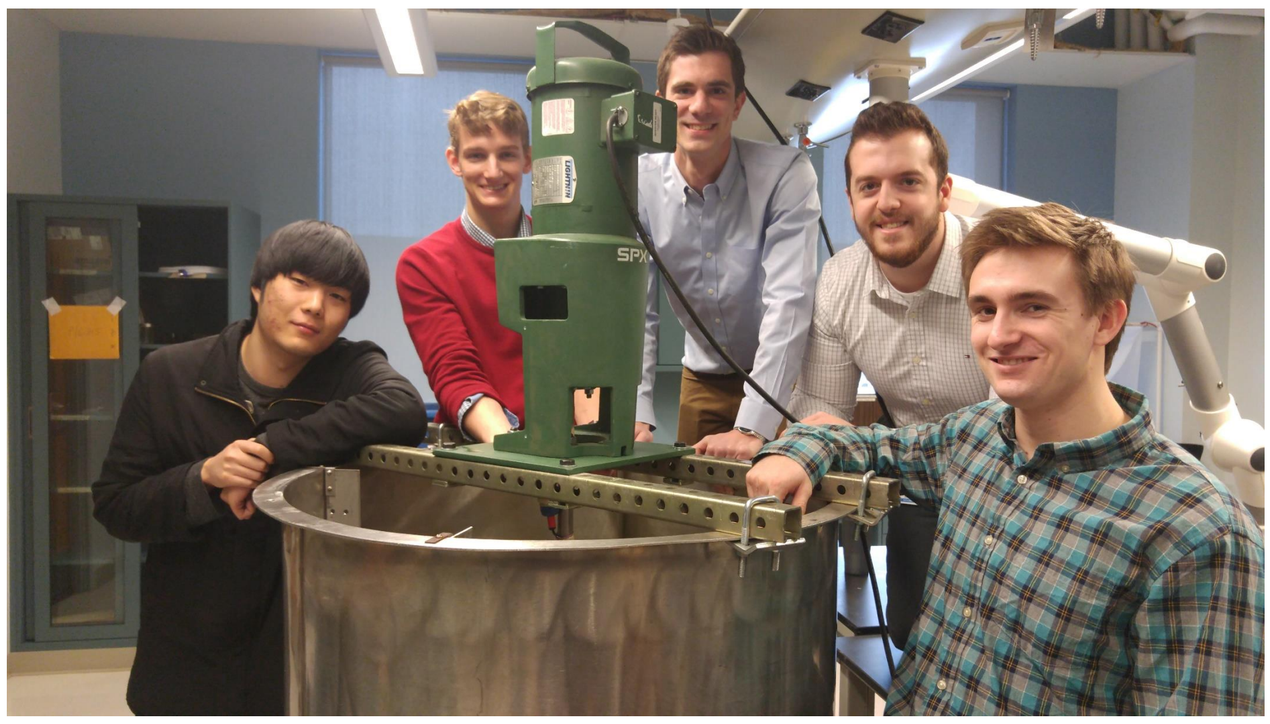
SPX DATA ACQUISITION

Senior Design Project P16315



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Faculty Guide: Gerry Garavuso

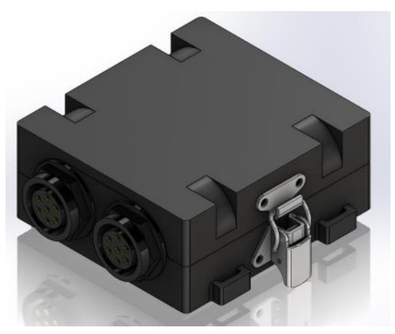
Customer: SPX Flow Technology
Joel Berg

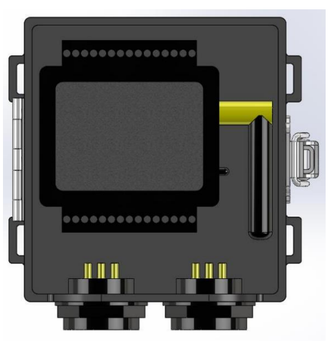
Customer Requirements:

- Wireless data transmission via a telemetry system
- Ability to collect data from four strain gauges simultaneously
- Exportable data to Matlab for processing
- Calibration procedure detailed for gauges and telemetry system
- Full assembly and operation manuals developed
- Demonstrate life cycle of test rig sensors

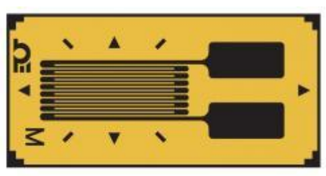
Project Background: Impeller blades can bend a significant amount during their normal operation due to the viscosity of the substances which they are mixing. Local company SPX approached our MSD team with the task of being able to measure this bending, convert our measurements into strain, and finally to wirelessly transmit all data to a computer for blade strength analysis. It is our hopes that this data and subsequent analysis may allow for a better understanding of underwater impeller dynamics, and SPX engineers will use our results to design more efficient and ergonomic products for industrial applications.

Design Concepts:

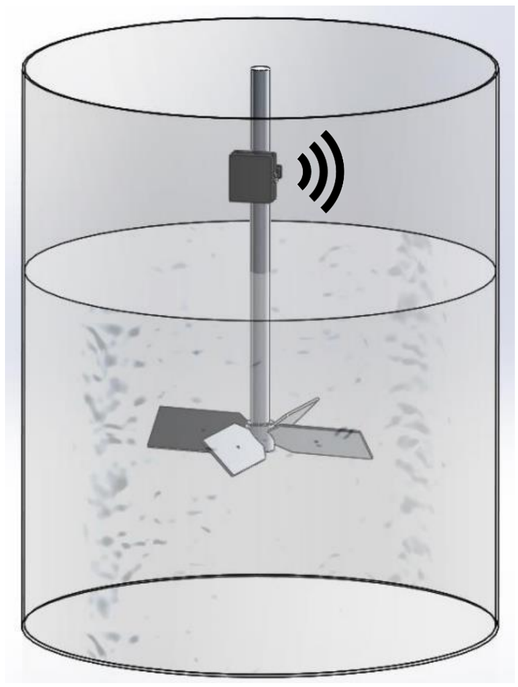




A case was designed in order to keep the data transmitter (telemetry system) close to the impeller blades. The case is water tight to protect the transmitter if the case ever falls into the water.



Linear strain gauges were chosen due to their sensitivity to the small changes in strain that will be seen during impeller blade operation.



The overall setup was designed around the test tank provided by SPX. Wires run from the enclosed telemetry system (box at the top of the shaft), down the shaft to the four strain gauges. The wire as well as its connections must be waterproofed, allowing for data to be safely and accurately transmitted. The strain gauges must also be waterproof, and they were covered with epoxy after mounting in order to ensure water protection.

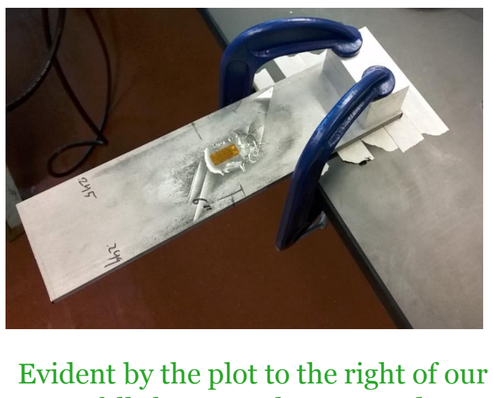
The data is being collected at 256 Hz, and can be collected at frequencies up to 512 Hz, giving us a maximum data transmitter battery life of 8-12 hours.

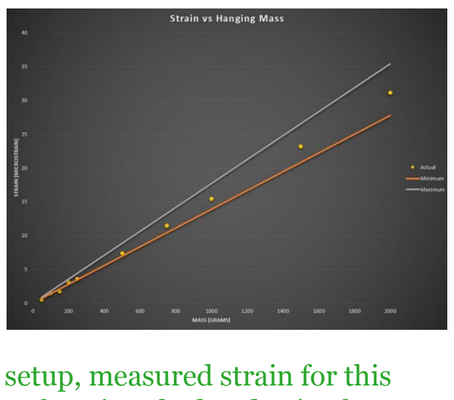
Once the transmitter receives data from the strain gauges, it transfers it to a nearby computer over the 2.4 GHz spectrum (Wi-Fi). This data can then be imported to Matlab or Excel for processing and analysis.

This process is easily repeatable and after the initial setup will only require the maintenance of charging the data transmitter battery.

Analysis and Testing:

Initial testing was done in order to validate both our design and calibration procedures. Loading a cantilevered beam with a known mass creates a situation where strain can be easily calculated using beam bending equations, and then compared to measured strain.





Evident by the plot to the right of our setup, measured strain for this setup falls between the expected range of strain calculated using beam bending equations with material tolerances taken into consideration.

This test validated our calibration procedures, gauge mounting procedures, and ensured that our waterproofing procedure did not impact strain measurements. Ultimately, the test gave us confidence to move forward to small-scale testing underwater in our test tank.

Conclusions:

Acknowledgements:

Thank you to SPX Flow Technology for funding our project.
Thank you to Joel Berg for the valuable guidance and engineering expertise along the way.
Thank you to Gerry Garavuso and the entire Senior Design faculty for helping us successfully complete our project.