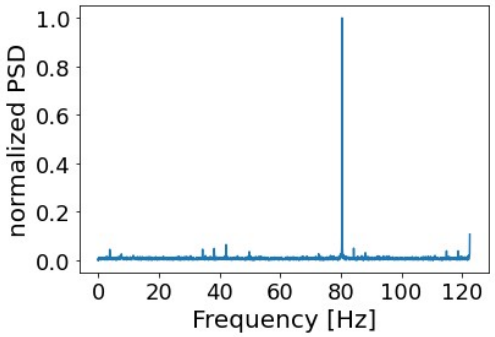
Laser Interface for optical MEMS-Sensor

The Danish company CEKO Sensor developed an all metal free micro-electro-mechanical-system (MEMS) acceleration sensor. The purpose of this sensor is to be used in harsh environments, where it is not allowed or not suitable to use electrical signal e.g. blades of wind turbines. Instead of electrical signal this sensor is operated with a laser.

Hardware developed in the bachelor thesis



FFT with a 80Hz acceleration signal

Initial Situation

The current system from CEKO is designed for lab use only. Therefore in collaboration with the FHNW a replacement system should be developed. The key part of this replacement system is a special laserdiode. The output wavelength of the laserdiode can be changed by applying a external voltage to an tuning contact. This is required by CEKO as it is necessary to cover a specific wavelength-spectrum for the sensor to work properly. The feedback from the sensor is measured with a simple photodiode.

Task

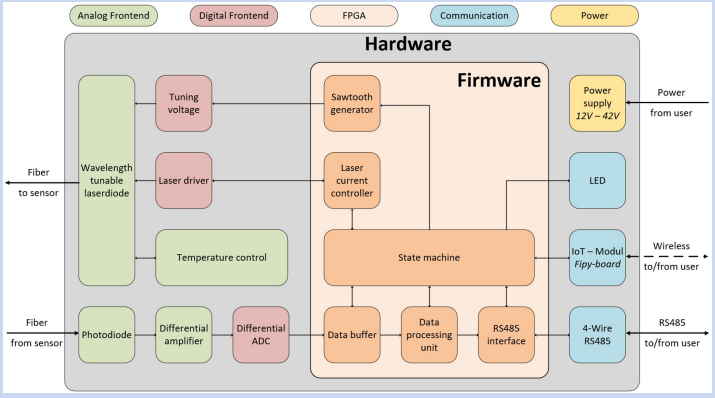
The prototype system consists of five different parts. A voltage source to control the output the wavelength of the diode, a current source to run the laser diode, a temperature controller, the photodiode with a differential amplifier and a FPGA as main control unit. With an additionally developed firmware for the FPGA it is possible to control the system and evaluate the incoming data. With a 4 Wire RS485 interface the data should be sent to a further data evaluation system. For this project a simple test environment should be written in python to simulate the data evaluation system.

Results

With the system it is possible to detect acceleration frequencies up to 245Hz. The Data sent by the system were analyzed with an FFT in the python GUI. As seen in Figure 2 it was possible to recognize a 80Hz oscillation from a loudspeaker. The hardware could support acceleration frequencies up to 3kHz but the firmware does not support this yet. While applying a constant acceleration of 2g to the sensor it was possible to determine the acceleration with an accuracy of less than 10%.

Infobox

Blockdiagram of the prototype hard- and firmware.



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