Test of Brake Pedal Sensor on Viking's Race Car

Søren Juul Jensen

16-12-2024

Contents

1 Introduction

The purpose of the experiment is to test the brake pedal sensors on Viking's race car together with the Zynq-based master controller.

2 Setup and Execution of the Experiment

A connection has been made between the race car's brake pedal and the test bench. The two brake sensors connected to the master controller have two non-intersecting transfer functions. It is therefore expected that the two signals have two different voltages at every point in time. It is furthermore expected that the signals measured on the oscilloscope are the same as the ADC values.

2.1 Equipment

The equipment used is shown in the list below.

- Power supply
- Rohde & Schwarz oscilloscope (R&S RTM3000 oscilloscope)
- Test bench
- Master controller
- Viking race car

2.2 Execution

Figure 1 shows the brake pedal being pressed. The brake pedal is very stiff, which has resulted in poor data quality due to the sample rate limitations, similar to the torque pedal but worse. The brake pedal is moved in a pattern, which makes it easy to identify when the data shall be compared.

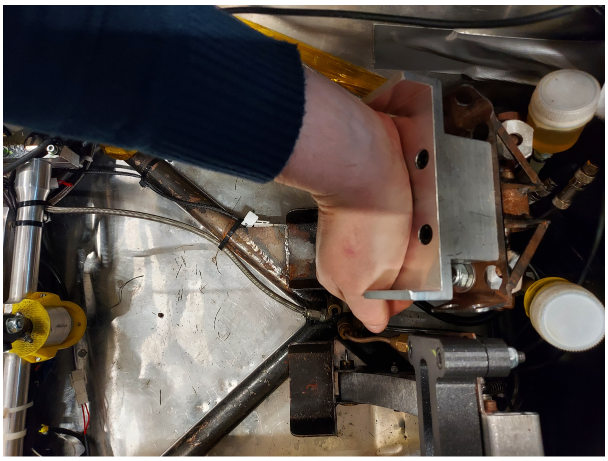

Figure 1: Brake pedal pressed.

3 Data Collection & Results

The results are measured over a period of 30 seconds. The data is manipulated to fit the same time axis. The scope measures supply a dataset of 130,000 samples which has to be compared to a sample rate of 2 Hz in the terminal. The terminal is used because there is no way to save data on the master controller at the time of the test.

3.1 Data Collection

The data is collected with the purpose-built library mcxADC. The voltage is then to be compared to the data from the oscilloscope. Figure 2 shows the data collection to the oscilloscope. The data is saved in a CSV file and compared to the data collected with the terminal in a Python script on the computer.

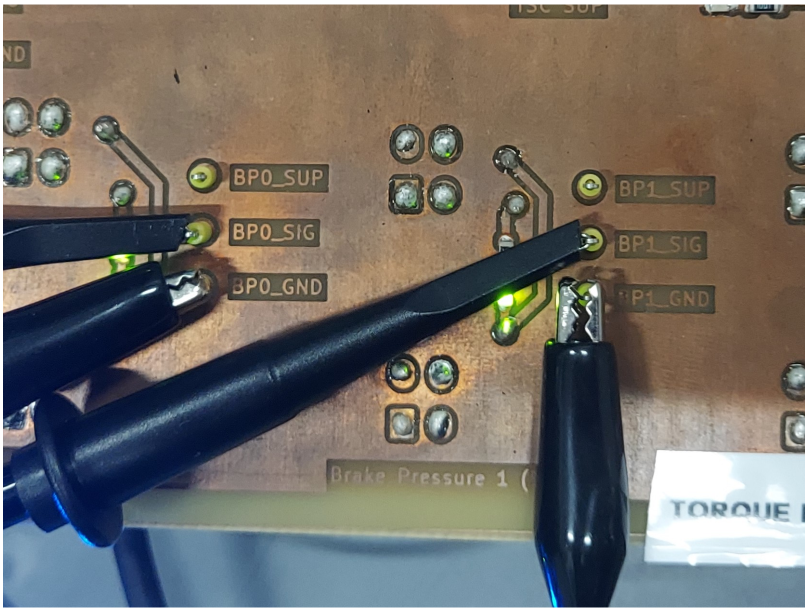

Figure 2: Data collection from oscilloscope.

3.2 Results

Figure 3 shows the voltage read from the ADC. It is clear that the two voltages do not intercept at any point, this is because of the different transfer functions.

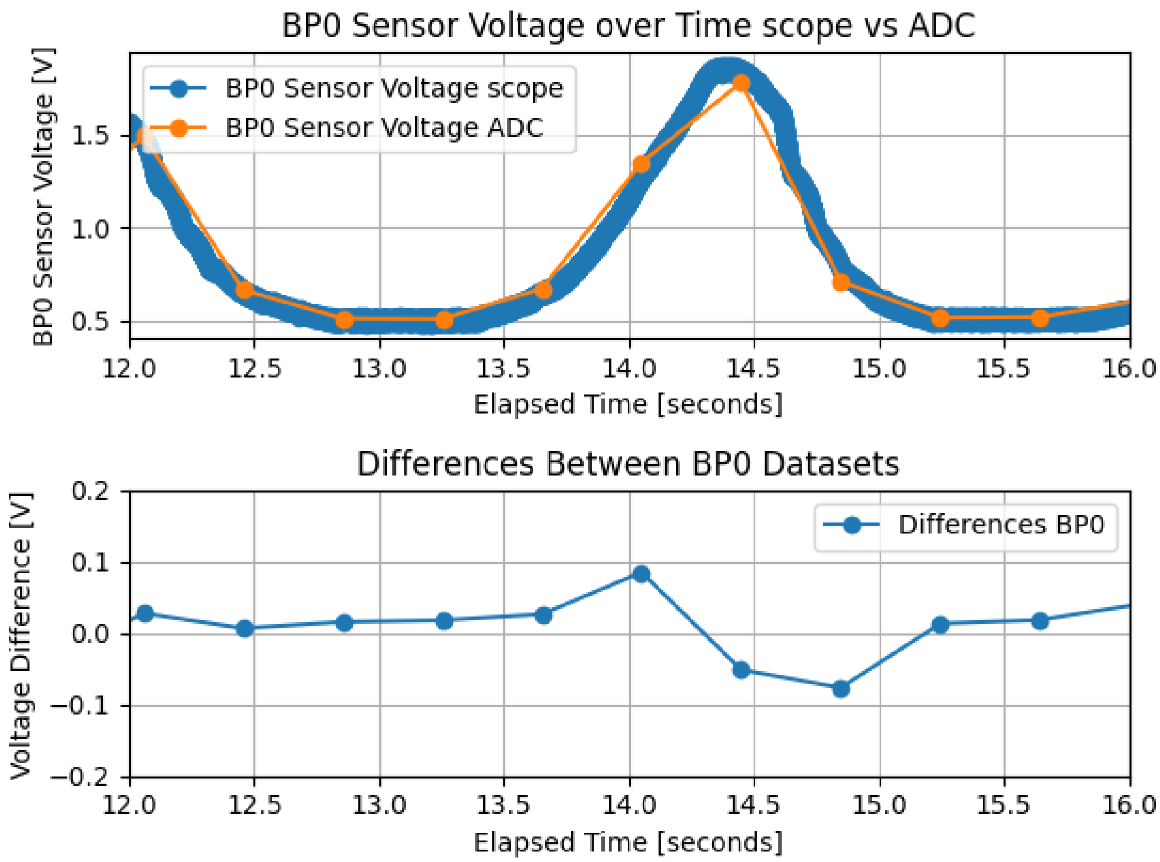

Figure 3: ADC voltage from ADC.

There is an outlier between 12 and 16 seconds. This outlier is a fast tap on the brake. This tap on the brake is faster than the sample rate (0.5 s).

3.3 Bitwise Error

The bitwise error is based on an average error of $\pm 8.19\,\mathrm{mV}$ and is found to be:

$$\mathrm{LSB} = \frac{8.19\,\mathrm{mV}}{0.244\,\mathrm{mV}} \tag{1}$$

$$\iff \mathrm{LSB} \approx 34\,\mathrm{LSB} \tag{2}$$

4 Discussion

The data is fine overall. There is the one outlier between 12 and 16 seconds which is to be looked away from. The bitwise error corresponds to 34 LSB which is higher than expected due to the stiffness of the brake pedal and the sample rate limitations. The outliers are higher and will result in a higher error, the error can be up towards 300 LSB. This is because the extrapolation of the measurements from the scope does not quite align in the time axis, this will result in a longer distance between the data points and therefore a larger error. This error is therefore made bigger. Another source of error is the way the data processing is done. The data processing has been challenging because of the resolution of the time axis in the dataset. The solution has been to extrapolate data from the scope dataset and compare it to the limited data from the ADC through the terminal in the computer.

5 Conclusion

The test is complete with satisfactory results considering the datasets.