# First Draft for Project Proposal (Smart Sensor IoT)

Thu Ta Aung

Motivation behind the implementation of efficient, versatile and fast self-calibration of signal path condition systems arises from rapid rise in multiple sensor applications. The fundamental idea of the signal path condition lies within the fact that given any analog sensor input into the signal path conditioning, the readings are heavily influenced and distorted by various factors including temperature inconsistencies, imperfection of electrical components, and noises from external factors [1]. In order to resolve this, there will be two stages of calibration. First, would be to have a DAC to help map the expected representation of m-DAC bits to n-ADC bits. Second would be to pass the m-DAC bits through the entire signal conditioning path to characterize how the expected data bits would have drifted or changed.

There has already been previous works about using a separate DAC to calibrate out the inconsistencies and the noise introduced by the signal conditioning path [2], but some of the known works have only explored one of the two techniques: 1) Generating a lookup table to record the voltage to bit representation based on the expenses of large amount of memory [3], 2) Fitting the sensor data into best fit polynomial at the expense of bigger runtime [4]. Hence, the proposed idea for the project is to explore the latter option while dynamically readjusting the best fit algorithm and incorporating the first option with the second to compensate for each of the method's weakness.

The multiple proposed solution is comprised of:

1) Reducing the datasets required for calibration based on the desired accuracy
2) Varying the threshold of RMS to tradeoff between accuracy and speed
3) Measuring the weight of different external factors that effects the drifts in the offset of the signal path and characterizing the noise accordingly. For instance, various temperature can be used for calibration and values can be stored into a reference table.

In order to analyze this, we have a prebuilt signal path conditioning on a protoboard that will be turned into a PCB so that the DAC can simulate different sensor values into the signal path for analyzing the best suited algorithm to characterize the offsets introduced by the signal path. Initially, we would try to characterize the full path calibration on the PCB using piecewise linear regression and slowly find the optimum RMS threshold and adequate datasets for a fast and desirable accuracy in the calibration. Next, we will try to expose our device to various external factors such as temperature and analyze the drifts in our data offsets. Based on the observation, conclusions will be drawn on whether the weighted external factors can be characterized and stored in a global lookup array.

## References

[1] P. T. Kolen, "Self-calibration/compensation technique for microcontroller-based sensor arrays," in *IEEE Transactions on Instrumentation and Measurement*, vol. 43, no. 4, pp. 620-623, Aug. 1994.

[2] P. T. Kolen, "Self-calibration/compensation technique for microcontroller-based sensor arrays," in *IEEE Transactions on Instrumentation and Measurement*, vol. 43, no. 4, pp. 620-623, Aug. 1994.

[3] P. T. Kolen, "Self-calibration/compensation technique for microcontroller-based sensor arrays," in *IEEE Transactions on Instrumentation and Measurement*, vol. 43, no. 4, pp. 620-623, Aug. 1994.

[4] J. M. Dias Pereira, O. Postolache and P. M. B. Silva Girao, "A Digitally Programmable A/D Converter for Smart Sensors Applications," in *IEEE Transactions on Instrumentation and Measurement*, vol. 56, no. 1, pp. 158-163, Feb. 2007.