# Model Based Design Approach for Temperature Dependent Sensors Compensation

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***Abstract:*** This work presents Model Based Design (MBD) approach to design an adaptive algorithm for temperature dependent sensors compensation. Closed-loop control system components, which are composed of sensors, sensing circuits, control, and adaptive block were modeled in MATLAB Simulink blocks. Then, the controller and adaptive block were deployed to an STM32 embedded board by Embedded coder. From the experimental results, the proposed adaptive algorithm effectively compensated the variation of sensing error caused by temperature changes.

***Keywords***: Model Based Design (MBD), adaptive algorithm, sensors

## INTRODUCTION

MBD approach is becoming more common tools for industries because of ease of digital control system design, validation and verification according to system requirements [1-3]. A target plant and sensors can be modeled in mathematical models. Then the controller is modeled in discrete or digital form. Here, more sophisticated algorithms can be invstigated to get the optimal one. All components are connected by drawing the directed lines. The controller model can be automatically deployed to a target embedded board. Finally, the results between Software-in-the-Loop (SIL) and Processor-in-the-Loop (PIL) can be directly compared and the numberical results can be plotted to verify the algorithm performance.

## MATERIALS AND METHODS

Fig 1 shows the proposed adaptive algorithm block diagram to compensate the sensing error. Least Mean Square (LMS) is used to adjust the gain for estimating the error to compensate the sensing signals.

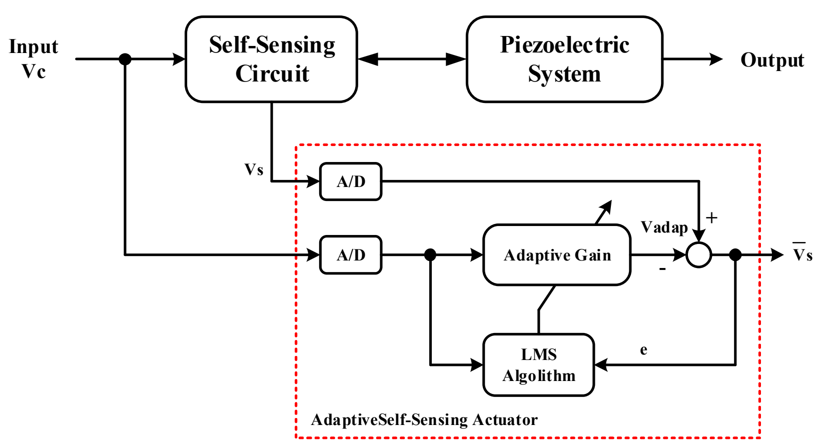


**Fig. 1. The proposed adaptive algorithm block diagram**

## RESULTS AND DISCUSSION

An experiment was setup to verify the accuracy of the proposed adaptive algorithm. The controller and adaptive block were run on an STM32 embedded board. The temperature change was simulated by changing the resistance on the sensing circuit to decrease and increase from the normal value to make the circuit unbalanced. The compensated signal was read out from the STM32 embedded board to calculate the resistance change. Fig. 2 shows that the estimated resistance is correlated with the actual resistance. Fig. 3 compares the sensing signal with errors and the compensated one .

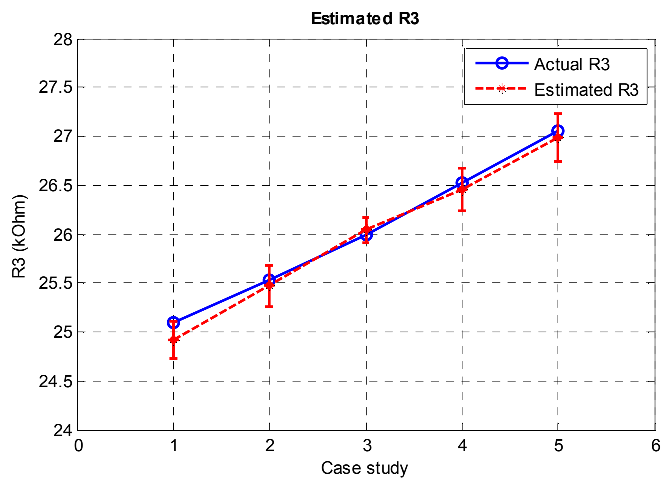


**Fig. 2. Estimation performance of the proposed adaptive algorithm**

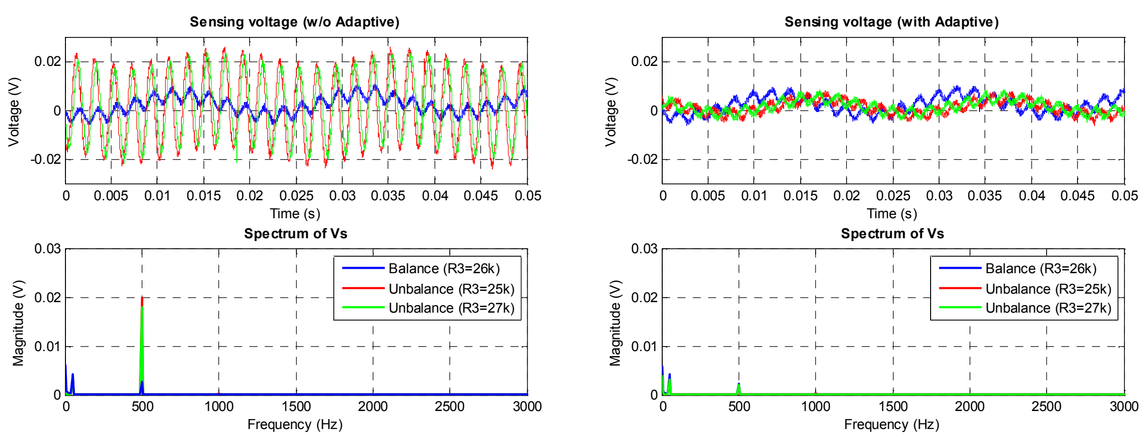


**Fig. 3. Sensing signal with errors (left) and compensated sensing signal (right)**

## CONCLUSIONS

MBD approach has been used to design an adaptive algorithm for temperature dependent sensors compensation. The algorithm was deployed to an embedded bord and verified. From the experimental results, the proposed adaptive algorithm effectively compensated the variation of sensing error caused by temperature changes.

## REFERENCES

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