PT-100 Lab Assignment

Gautam Singh

Contents

***Abstract*—This document contains a lab report on the modeling of the voltage-temperature characteristics of the PT-100 RTD (Resistance Temperature Detector) using least squares method.**

1 Training Data

The training data gathered by the PT-100 to train the Arduino is shown in Table 1.

Temperature (°C)	Voltage (V)
66	1.85
27	1.76
2	1.66
23	1.72
56	1.82
34	1.76
33	1.75
31	1.74

TABLE 1: Training data.

The C++ source `codes/data.cpp` was used along with *platformio* to drive the Arduino.

2 Model

For the PT-100, we assume a linear relation between celsius temperature T and output voltage V given by

$$T = mV + k \tag{1}$$

$$\implies \boldsymbol{\theta}^\top \mathbf{x} = y \tag{2}$$

where

$$y = T,\ \boldsymbol{\theta} = \begin{pmatrix} m \\ k \end{pmatrix},\ \mathbf{x} = \begin{pmatrix} V \\ 1 \end{pmatrix} \tag{3}$$

3 Optimization

To find the optimal parameters of the model (2) can now be modeled as an unconstrained optimization problem (4)

$$\min_{\boldsymbol{\theta}} \sum_i \left| \boldsymbol{\theta}^\top x_i - y_i \right|^2 \tag{4}$$

which is solved by the Python code `codes/lsq.py`.

The optimized parameters are

$$\boldsymbol{\theta} = \begin{pmatrix} 333.05 \\ -551.34 \end{pmatrix} \tag{5}$$

The fitting is shown in Fig. 1.

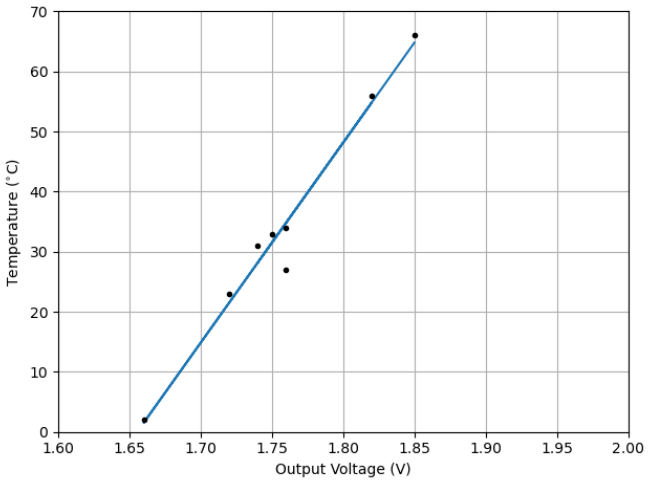

Fig. 1: Training the model.

4 Validation

The validation dataset is shown in Table 2. The results of the validation are shown in Fig. 2.

Temperature (°C)	Voltage (V)
4	1.67
25	1.73
61	1.83
35	1.77

TABLE 2: Validation data.

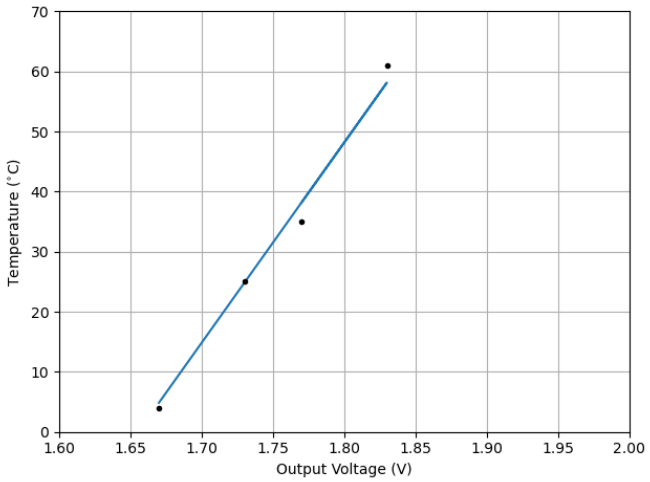

Fig. 2: Validating the model.

5 Conclusion

This lab experiment demonstrates how machine learning methods can be used to model the behaviour of an unknown device, and find the right parameters that fit the model. It also shows how to use Python libraries and frameworks to collect data and perform optimization.