

# Least Squares approximation for humidity sensor

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## 1 Introduction

In the table below, *hum* stands for the humidity measured by a gehaka measuring device that is calibrated correctly. This is the reference humidity that we are trying to calibrate on. The variable *cycles* is the amount of cycles measured by our device.

Sample number	Cycles	Humidity
0	3497	11.1
1	3994	11.9
2	4511	13.0
3	4913	14.1
...	...	...
n	2900	10.1

$$y_n(x) = \sum_{k=0}^n 'a_k T_k(x) \quad (1)$$

We will attempt to make a function of the following form, making the *error* term as small as possible

$$a * cycles + b = hum + error \quad (2)$$

The function that yealds the distance between the real and estimated humidities is denoted as follows

$$f(a, b) = [hum_0 - (a * cyclos_0 + b)]^2 + [hum_1 - (a * cyclos_1 + b)]^2 + ... + [hum_n - (a * cyclos_n + b)]^2 \quad (3)$$

$$f(a, b) = hum_0^2 - 2 * hum_0 * (a * cyclos_0 + b) + a^2 * cyclos_0^2 + 2 * a * b * cyclos_0 + b^2 + hum_1^2 - 2 * hum_1 * (a * cyclos_1 + b) + a^2 * cyclos_1^2 + ... \quad (4)$$

To minimize this distance function, we need to set all first partial derivatives to zero:

$$\frac{\partial}{\partial a} f(a, b) = 0 \quad (5a)$$

$$\frac{\partial}{\partial b} f(a, b) = 0 \quad (5b)$$

$$\frac{\partial}{\partial a} f(a, b) = -2*hum_0*cyclos_0+2*a*cyclos_0^2+2*b*cyclos_0-2*hum_1*cyclos_1+2*a*cyclos_1^2+2*b*cyclos_1+...-2*hum_n$$

(6a)

$$\frac{\partial}{\partial b} f(a, b) = -2*hum_0+2*a*cylos_0+2*b-2*hum_1+2*a*cylos_1+2*b+...-2*hum_n+2*a*cylos_n+2*b$$

(6b)

$$b = \frac{\sum_{i=0}^n hum_n}{n}$$

(7a)

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## 2 Conclusion

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