Terrence Ho, UID: 804793446

Date of Lab: 4/11/17

Lab Section: Tuesday, 5 P.M.

TA: David Bauer

Lab Partners: Robathan Harries

**Experiment 0: Sensor Calibration and Linear Regression Report**

**2)** The equation used to find

At **v =**  , **t =** :

**3)** The maximum digits Capstone will display is 16, with a maximum of 15 decimal points and one whole number digit.

The actual measurement precision is still only 4 digits, because the other digits are too small for the machine to accurately measure. As such, in digits 5-10, you’d expect to see digits constantly shifting, usually within the bounds of some uncertainty range.

Turning down the sensor to eliminate any shifting digits may not be a good idea, because you still want at least 1 digit of fluctuation to see what the error range could be. Thus, by leaving out any shifting digits, you actually lose a bit of precision. Leaving in one digit shows you exactly the most precise measurement the machine can make and gives you some idea of the error bound.

**4)**

Collected Data

|  |  |  |
| --- | --- | --- |
| Mass (g) | Force (N) | Sensor Voltage (V) |
| 0 | 0 | 0.0128 |
| 50 | 0.49 | -0.0646 |
| 100 | 0.98 | -0.1421 |
| 150 | 1.47 | -0.2192 |
| 200 | 1.96 | -0.2970 |
| 250 | 2.45 | -0.3746 |
| 300 | 2.94 | -0.4523 |
| 350 | 3.43 | -0.5300 |
| 400 | 3.92 | -0.6073 |

Figure 1: This graph represents the correlation between applying tension to a hook and measuring the resulting voltage measured by the machine.

Equation (with uncertainty): V = aF + b

a = (-0.15824 ± 0.00006 ) V/N, b = (0.0130 ± 0.0002) V

V = (-0.15824 ± 0.00006 )F + (0.0130 ± 0.0002)

**5)** The Voltage measured from the hook grew in larger negatively as greater mass was hung onto the sensor. Starting at mass = 0g, the resulting voltage was 0.0130 V, with an uncertainty range of ±0.0002 V. Voltage measured decreased at a rate of 0.15824 per N, with an uncertainty range of ± 0.00006 V/N. The final trendline of the equation, with uncertainty factored in is

V = (-0.15824 ± 0.00006 )F + (0.0130 ± 0.0002)

The taring process is largely effective, as zero mass on the hook resulted in a close to zero voltage from the sensor. However, because it was not zero indicates that taring still does not entirely remove inconsistency from the hook’s measurements, and more specifically, the ability to tell what is the force of the mass that is hooked on.

**6)** Equations 0.1 and 0.3 tell us how to convert a known tension F into a predicted output voltage of the sensor V (including the uncertainty in this conversion), but to use this as a “force sensor,” we really want to know how to convert V into F, right? Use the measured values of abest ± δa and bbest ± δb that you presented in your response to the previous question to rewrite your calibration curve in the form F = cV + d, including the appropriate uncertainties in c and d. Hint: look at Eq. ii.23.

At **b =**  , **a =** :

FINISH CALCULATION IF NEEDED

**7)** The average scores in Frankie’s class were lower than the scores in Avril’s class, which means compared to other students in his lab class, Frankie did better than Avril did compared to his own class. Lab scores are normalized to prevent different grading styles among TAs to affect student’s grades.