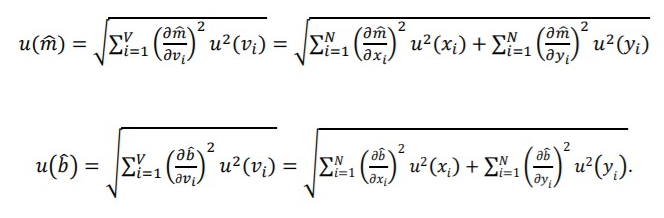
|  |  |
| --- | --- |
| DEEC_medium.jpg | **Big Data Measuring Systems** |

**LAB 1 Short Report: Uncertainty**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Week day** | **Date** | **Hour** | **Group** | **Students Numbers** | |
| Tuesday | 24/3 |  |  | Paolo Frazzetto | 94942 |

**Step 1**

|  |  |
| --- | --- |
| **Uncertainty**  **propagation law** |  |

**Step 2**

|  |  |
| --- | --- |
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**Step 2**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **10** | **25** | **50** | **75** | **100** | **150** | **200** | **500** |
|  | 0.022 | 0.015 | 0.011 | 0.009 | 0.008 | 0.006 | 0.005 | 0.003 |
|  | 0.064 | 0.040 | 0.028 | 0.023 | 0.020 | 0.016 | 0.014 | 0.009 |
|  | **0.001** | **0.01** | **0.05** | **0.1** | **0.5** | **1** | **5** | **10** |
|  | 0.003 | 0.003 | 0.005 | 0.008 | 0.033 | 0.062 | 0.158 | 0.193 |
|  | 0.001 | 0.002 | 0.010 | 0.020 | 0.100 | 0.200 | 1.003 | 2.043 |
|  | **0.001** | **0.01** | **0.05** | **0.1** | **0.5** | **1** | **5** | **10** |
|  | 0.19 | 0.20 | 0.18 | 0.20 | 0.21 | 0.20 | 0.23 | 0.25 |
|  | 2.01 | 2.05 | 2.00 | 2.02 | 2.01 | 2.00 | 2.00 | 2.08 |
| **Observations:**  As expected for the central limit theorem, increasing N lead to a general smaller uncertainty.  u(x) has a larger impact on the parameter’s errors, since the datapoints are more spread and both intercept and slope can vary significantly depending on a specific sample. In fact, the linear least squares method assumes negligible uncertainty on the dependent variable. On the other hand, u(y) does not affect so significantly the uncertainties since, even for larger variances, it is still normally distributed. | | | | | | | | |

**Step 3**

**Multimeter Accuracy: 0.1%**

**Luxmeter Accuracy: 4% rdg + 8 dgts**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Maximum error (uniform distribution) to uncertainty** | |  | | | | | | |
| **Luminosity** | **[Lux]** | 651 | 940 | 1450 | 1932 | 2640 | 3420 | 3885 |
| **Maximum error** | **[Lux]** | 34 | 46 | 66 | 85 | 114 | 145 | 163 |
| **Voltage** | **[V]** | -0.540 | -0.402 | -0.260 | -0.076 | 0.021 | 0.151 | 0.230 |
| **Maximum Error** | **[V]** | 0.00054 | 0.00040 | 0.00026 | 0.00008 | 0.00002 | 0.00015 | 0.00023 |
|  | |  | | | | | | |
|  | |  | | | | | | |

**Step 4**

|  |  |
| --- | --- |
| **Luminosity as a function of the sensor measurement** |  |
| **Uncertainty as a function of the sensor measurement** |  |

**Step 5**

|  |  |
| --- | --- |
| **Temperature effect on the LDR sensor** | Semiconductors are sensible to temperature, therefore even a small variation can play a relevant role. In this setting, increasing temperature diminishes the LDR resistance, causing biased luminosity measurements. |
| **Uncertainty as a function of the sensor measurement** | The LDR datasheet states that the device working range spans but additional information about the temperature response are not provided. Once modeled, this unknown effect can be incorporated into the uncertainty: |
| **Observations:**  There are various models to describe the relation between Resistance and Temperature of semiconductors, relating the ions of the semiconductor with the thermal energy of the charge carriers. At room temperature, we can assume that this will not affect the calibration and reproducibility of the experiment, whereas it may be relevant at different temperature conditions. | |

**Conclusions**

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| --- |
| The laboratory experiment was carried out successfully. The measurements and their uncertainties have been combined to obtain a simple linear calibration model that relates the sensor output with the physical quantity. |