DRIVES

Development and Research on Innovative Vocational Education Skills

SENSOR FUSION EXPERT

SFE.U2.E3 HANDLING SENSORS

Essential Sensor Foundations

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LEARNING OBJECTIVES

The student is able to …

SFE.U2.E3.PC1	The student knows how to perform sensor calibration.
SFE.U2.E3.PC2	The student is able to model common sensors and their measurements.
SFE.U2.E3.PC3	The student can combine and synchronize sensors.

CALIBRATION OF SENSORS

Calibration of Sensors

- When we have a sensor, the first thing we have to do for its implementation is to clair it.
- Calibration consists of gauging a sensor to compare it with values (units of magnitude) that already exist.

CALIBRATION OF SENSORS

Calibration of Sensors

- The calibration process takes place when a given sensor is subjected to an input with a known unit and thus compared with its output value.

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Calibration of Sensors

- A good example of this is a load cell (used in digital scales)
- At the bottom, to calibrate the cell, a weight of 1kg is placed, which will correspond to an output with a unit of measure.
- Then place a weight of 5KG and it will correspond to another output different from the first.
- There is also a weight of 10 kg and will correspond to a different output from the other two.
- Thus, a scale will be obtained in order to have data to assign the remaining values of the sensor to the measurement unit, in this case, the weight in KG or Grams.

CALIBRATION OF SENSORS

Calibration of Sensors

- Other inputs can be placed in other types of sensors to carry out their calibration, namely, gravity or temperature.

CALIBRATION OF SENSORS

Correction Factors

- In order to understand and take advantage of sensors, it is necessary to identify their transfer function.
- The transfer function has the functionality to understand, correct and convert the result generated by the sensor to a known quantity.
- The correction factors are composed of:
  - Offset;
  - Gain,
  - Asymmetry,
  - Nonlinearity,
  - Dead zone
  - Quantization.

Correction Factors

- **Offset**
  - It is the difference between the actual value and the measured value
  - It is the value shown by the sensor by measuring the real magnitude at 0
    - Example: A current sensor that in a circuit shows a certain output value
- **Gain**
  - Defines the proportionality between the actual value and the measured value.
    - Example: Voltage divider for measuring a battery or an external voltage source

Correction Factors

- **Asymmetry**
  - Characteristic that some sensors have for positive and negative values.
    - Example: magnetic field sensor that is more sensitive to the field in one direction than the other
- **Nonlinearity:**
  - It is a correction factor that relates the sensor output through some mathematical function other than linear
    - Example: air speed sensor, which depends on the difference in total and static pressure, which varies as the square of the speed

Correction Factors

- **Dead zone**
  - It is a very common feature in mechanical sensors.

- **Quantization**
  - It is the number of discrete values used to represent a measure numerically

CALIBRATION OF SENSORS

Correction Factors

- The result of a calibration allows you to determine the measurement values, as well as the determination of corrections to be applied.

Units of Measure

- The International System (SI) is composed of these measurement units:

Meter (m)	Compliance [L]
Kilogram (kg)	Mass [M]
Seconds (s)	Time [T]
Ampère (A)	Electric Current Intensity [I]
Kelvin (k)	Thermodynamic Temperature
Mole (mol)	Amount of Matter
Candela (cd)	Light intensity

Units of Measure

- The measurement units shown are those used in most sensors.

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This Training Material has been certified according to the rules of **ECQA – European Certification and Qualification Association.**

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UMINHO – University of Minho (https://www.uminho.pt/PT)

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Thank you for your attention

DRIVES project is project under **The Blueprint for Sectoral Cooperation on Skills in Automotive Sector**, as part of New Skills Agenda.

The aim of the Blueprint is **to support an overall sectoral strategy and to develop concrete actions to address short and medium term skills needs.**

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