DRIVES

Development and Research on Innovative Vocational Education Skills

SENSOR FUSION EXPERT

SFE.U3.E1

SENSOR FUSION BACKGROUND AND OVERVIEW

Introduction to Sensor Fusion

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LEARNING OBJECTIVES

The student is able to …

SFE.U3.E1.PC1	The student is able to define the sensor fusion approach.
SFE.U3.E1.PC2	The student is able to define the key features of data fusion and sensor integration
SFE.U3.E1.PC3	The student is able to identify the motivating factors behind sensor fusion.
SFE.U3.E1.PC4	The student can explain the value proposition of sensor fusion.

SENSOR FUSION

What is a sensor fusion

- Sensor Fusion is a technology that uses information provided by various sensors;
- This is because for very simple tasks, only one sensor is not enough to improve certain information.

SENSOR FUSION

What is a sensor fusion

- The fusion sensor appears with the purpose of minimizing the error margin in the sensor calculation.
- This increases confidence in the measurement obtained, as it allows for greater certainty in what is measured.

What is a sensor fusion

- One of the characteristics of sensor fusion is that it is based on the principle of focusing that sensors have their advantages and disadvantages and therefore can, through different scale factors, present the same measurement with their particular sources of error.

SENSOR FUSION

What is a sensor fusion

- Therefore, sensor fusion takes data from multiple sensors and thus applies various scaling factors and an estimate of next states and correction methods. Displays as output result:
- More accurate and better calculated information directly from the sensors

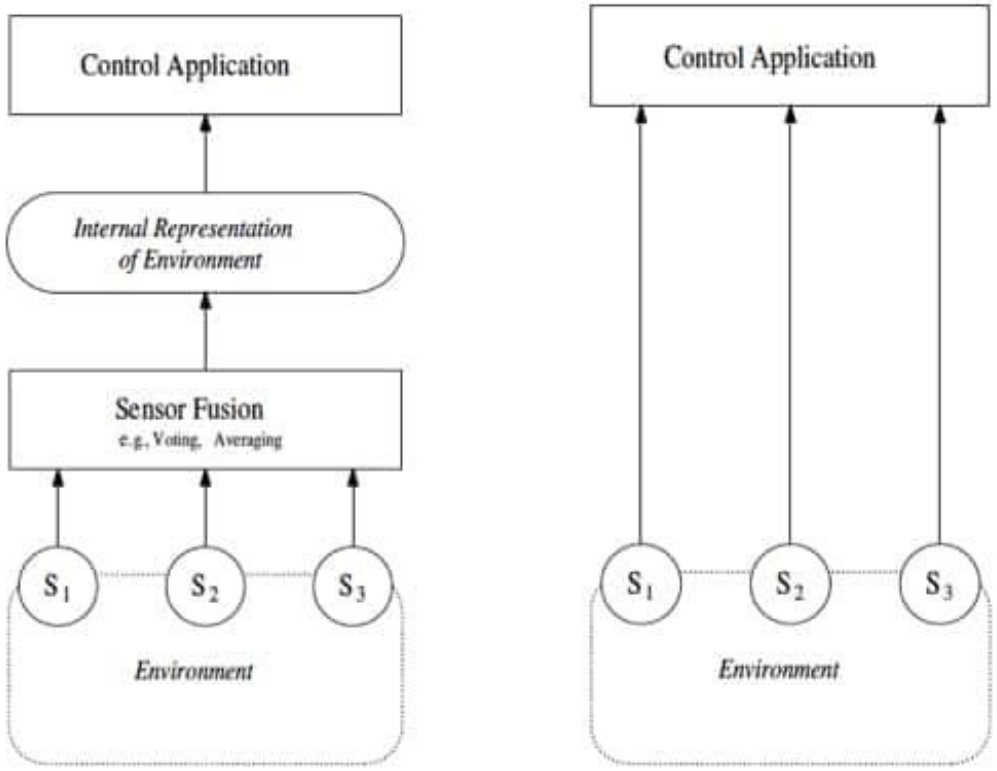
What is a sensor fusion

- In summary, the goal is to get the best out of each sensor and combine it into a single set of measurements.
- This will make the sensors present a higher result in terms of reliability.

MULTISENSORY FUSION

Understanding the Diferences

- **Sensor Fusion:** Combines sensory data so that the information is better than it would be possible if the sources were used individually
- **Multisensor Integration:** "The synergistic use of sensor data to perform a task by a System."



(a) Sensor fusion

(b) Multisensor integration

Realize Sensor Fusion with Analogies

- Let's imagine that we intend to obtain the degree of reliability (Great Certainty) that a given individual lives in Portugal.
- For this it is not enough to say that this person has Portuguese nationality, as there are Portuguese people all over the world.
- So a person's nationality and birthplace do not guarantee that he or she lives in Portugal.

Realize Sensor Fusion with Analogies

- Therefore, if we get that individual's telephone contact, and he is Portuguese, the probability of that person living in Portugal increases.
- Even so, it is not guaranteed that the individual will live in Portugal.
- Thus, more information is needed to obtain a greater degree of certainty.

Realize Sensor Fusion with Analogies

- So if we manage to obtain an address for the water or electricity bill, vehicle fines, credit card transactions, and we verify that the activity is carried out in Portugal, it is very close to absolute certainty that we can say that this individual lives in Portugal.

Realize Sensor Fusion with Analogies

- So the concept of sensor fusion is to obtain as much relevant information from a group of sensors to give us the certainty of what we want to prove.

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Realize Sensor Fusion with Analogies

- For this to happen, several sensor channels and of different natures are combined in order to present absolute certainty through mathematical calculations, avoiding as much as possible the error margins and their corrected measurements.

DATA FUSION

Definition of Data Fusion

- Data Fusion consists of the process of integrating several data sources in order to create richer and more specific information.
- In essence, it is a subset of information fusion.

Definition of Data Fusion

- This concept comes from combining the senses to improve information for what is needed. An example of this is when the human being uses the smell, touch, taste and sight to check if a certain food is edible or not.
- This concept has a lot to do with what we have already explained here in the previous slides.

DATA FUSION – DFIG MODEL

Composition and application of Data Fusion

- With the evolution of the internet, data fusion included the fusion of data, sensors and information.

- The Joint Directors of Laboratories (JDL) formed the Data Fusion Information Group (DFIG) introduced a data fusion model that divided the various processes into six levels:

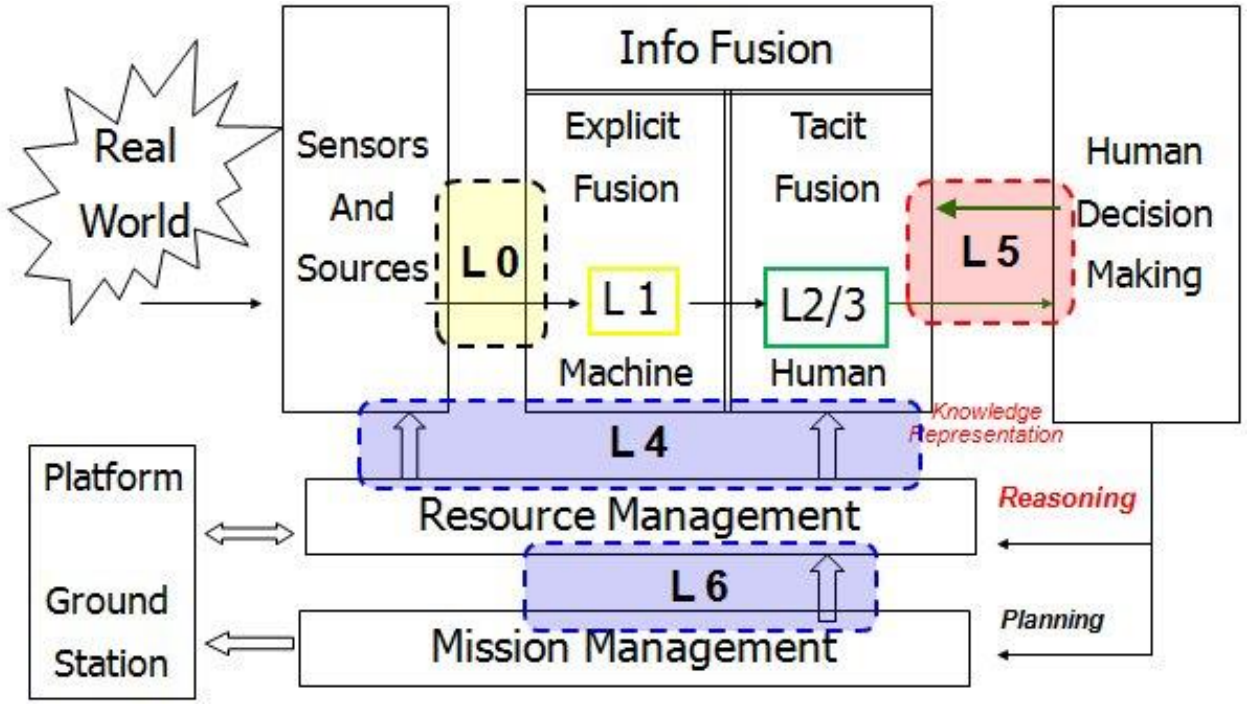
DATA FUSION – DFIG MODEL

Composition and application of Data Fusion

- **Level 0:** Source pre-processing (or data evaluation)
- **Level 1:** Object Evaluation
- **Level 2:** Situation Assessment
- **Level 3:** Impact Assessment (or Threat Refinement)
- **Level 4:** Process Refinement (or Resource Management)
- **Level 5:** User refinement (or cognitive refinement)
- **Level 6:** Mission Refinement (or Mission Management)

DATA FUSION – DFIG MODEL

Composition and application of Data Fusion



DATA FUSION – DATA INTEGRATION

Data Integration

- In business intelligence, data integration can be seen as a joining of sets where the larger is retained, while merging is a technique of reducing sets with greater confidence.

DATA FUSION – DATA INTEGRATION

Data Integration

So these sets can be applied to:

- Bioinformatics
- Biometry
- Business Intelligence
- Business performance management
- Chemformatics
  - Quantitative structure-activity relationship
- Science discovery
- Geospatial Information Systems
- Intelligence services
- Intelligent transport systems
- Loyalty card
- Oceanography
- soil mapping
- Wireless Sensor Networks

Composition of Sensor Integration

- **Sensor integration consists of three levels**
  - Signal Level
  - Level of Evidence
  - Level of Dynamics

Composição da Integração de snsores

- **Signal Level**
  - Sensor integration and data fusion takes place through correlation and learning

Composição da Integração de snsores

- **Evidence Level**
  - “The sensors collect data from the phenomenon or the process and process it along with other information that may have been collected from other sensors depending on the sensors topology and communication network.”

Composição da Integração de snsores

- **Level of Dynamics**
  - As a rule, there is a mathematical model that exemplifies the process of data obtained by sensors
  - Data can be joined in a unified way by joining the observations and then processing them as one.

Conclusion

- The great asset of the fusion sensor is to integrate all the data from the sensors so that they present more reliable information.
- This technology came to create a new technological revolution

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REFERENCE TO AUTHORS

Carlos Alves

- PhD student in Computer Science
- Research Collaborator of the Algoritmi Research Center

0000-0001-8320-5295

Regina Sousa

- PhD student in Biomedical Engineering
- Research Collaborator of the Algoritmi Research Center

0000-0002-2988-196X

Diana Ferreira

- PhD student in Biomedical Engineering
- Research Collaborator of the Algoritmi Research Center

0000-0003-2326-2153

REFERENCE TO AUTHORS

José Machado

- Associate Professor with Habilitation at the University of Minho
- Integrated Researcher of the Algoritmi Research Center

0000-0003-4121-6169

António Abelha

- Assistant Professor at the University of Minho
- Integrated Researcher of the Algoritmi Research Center

0000-0001-6457-0756

Victor Alves

- Assistant Professor at the University of Minho
- Integrated Researcher of the Algoritmi Research Center

0000-0003-1819-7051

REFERENCE TO AUTHORS

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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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