DRIVES

Development and Research on Innovative Vocational Education Skills

SENSOR FUSION EXPERT

SFE.U3.E2

SENSOR FUSION NETWORKS

Introduction to Sensor Fusion

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LEARNING OBJECTIVES

The student is able to …

SFE.U3.E2.PC1	The student knows how to explain the principles of sensor fusion systems.
SFE.U3.E2.PC2	The student is able to list and understand the basic components of a sensor fusion network.
SFE.U3.E2.PC3	The student can explore sensor fusion networks and critically analyse the possibility of making any changes that may improve their performance.

SENSOR FUSION

How Sensor Fusion Works

- Sensor Fusion combines multiple sensors to determine a more accurate result than intended.
- However, it is necessary to understand how this is done.

How Sensor Fusion Works

- To understand what the fusion sensor is and how it works. So it is essential to understand how this technology can be classified, namely:
  - By Abstraction Level
  - Centralized, Decentralized and Distributed
  - Competitive, Complementary and Coordinated

SENSOR FUSION – HOW IT'S WORKS

By Abstraction Level

- When we talk about fusion sensor by traction level we have to take into account that the level has an implication in the storage demand. In this case, they are divided into 3 levels.
  - Low level
  - Middle Level
  - High level

SENSOR FUSION – HOW IT'S WORKS

By Abstraction Level

- **Low level**
  - The fusion sensor has raw data as input data;
  - Refers to sensor point data measurements;
  - Ensures that no noise is added to the data after post-processing;
  - The only downside is that it requires processing a large amount of data.

SENSOR FUSION – HOW IT'S WORKS

Por Nível de Abstração

- **Middle Level**
  - Data fusion operates on object hypotheses
  - Uses data that has been interpreted by the sensor itself
  - It can weight information between sensors for the same purpose.

SENSOR FUSION – HOW IT'S WORKS

By Abstraction Level

- **High level**
  - The fusion of two hypotheses exists in a balanced way
  - Assumptions are not just about the position of an object.
  - The hypotheses are about its trajectory, thus incorporating its past and future states.

SENSOR FUSION – HOW IT'S WORKS

Centralized, Decentralized and Distributed

- **Centralized**
  - All data are processed in a central system,
  - This System will be able to do a low-level sensor fusion
    - Data are processed only on one site.
  - The bandwidth required by a System can get out of control

SENSOR FUSION – HOW IT'S WORKS

Centralized, Decentralized and Distributed

- **Decentralized**
  - Each sensor merges the data locally, and then forwards it
  - Fusion nodes communicate with each other
  - In the extreme, each fusion node communicates with the other nodes, which will cause a large growth of connections

SENSOR FUSION – HOW IT'S WORKS

Centralized, Decentralized and Distributed

- **Distributed**
  - Process the data locally before sending it to a central unit where sensor fusion takes place
  - May have one or more fusion nodes

SENSOR FUSION – HOW IT'S WORKS

Competitive, Complementary and Coordinated

- **Competitive**
  - The signals from the sensors can be combined in various ways;
  - When you merge two sensors that measure the same, it can be considered a competitive merge;
  - The goal is to more precisely achieve the intended

SENSOR FUSION – HOW IT'S WORKS

Competitive, Complementary and Coordinated

- **Complementary**
  - It refers to the fusion of two sensors for the purpose of measuring something that only one sensor could not do;
  - The goal is not to increase accuracy but to produce an object that cannot be observed by just a sensor

SENSOR FUSION – HOW IT'S WORKS

Competitive, Complementary and Coordinated

- **Coordinate**
  - Two or more sensors are used to observe the same object
  - By combining these sensors, a new perspective can be obtained;
  - Example: Combining images from two cameras at different angles can yield a three-dimensional view.

SENSOR FUSION – HOW IT'S WORKS

How to improve the use of sensor fusion

- This question can be answered according to what you have read so far.
- Note that depending on what you want to measure, it is the factor that may lead you to choose which methodology will determine the use of Sensor Fusion.

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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

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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DRIVES

Development and Research on Innovative Vocational Education Skills

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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